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Poultry Housing Tips

Local Thunderstorms and Their Effect on Poultry House Cooling

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On a hot, summer day a localized thunderstorm can be a benefit or a problem for a poultry producer, depending on what happens after the rain ends. On the typical summer morning the outside air temperature will be around 70°F in most poultry growing areas of the U.S. with a relative humidity around 90%. As the day progresses the outside temperature will increase and the relative humidity will decrease due to the fact that moisture-holding ability of air increases with temperature. In fact, for every twenty degrees the outside air temperature increases, the moisture-holding ability of air doubles, which results in the relative humidity being cut in half. This relationship can be seen in the graph of outside air temperature and relative humidity on a fairly typical July day in Georgia (Figure 1). At 8:00 a.m. the outside air temperature was 75°F and the relative humidity was approximately 84%. By 2:00 p.m. the outside temperature increased to 95°F (a 20°F increase) and the relative humidity dropped to 40% (cut in half). The fact that the relative humidity is lowest during the hottest periods of the day is of significant benefit because it means that our evaporative cooling pads and fogging nozzles produce the maximum amount of cooling when we need it the most.

During the afternoon as we evaporate water into the air entering our houses, either using pads or fogging nozzles, energy is removed from the air, thus lowering its temperature. The more water we can evaporate into the incoming air, the greater the amount of energy removed from the air, the greater the temperature decreases. The downside of evaporative cooling is that by evaporating water into the air we increase the relative humidity of the air, which can have a negative effect on a bird's ability to cool itself through panting. In general, for every one degree of cooling produced, the relative humidity will increase approximately 2.5%. As a result, when our pads or fogging nozzles are producing for instance, 10°F cooling, the relative humidity of the air will increase approximately 25%.

It is important to realize that though the relative humidity does increase when using evaporative cooling, if we have sufficient air speed, 500 ft/min or better, it does not necessarily result in increased heat stress. The higher the wind speed we have moving over the birds, the greater the amount of heat we are pulling from their bodies, which means they have to rely less on panting to cool themselves. The less the birds have to rely on panting to cool themselves, the less problematic a high humidity is. To put it simply: A high relative humidity with a low air speed is a deadly combination. A high wind speed when it is very humid makes a tough situation bearable.

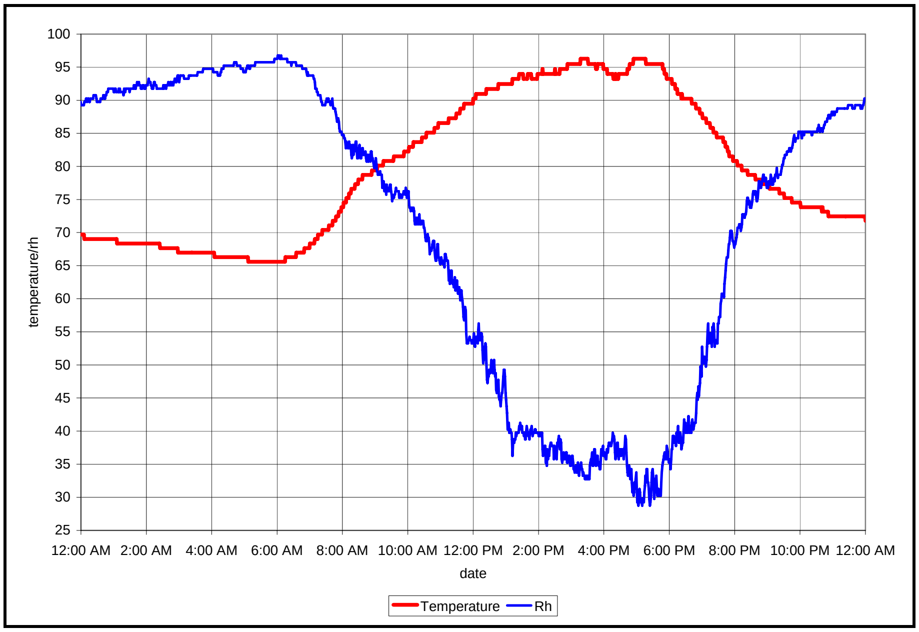

Figure 1. Outside temperature and relative humidity on a hot summer day in Georgia.

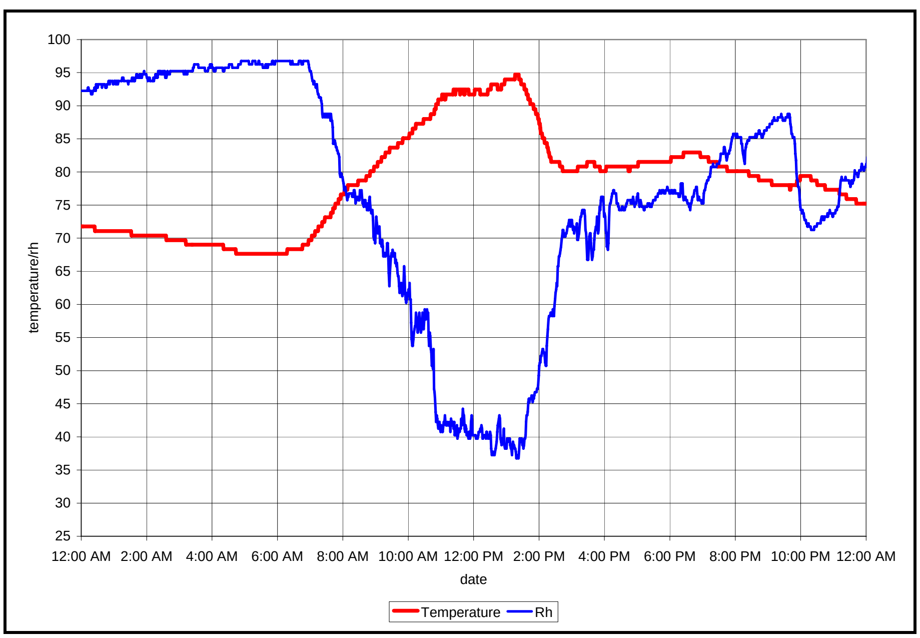

Figure 2. Outside temperature and relative humidity before and after a localized thunderstorm.

Evaporative cooling does not just happen within a poultry house. A thunderstorm is in effect a very large external evaporative cooling system. As it begins to rain, moisture is evaporated into the air which, like in a poultry house, removes energy from the air, thus lowering the temperature of the air and increasing relative humidity. The effect that a rain storm has on temperature and humidity can be seen in Figure 2. At 1:30 p.m. outside temperature begins to fall and relative humidity increases due to a nearby thunderstorm (no rain actually fell on the farm where weather conditions were being monitored). The evaporation of water into the air decreased the temperature from 95ºF to 80ºF, a 15ºF decrease. Relative humidity increased from 40% to 75% which is what we would expect due to the fact that for every one degree of cooling produced through the evaporation of water the relative humidity will increase 2.5% (2.5 X 15ºF = 38%, 40% + 38% = 78%).

The nearby thunderstorm shown in Figure 2 would have been a welcome relief for a poultry producer with older birds. An incoming air temperature of 80ºF would have likely meant that the evaporative cooling system would probably not have been needed and the birds would have been reasonably comfortable provided the birds had sufficient air speed moving over their bodies (+500 ft/min). The truth is if an evaporative cooling system would have been used in this situation it would only have produced just a few degrees cooling, considering the fact that the air was already fairly saturated by the thunderstorm (outside Rh +75%).

In many ways, a thunderstorm like the one depicted in Figure 2 is the best type for a poultry farm with older birds. First, the rain occurred a couple of miles away, so the farm received the cool air from the storm and not a lot of moisture. Second, the sun did not come out after the storm. Had it rained on the farm, then gotten sunny, it would have been a very different situation.

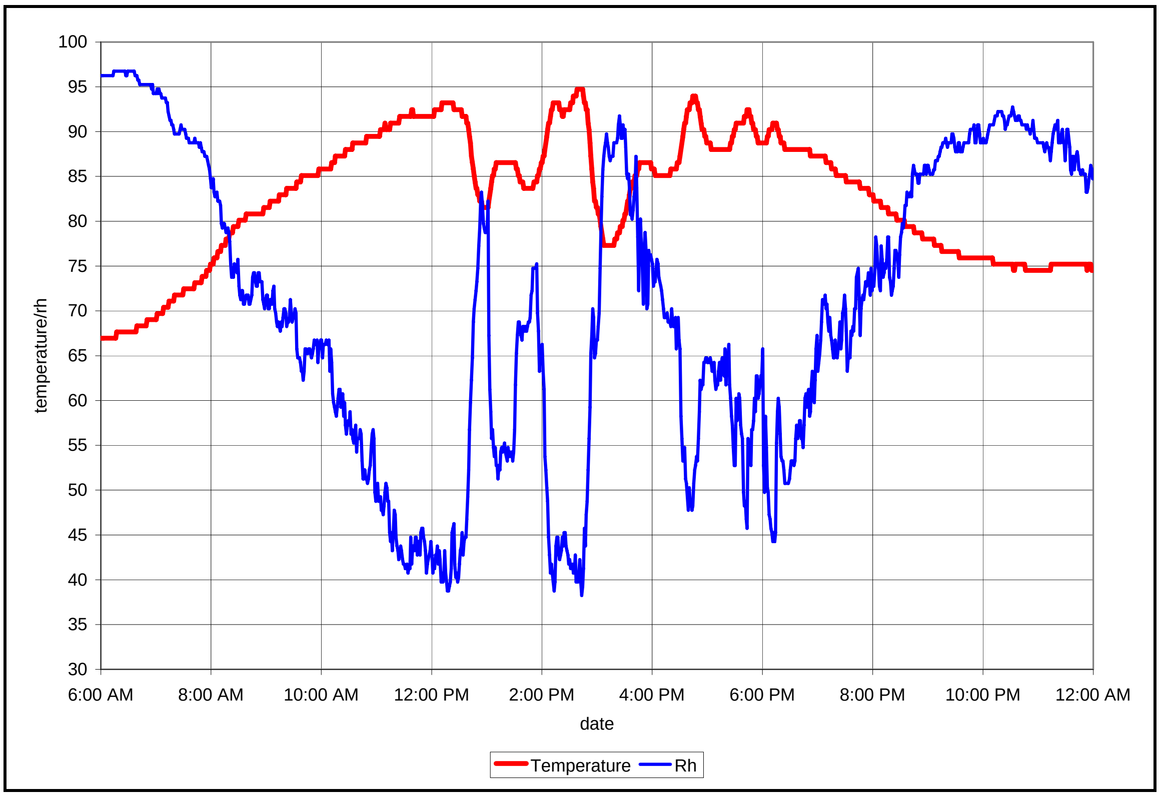

Figure 3. Outside temperature and relative humidity before and after multiple thunderstorms.

Figure 3 is a graph of temperature and relative humidity on a day with multiple thunderstorms a few days after that shown in Figure 2. There was a brief rainstorm producing less than 0.02" of rain at approximately 12:45 p.m., which dropped the outside air temperature about 12ºF and increased the relative humidity from 45% to 80%. The sun came out, the temperature increased approximately 5ºF and the relative humidity decreased 25%. Then another short thunderstorm occurred nearby, again decreasing the temperature and increasing the relative humidity. Shortly afterward the sun came out and the temperature increased and the relative humidity once again decreased to around 40%. At 3 p.m. the farm was hit with a brief downpour producing 0.12" in just a few minutes, resulting in the outside temperature dropping into the seventies and the relative humidity increasing to approximately 90%. Once again, the sun came out and the temperature increased and the relative humidity decreased, but not to the same levels experienced before the

3 p.m. storm. When the sun came out this time there was a significant amount of moisture on the ground, trees, etc., which when it evaporated due to the heat produced by the sun, led to significantly higher humidity levels.

How would a day like this affect a producer's ability to keep his birds cool? The first couple of showers would have been more of a benefit than a detriment. The third storm, would have caused significant problems for a poultry producer with older birds. First, the good news. Due to the relationship between temperature and relative humidity, whenever the outside temperature was above 80ºF the relative humidity was for the most part below 80% and an evaporative cooling system would have produced some cooling. The bad news is that after the major rain storm at 3 p.m., the relative humidity was approximately 10% to as much as 15% higher than it was before the storm at the same temperature, which is very typical for this type of weather event. For instance, in the morning when the outside temperature was 90ºF, the relative humidity was 55%; immediately after the storm outside temperature again rose to 90ºF but this time the relative humidity decreased to 65%. This may not seem like much of a difference, but when it comes to keeping chickens cool, it is. Before the storms, when it was 90ºF, the incoming air temperature for a house using a six-inch evaporative cooling pad system would have been 79ºF and the relative humidity would have been 83%. After the 3 p.m. storm, the incoming air temperature would have been 83ºF with a relative humidity of 89%. On the surface, a four-degree hotter house does not sound that bad, but keep in mind the relative humidity of the incoming air is also seven percent higher. The increase in both air temperature and relative humidity would have likely increased the "effective temperature" six or more degrees after the thunderstorm when the outside temperature rose again to 90ºF, leading to significantly greater heat-stress-related problems.

What should a producer do to minimize the potential negative effects of a brief thunderstorm? First, keep in mind that though the relative humidity during a rainstorm increases to around 90%, the temperature will typically fall below 80ºF. When the sun does come out, the relative humidity will go down. It will not be 90ºF with a relative humidity of 100%! It may feel like it is, but it is simply not the case. By the time the temperature rises into the mid eighties, the relative humidity will fall below 80% and an evaporative cooling system will produce some cooling. Not as much as before the storm, but it will cool the incoming air and therefore in general should be used. The most important thing to concentrate on after a brief shower is wind speed. When you have hot, humid conditions, wind speed becomes crucial in keeping your birds comfortable. Make sure all your fans are operating after the storm. Brush dust off the shutters and make sure the belts are not in need of replacing. Check to see if your tunnel curtain is fully opened. The fact is, as with most things in a tunnel-ventilated house, it always comes down to moving as much air over birds as possible to keep them cool when it is hot outside.

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