

Sprinklers Offer Flock Cooling Benefits and Water Conservation Opportunities



Maintaining bird comfort during the hot, humid summer is critical for optimum weight gain, feed conversion, and livability. In most situations, modern-day poultry houses are equipped with tunnel ventilation systems with large exhaust fans at one end and evaporative cooling pads at the opposite end. Evaporative pads are chosen mainly for their high efficiency, while foggers (low-pressure misting systems) may be installed as a supplement to cool cell systems.

Unfortunately, however, fogging systems used after cool cells **further increase already high humidity levels** in the house, making it difficult for birds to cool themselves by heat removal from the respiratory system. Extremely high in-house humidity levels and the inability of the bird to effectively cool itself often **result in large heat loss numbers**, even though in-house temperatures may be in only the low 80s because cool cells can maintain relatively low in-house temperatures.

Sprinkler systems, which operate on low water line pressure (no booster pump), offer an alternative to cool cells and foggers. They sprinkle coarse water droplets on birds at timed intervals and take advantage of wind chill and evaporation locally on the chicken surface (Liang et al., 2012). **Sprinklers abandon the idea of cooling the entire house** and focus on cooling individual chickens. Early work with experimental sprinkler systems began at the University of Arkansas in 1995, long before commercial sprinkler systems were available (Tabler et al., 2008).

Commercial systems are now available, and **commercial sprinklers have proven successful** at both the University of Arkansas and Mississippi State University poultry science departments. However, **you have to be pretty open-minded** and willing to change your thought process about bird cooling because sprinklers take some getting used to and offer a totally different method of cooling broilers.

Cool Cell Pad Water Use

Three factors determine water use by cool cell pads:

- Amount of air being drawn through the pads
- Outside air temperature
- Outside humidity

The lower the humidity (the drier the air), the more water the pads will evaporate, the more cooling they will produce, and the more overall cool cell water is used. If we assume a typical cooling efficiency of 75 percent for a 6-inch evaporative pad, the amount of water used can be predicted based on the hourly outside temperature and humidity (Liang and Tabler, 2018). **Figure 1** shows hourly water use by cool cell pads in a 40-by-400-foot broiler house ranging from 100 to 280 gallons per hour as ambient temperature rises from 85°F in the morning to 98°F in midafternoon on a typical summer day.

In fact, **cooling water demand could exceed daily drinking water** amounts for older birds during periods of extended hot and dry weather (**Figure 2**). Pad water use increases as the number of tunnel fans operating increases throughout the day. **Water use by cool cell pads is not dependent on bird age**. In hot weather with near-market age birds, all tunnel fans may operate 24/7. In newer

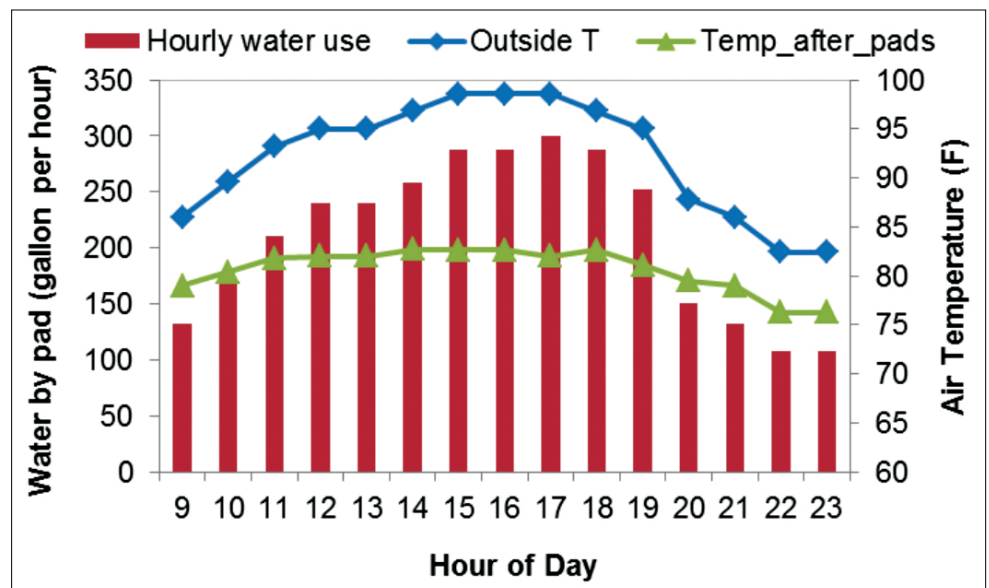


Figure 1. Hourly cooling water with outside air temperature and air exiting pads on a summer day in a 40-by-400-foot broiler house with 160,000 cfm fan capacity (total daily water use of 3,000 gallons). (Adapted from Liang and Tabler, 2018)

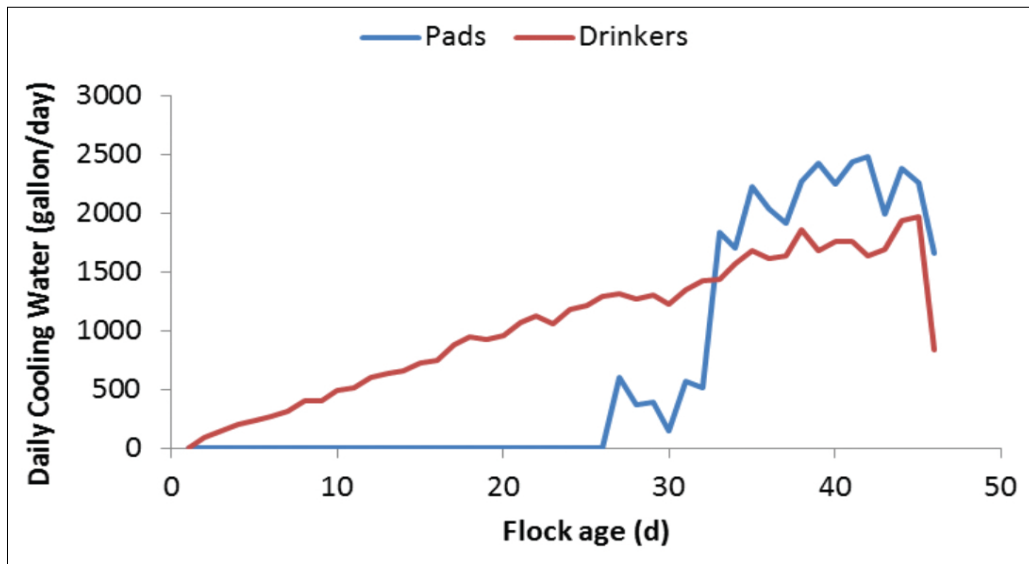


Figure 2. Cooling water use could exceed that from drinkers during a summer flock. (Adapted from Liang and Tabler, 2018)

houses with high-capacity tunnel ventilation capable of delivering 800 feet per minute (or more) air speed, large amounts of cooling water (5,000 gallons per day or more) are consumed to produce convective cooling (cooling the in-house air temperature), regardless of bird age.

Sprinkler Water Use

Unlike cool cells, **sprinkler water use is dependent on bird age**. Again, sprinklers attempt to **cool individual chickens** instead of the environment the chickens live in. With sprinkler cooling, direct evaporation of water from chicken surfaces releases metabolic heat to the surrounding environment, and ventilation fans can remove this heat from the house. This **phase change from liquid to water vapor taking place on the bird surface** is much more efficient (substantial heat loss with a small amount of water) than convective heat transfer between chickens to the slightly less warm surrounding environment (Liang and Tabler, 2018).

However, you must allow a house where sprinklers are used either alone or in combination with cool cells to run hotter, and this **higher temperature scares most folks**. While you may try to maintain your cool cell house at 82–84°F, a house using sprinklers needs to run at around 88–90°F. A sprinkler house has to run that hot for sprinklers to be effective.

There are multiple reasons why hotter may be necessary for the chickens. First, because houses are hotter (and, therefore, drier), water evaporates more readily, reducing wet litter conditions commonly seen in pad houses, particularly in the pad end.

Second, because larger birds need increased metabolic heat dissipation than smaller birds (7 pounds versus 3

pounds, for example; see **Figure 3**), sprinkler controllers ramp up sprinkler rates with bird age to accommodate the increased demands of heat production as birds grow. This ensures precise and more efficient use of cooling water.

Third, **birds do better in a lower humidity environment**. Birds can withstand some pretty high air temperatures if the humidity level is reasonably low. It is the combination of heat and high humidity that kills chickens. While sprinkler houses may have higher air temperatures than cooling pad or fogger houses, adequate cooling is still achieved by direct evaporative heat loss from the heads, necks, and feathers and increased respiration losses from the birds' lungs because of lower air relative humidity (**Figure 4**).

As humidity goes down, air temperature goes up. Think of any sunny day in August. The coolest (and the most humid) part of the day is just before sunrise. By 4 p.m., the temperature may be 100°F, but the humidity may now be only 40 percent or so instead of 90 percent or more as it was at sunrise. Cool cell pads may be able to lower that 100°F outside temperature to 82°F inside the chicken house, but in doing so, they will have also increased the humidity level to 80 percent or more inside the house, making conditions stressful for the chickens. With sprinklers, **you must allow the house to run hotter, but the humidity will be lower**, and that lower humidity allows you to maintain bird performance without undue heat stress on the chickens, even though the house is hotter.

Low humidity is one key to the effectiveness of sprinkler systems but not the only key. Another key is wind-chill effect. When managed properly, you sprinkle the birds for a short duration, turn off the sprinklers, and

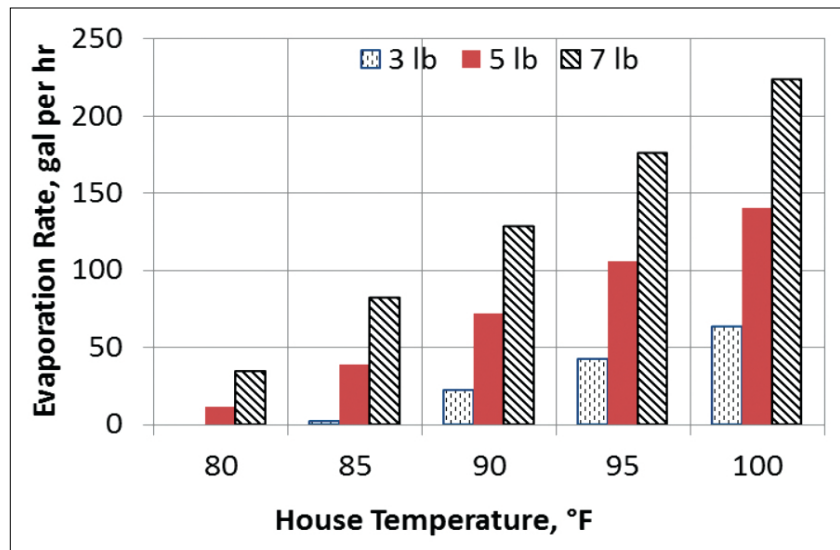


Figure 3. Sprinkler water rates increase positively with house temperature and bird weight. (Adapted from Liang and Tabler, 2018)

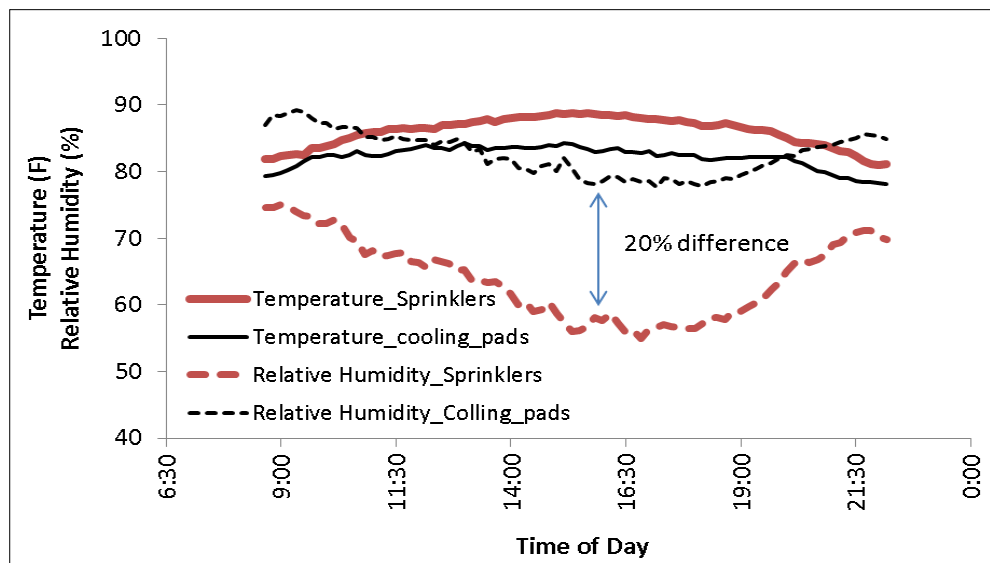


Figure 4. Inside temperature and relative humidity on a typical summer day using either sprinklers or cooling pads. (Adapted from Liang et al., 2012)

let the fans dry off that water. It is similar to jumping in the creek on a 100°F August afternoon when you have a breeze blowing. When you get out of the creek, it's still 100°F, but it doesn't feel that hot because the breeze blowing against your wet skin (wind chill) feels pretty good. It's the same principle in the chicken house. You are bluffing the chickens into thinking that conditions are actually pretty good.

Keep in mind that sufficient air velocity to provide a good wind-chill effect is more important than any other factor in a hot-weather broiler house (Donald, 2000). Wind speed that drops from 500 feet per minute to 300

feet per minute because of poor fan maintenance, wet belts, or pulleys that are slipping will cause a significant loss of wind-chill effect (Czarick and Fairchild, 2003). Such a situation almost guarantees major bird losses. In other words, **lost wind speed means lost chickens** (Tabler et al., 2013).

Another important feature of sprinklers is that, whenever the chickens are sprinkled, the majority of them stand up. Standing releases the trapped heat from between and among the birds, so the fans can pull this heat out of the house. In addition, once they stand up, many of them make trips to the feeders and drinkers. It's as if they figure,

“Well, I’m up, so I might as well go get something to eat and drink.” It is these four things that allow sprinklers to be effective: **1) lower humidity; 2) wind chill effect; 3) released heat from standing up, and 4) stimulated eating and drinking.**

Sprinklers Save Water

Conserving water, growing chickens with a reduced carbon footprint, and producing a smaller environmental impact are all important issues today. Sprinklers save water either alone or in combination with cool cells. At the University of Arkansas, we saw that cooling water used by sprinkler-only houses was **70 percent less** than cooling water used by cool pad-only houses. At Mississippi State University, results from three summer flocks when sprinklers and cooling pads were used in combination showed that a sprinkler/cool cell combination house **saved 40 percent of cooling water** compared to its paired pad-cooled house. (Cool cell set points were set at 17°F higher than house environmental controller set points.)

Summary

Overhead sprinklers in broiler houses used in combination with tunnel ventilation systems can successfully cool birds, maintain performance, and conserve substantial amounts of water. Birds are intermittently sprinkled with large drops of water uniformly throughout the house. Sprinkler use does require an open mind and a different thought process when it comes to cooling birds. House temperature is hotter, but humidity level is lower, helping to remove heat from the birds’ respiratory system and offering a better chance for moisture removal from the litter. This allows the litter to remain drier, resulting in better animal welfare conditions for the birds (reduced threat of footpad dermatitis and improved paw quality).

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