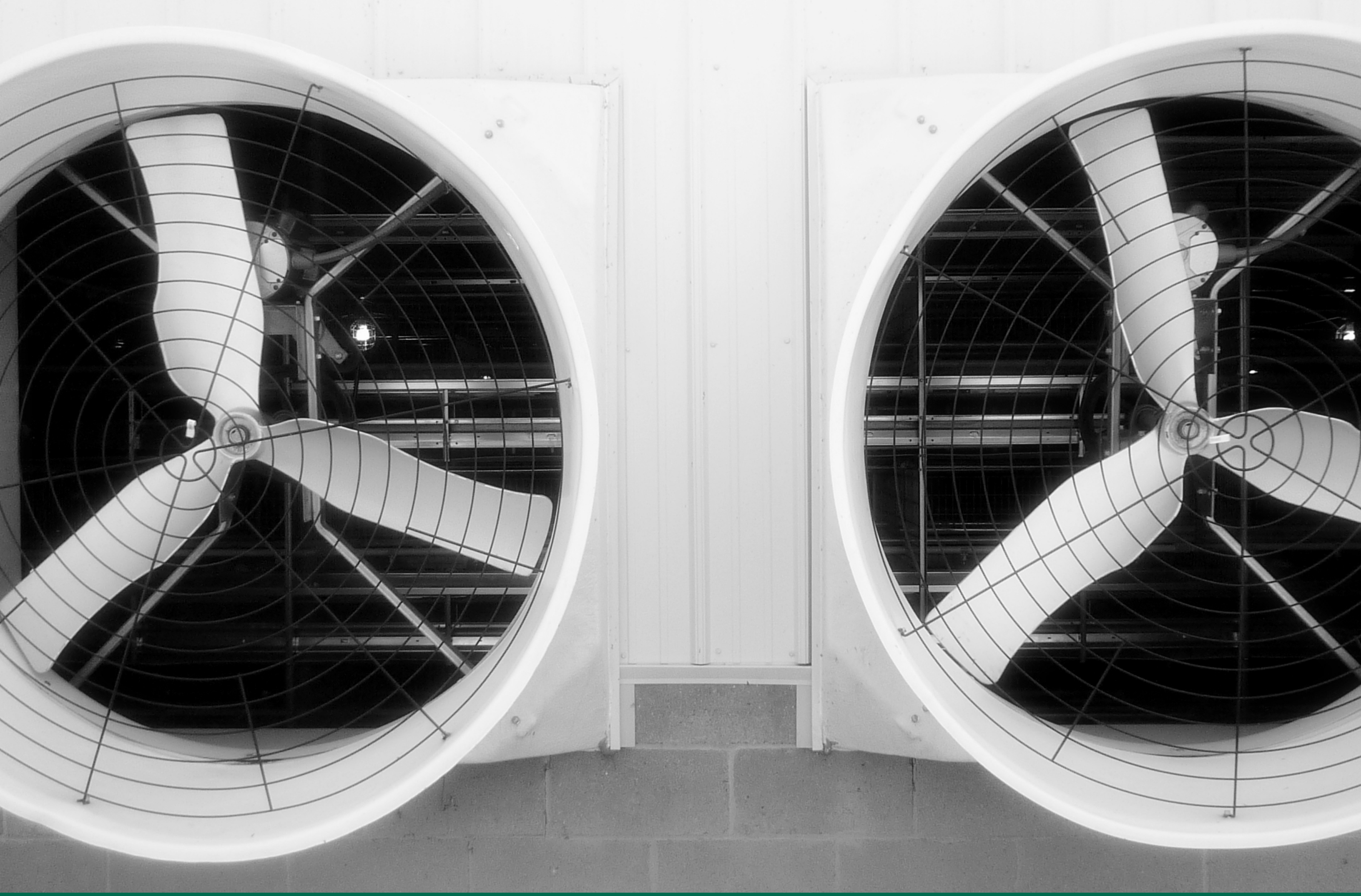

Hot Weather Management

Heat Stress, Cool Cells, and Effective Fogging

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Evaporative Cooling
Quick Guide

Air Speed First

Air movement is vital to removing heat from above, below, and between birds.

Bird Density

An over-crowded house decreases the amount of heat lost to air movement.

80-80 Rule

At 80°F, humidity is roughly 80%. When temperatures are above 80°F outside, evaporative cooling can safely be used to remove heat from inside the barn.

Relative Humidity

For every 2.5% Rise in relative humidity, 1°F is removed from the air. For every gallon of water evaporated into the air, 8700 BTU's of heat are removed.

Pad Cooling

Check that water is distributed evenly. Dry areas on the pad results in hot air entering the barn.

Fog Cooling

Air currents created by the fans move the water droplets along the house to remove heat from the air.

Poultry farmers are no strangers to extremes, especially extreme temperatures. Perfect growing conditions might only exist a few days out of the year, and the rest of the time is spent trying to manufacture the perfect environment. Peak summertime temperatures can be detrimental to flocks, so its imperative that effective cooling strategies are used. To do this well, first understand how bird's naturally cope with heat stress, as well as, the relationship between heat and humidity.

Adult chickens are homeothermic, meaning they produce and dissipate heat to maintain a constant body temperature. The deep body internal temperature of a chicken ranges between 105-107°F (40.6-41.7°C) . They can withstand fluctuations fairly well, but their upper lethal limit is 113-117°F. If producers can keep chickens within, or as close as possible to, their thermoneutral zone, then productivity will remain relatively consistent. The comfort zone for poultry is about 90°F (32°C) at hatching, and it declines to 75°F (24°C) by four weeks of age, before leveling out.

Heat Stress:

All producers are familiar with it. It reduces productivity, can suppress immune systems, and often leads to greater mortality. Meat quality is often compromised, as is egg shell quality and quantity in breeders and layers. Birds subjected to heat stress conditions spend more time drinking, panting, resting and elevating their wings, and less time eating and walking.

Chickens can be fairly adaptable when it comes to heat stress. They lack functional sweat glands, but still manage their heat loss through circulation and respiration. Birds will first increase blood flow to the surface of the body in an attempt to lose heat to the air. They will often be seen lifting their wings to expose more body surface. When this proves inadequate, chickens resort to panting, where the cooling effect takes place in the lungs and airways as air is evaporated off the air sacs. Panting under heat stress conditions can lead to decreased carbon dioxide levels and a high blood pH (alkalosis) which compromises egg shell quality.

As the relative humidity in the barn increases, the efficiency of panting decreases. A 80% relative humidity makes it almost impossible for a bird to lose a significant amount of heat through panting because the moisture gradient between the exhaled air and the barn air is similar.

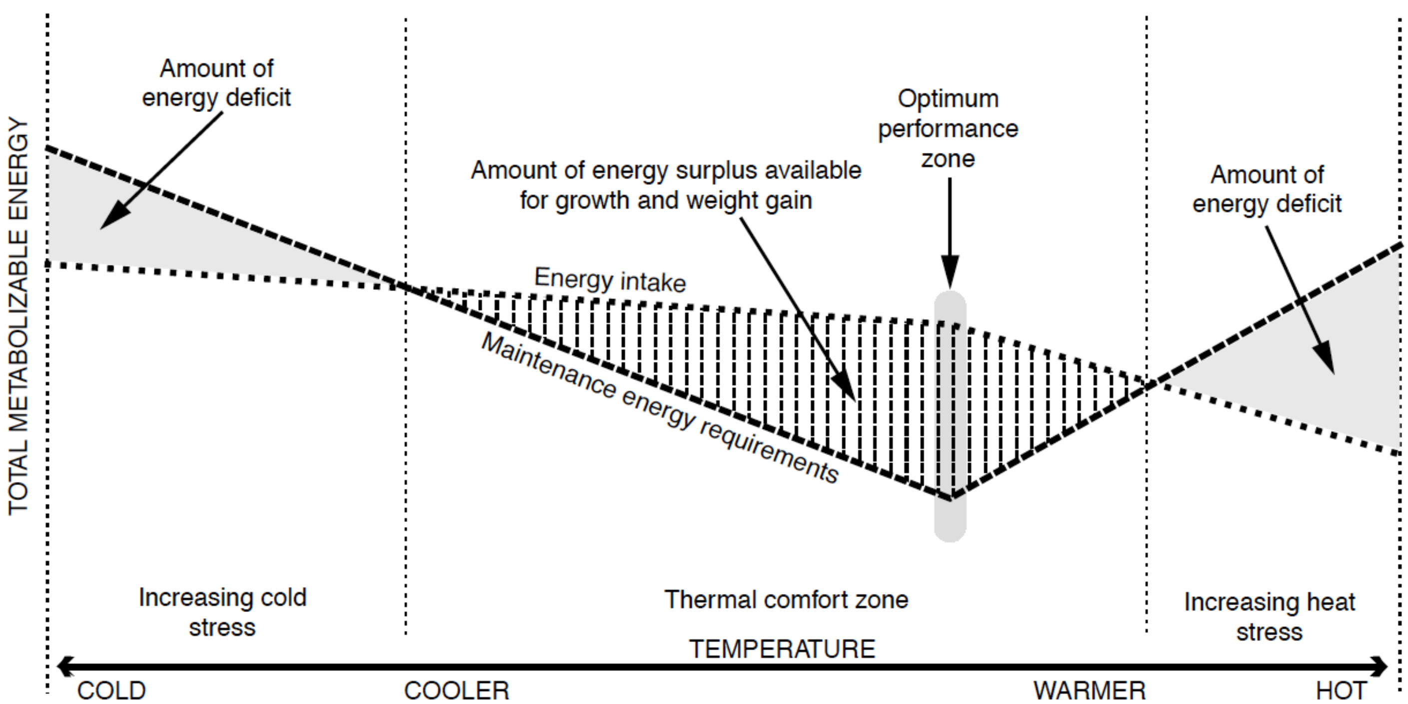


Image 1
As temperatures increase or decrease from optimum performance, energy is used more to heat or cool birds than for growth.

Accompanying panting and prostration, birds will also decrease their feed intake and increase their water intake. Increased water consumption can be of benefit as water acts as a heat receptor and can increase the amount of heat dissipated per breath. However, prolonged heat stress is nothing but detrimental. Respiration can increase to almost 260 breaths per minute when acute heat stress is experienced, and a prolonged increase in respiration can result in respiratory alkalosis.

The unfortunate reality is that some heat stress is inevitable during the warmest months of the year, but producers can prepare ahead and implement management practices that will help their flocks cope. The first point of concern should be to check that the house is well insulated and can maintain the appropriate static pressure.

Much of the heat in the barn comes from two sources: the birds themselves, and solar heat gain. It isn't always reasonable (or possible) to adjust the stocking density of the birds, but something can be done about solar heat gain.

Solar heat gain is the radiant transfer of heat from the hot outside to the birds inside. Sheet metal roofs on houses may easily be heated to 150°F (66°C) or higher in the summertime. If that roof is uninsulated, the heat transfers directly to the birds. Insulation in the roof, in both open sided and tunnel ventilated barns, slows the transfer of heat and reduces the severity of heat stress.

House tightness is essential all year round. Air leaks reduce static pressure and decrease windspeeds. Higher windspeeds create a "wind chill effect" that removes heat from above, below, and between birds. Most houses should be able to attain 600-700 feet per minute across the width of the house. Having uniform air speeds is just as important as having enough air speed. When checking air speed, take measurements five to ten feet from the sidewall. If speeds are adequate here, it follows that the majority of the flock is benefitting.

Bird Density:

As density increases, air movement around each bird decreases, resulting in reduced heat removal and elevated temperatures. Stocking density has the greatest effect on deep body temperatures at night when lights are off and birds sit down. Body temperatures go up due to decreased heat loss via air movement. Air movement around a bird is already decreased because of the close proximity of other birds. The longer the bird sits, the more the body temperature will rise.

Uniform bird density is crucial to managing heat stress. Birds will migrate to the pad end where temperatures are cooler, but this will decrease access to food and water, as well as reduce the cooling

effect. Migration fencing can help limit the number of birds that can gather in one area.

Effective Temperature:

The effective temperature is the combined effects of air temperature, air velocity, relative humidity, and radiant heat. The ideal effective temperature is dependent on the birds' growth stage and function. When determining the goal temperature, the body weight of the bird is an important consideration, as well as diet, age, management practice, and previous heat exposure. Smaller chicken breeds have a higher temperature than larger ones . Males produce more heat than females. Broilers and pullets are more comfortable at 92°F at birth and 73°F at four weeks of age. Laying hens do best between 78°F and 82°F.

Evaporative Cooling:

Air speed is the first defense against heat stress, but once the outside air temperature exceeds the temperature of the bird's skin (about 95°F), it will increase their discomfort. At this point, evaporative cooling becomes necessary. Evaporative cooling works because when water changes phases from liquid to gas, it removes substantial amounts of heat from the environment. Cool cells, fogging, and sprinkler systems are all viable evaporative cooling options.

The key to an effective evaporative cooling program is understanding the relationship between relative humidity, temperature, and bird physiology. For every one gallon of water that is evaporated into a barn, 8700 BTUs of sensible heat are removed from the air, and converted to humidity. Roughly speaking, for every 2.5% increase in relative humidity, 1°F (.5°C) is removed from the air temperature.

Evaporative cooling programs must be balanced with heat and humidity. If the humidity is above 85%, birds cannot cool themselves through panting. The meeting point of heat and humidity is around 80°F. At 80°F on humid days, the humidity is roughly 80%. The ability for air to hold moisture increases as the temperature rises, so when temperatures are above 80°F outside, evaporative cooling can safely be used to remove heat from inside the barn.

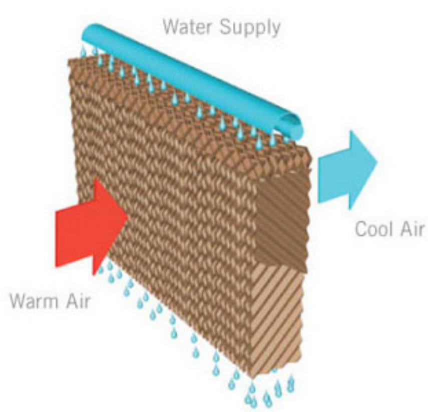
Pad cooling considerations:

If static pressure in the house increases by more than 0.01" when water is circulating over the pad, the pads probably need to be cleaned.

Keep water in the pad system as clean as possible to minimize algae growth and mineral build up. Dump all water in the system weekly.

Cool cells shouldn't be operated 24 hours per day. Humidity increases at night when temperatures are lower and running cool cells can have a negative effect. It is safest to operate cool cells between 10am and 10pm or whenever temperatures are above 82°F (28°C). This allows the pads to dry out which will prevent excess algae growth. The lifespan of the pads and system pump are extended because they are not over used. Litter will dry more effectively when excess moisture from pads is not being added to the barn.

Fans should continue running over night. As birds cool appetites increase and this will cause some heat production before they settle down for the night. Research has also shown the birds who are made more comfortable at night can better handle the heat of the following day.



Avoid algae because it can lead to clogged pads and will reduce cooling capacity. Don't let the pad sit in the water. Clean sumps and pumps several times over the course of the summer to prevent algae growth and sediment clogging. Allow pads to dry out at least once every 24 hours.

Check that water is distributed evenly. Dry areas on the pad results in hot air entering the barn and are a dead giveaway that the distribution pipe is clogged. The pipe can be clogged with debris or scale build up from poor quality water being used. Control scale build up with additives if needed and always follow manufacturer recommendations. Replace system water weekly.

Cleaning the system:

1. Remove pads from the system and inspect for damage like age, wear, or rodent nests.
2. Rinse dirt and debris from both sides using a garden hose and nozzle. DO NOT HIGH PRESSURE WASH!
3. Clean pad framing by removing cobwebs and debris. High pressure wash if necessary.
4. Clean gutters.
5. Remove debris from sump using a shop vac or trash pump.
6. Clean filters.
7. Refill system with clean water and turn on.
8. Flush the distribution pipe and unclog any plugged holes (small screw driver or wire brush). Flush again.
9. Replace pads into system.

Fogging system considerations:

Make sure temperature sensors are protected from moisture. A damp sensor will show a lower reading and cause fans to shut off early.
Effective fogging systems work with a properly designed ventilation system. When designing a

fogging system, droplet size must be considered. Droplets need to be kept aloft as long as possible to evaporate as much water as possible – there is no cooling effect once the drop hits the floor. The longer the droplet is suspended, the cooler the air and the drier the litter.

Therefore, droplets need to be as small as possible. A lower nozzle flow rate at higher pressure creates a smaller drop. Air movement helps to keep drops suspended. Air currents created by the fans move the droplets along the house to remove the heat from the air. For maximum suspension, nozzles should be close to the ceiling along the center of the house so droplets are suspended above the airstream. Outside this area, wind speed could be too slow to keep droplets suspended, creating wet floors.

Cross lines of nozzles that provide a curtain of fog across the house are fairly effective. Lines of nozzles should be located close together near the air inlets, then spaced farther apart along the house, ending at least 60ft from the exhaust fans. Tunnel ventilated houses can use substantially more fogging capacity than natural ventilated houses because the air movement creates more evaporation.

Comparative Size

Relative Size	Comparative Size	Atomization
	Point of Needle (25 Microns)	Fog
	Human Hair (100 Microns)	Fine Mist
	Sewing Thread (150 Microns)	Fine Drizzle
	Staple (420 Microns)	Light Rain
	#2 Pencil Lead (2000 Microns)	Thunderstorm

Many farmers choose to use a fogging system in addition to their cool cells pads. In exceptionally dry climates, this can help greatly to reduce heat stress, though in more humid climates it might create some problems if not monitored closely. Running foggers may increase the heat stress load if humidity levels are already high because birds are unable to cool themselves through panting and the air movement alone isn't enough. Additionally, foggers could decrease air movement through the barn. If shutter blades are dusty, that dust could turn to mud as the fog moves through the fans, weigh down the shutters and prohibit air movement. Ideally, all fog would be evaporated by the time it reaches the fans, but when the humidity is high, the droplets can't evaporate.

Be sure to always consider your personal circumstances when deciding on an evaporative cooling program. Consider your location, weather patterns, flock size, and fan capactiy when trying to mitigate heat stress in hotter months. If you would like assistance in planning an evaporative cooling program, just give us a call.

Key Take-aways:

1. Air speed must be between 600-700 ft/min across the width of the house.

2. Run fans at night helps birds cool down and be better able to deal with the next day's heat.

3. Operate evaporative cooling systems only when the temperature is above 80°F.

4. Allow cool pads to fully dry out at least once every 24 hours.

5. Use fogging systems in conjunction with proper ventilation for optimal cooling.

To learn more about our
evaporative cooling solutions...

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