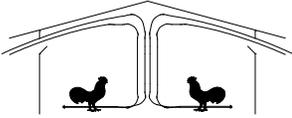




The University of Georgia

College of Agricultural and Environmental Sciences
Cooperative Extension



Poultry Housing Tips

Do Sprinkling Systems Reduce Broiler Breast Temperatures?

Volume 29 Number 4

2017



The hottest place in a poultry house on a hot summer day with market-age birds is not next to the ceiling, but rather down between the birds. A house full of market-age broilers can produce a tremendous amount of heat. In fact, 20,000, eight-pound broilers produce approximately the same amount of heat as 20 radiant brooders, which is 16 times the amount of heat that enters through the typical poultry house ceiling. The high level of heat being generated at floor level can easily lead to air temperatures at floor level being five or more degrees higher than those near the ceiling. The challenge for poultry growers during hot weather is not only removing this hot air from between the birds thereby keeping air temperatures from becoming excessive, but more importantly removing the heat from the birds keeping their body temperature from becoming excessive.

A producer's best heat removal tool is air movement. The higher the level of air movement at floor level, the greater the amount of heat removed from the birds, and the cooler they will feel. The amount of cooling a bird can receive through air movement is in part determined by the amount of its surface area that is exposed to air movement. For instance, a bird standing by itself will have air moving over essentially its entire body (back, head, sides, and underside) which will maximize heat removal from the bird and therefore maximize bird cooling (Figure 1). In contrast, a bird that is sitting within a group of tightly packed birds will only have air movement over its back and head (Figure 2). Since significantly less surface area of a bird is exposed to air movement, heat removal is dramatically lower, and bird body temperature will increase. Though growing birds at commercial densities can make it difficult to get adequate air movement over all the surfaces of a market-age bird, it becomes even more challenging on the evaporative-cooling-pad end of a house when migration occurs. To insure that heat removal is maximized for all the birds in a house it is crucial that the correct number of migration fences are installed in a timely manner and are properly managed so that the birds remain evenly distributed throughout the house.

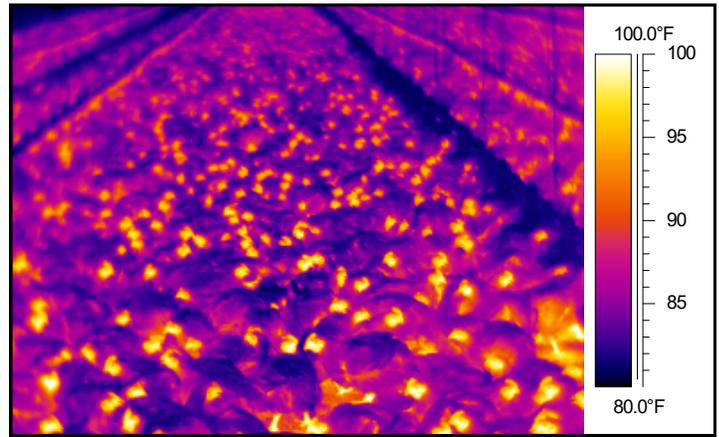
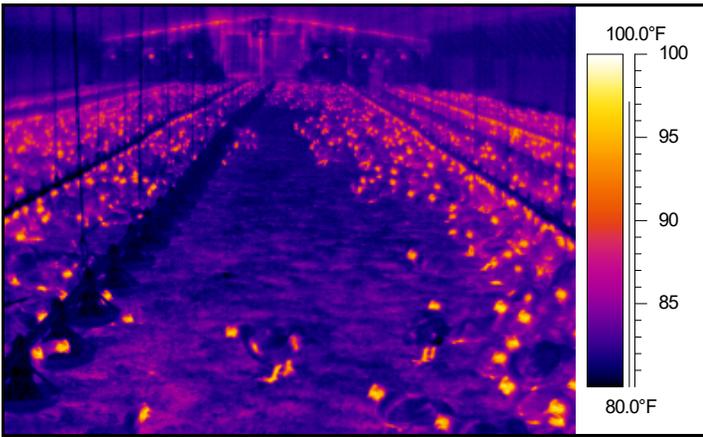


Figure 1. Thermal image of low-density birds near tunnel fans (same house shown in Figure 2).

Figure 2. Thermal image of high-density birds near tunnel inlet (same house shown in Figure 1).

Even in the best-managed houses the one bird surface which typically receives very little air movement is the breast or underside of the bird. Broilers tend to sit and rest for much of the day, especially when they are older. When a bird is seated not only is there no air moving over its underside, which is a significant portion of its total surface area, but the litter that the bird is sitting on acts as an insulator preventing the bird from losing any heat from its underside. The longer a bird sits, the more the temperature of its breast and the litter underneath the breast will tend to rise. It is only when a bird stands that air can start to move under the bird, helping to remove heat not only from the bird's breast but the litter as well.

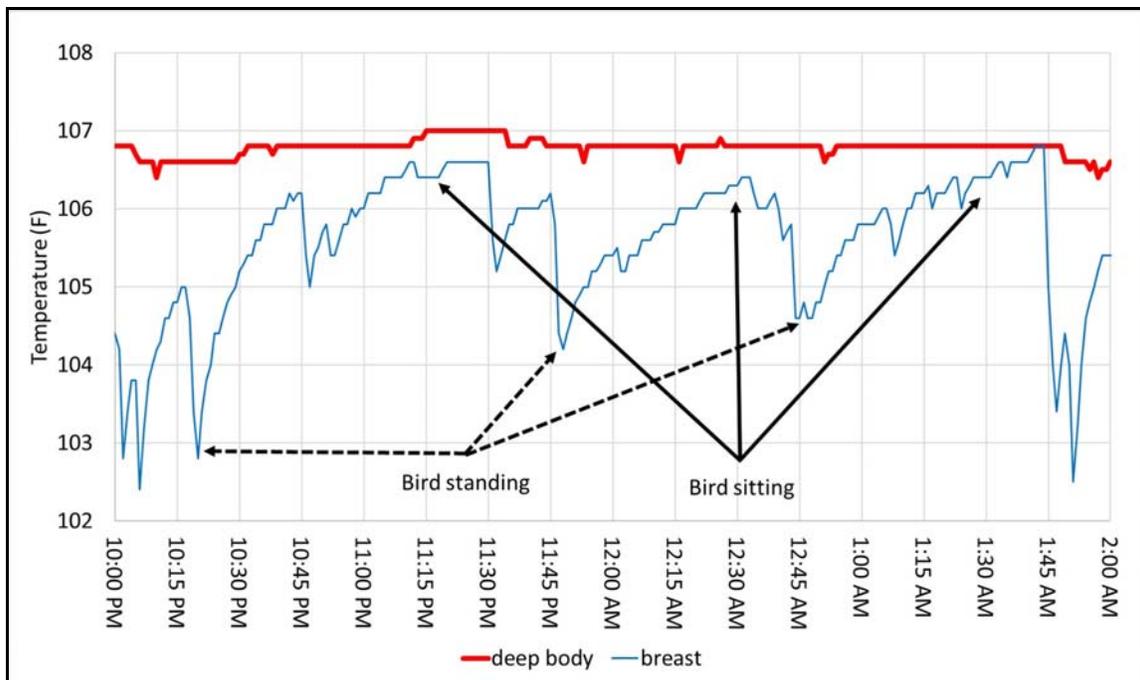


Figure 3. Deep body and subcutaneous breast temperatures.

Figure 3 illustrates how subcutaneous breast temperatures can change as a bird moves from a sitting to standing position and back again. When the bird was sitting, the lack of air movement and the insulating nature of the litter caused the temperature of a bird's breast to slowly rise over a period of 30 minutes to an hour. The longer the bird sat, the closer the subcutaneous breast temperature approached deep body temperature (107°F). The fact that the subcutaneous temperature increased as the bird sat is a good indication that little to no heat was being lost from the breast. When the bird stood up breast temperatures tended to quickly drop to between 105 and 103°F. The good news is that whereas it can take 30 minutes or more for the breast temperature to heat up two to three degrees, it can drop the same amount in just a couple of minutes when the bird goes from a sitting to a standing position.

For years it has been debated whether it is beneficial for producers to get their birds to briefly stand up by slowly walking through them during hot weather. Some believe that by slowly walking through a house the heat that builds up under the birds can be released, making the birds cooler. In addition, walking the birds encourages them to get water and feed. Others believe

the likelihood of birds piling against migration fences and the increased level of bird activity and therefore heat production does more harm than good. Furthermore, many producers simply do not have the time to walk through all the houses on a farm multiple times each afternoon.

Recently, some producers have installed bird sprinkler systems, in part, as a way to get the birds to stand up without all the negative aspects of walking birds. The thinking is that since birds tend to get up when a sprinkler system is used that this will provide a brief opportunity to cool the litter as well the breast of the bird. Furthermore, a sprinkler system can be used to get the birds to stand up multiple times an hour without the any labor or the concern of birds piling against the migration fences as a house is walked. Though the logic seems sound, the question is whether a sprinkler system will actually significantly reduce breast temperatures during hot weather.

A study was conducted on a commercial broiler farm to explore the relationship between sprinkler usage and subcutaneous breast temperature of market-age birds during hot weather. A commercially available sprinkler system was installed in two adjacent 42' X 500' tunnel-ventilated broiler houses. Bird and sprinkler water usage, outside temperature and relative humidity as well as inside temperature and relative humidity were recorded on a minute-to-minute basis for the last 11 days of a 60-day flock.

Micro-temperature data loggers were implanted subcutaneously near the keel bone of six broilers, 12 days prior to the catch date. Three birds were placed in each of the two study houses and were allowed to roam freely throughout the house. Prior to catching, the data loggers were removed from the birds and the temperature data was downloaded to a PC. When the data was analyzed it was discovered that one of the loggers failed which resulted in having only two subcutaneous breast temperature measurements in one of the two study houses.

The high accuracy temperature logger not only provided a method of measuring breast temperatures but also a way of indicating bird activity. When a bird is quietly sitting breast temperature will slowly rise with very few variations in temperature. But, when a bird stands up or even briefly repositions themselves the temperature of the surface of the breast will quickly drop as it is exposed to the cool air as compared to the warm litter. The longer the bird stands the greater the decrease in breast surface temperature. Since breast temperature was measured every minute, bird activity, specifically their response to a sprinkler system, could be monitored on a minute-to-minute basis.

The sprinkler system was operated for the most part according to manufacturer recommendations. The sprinkler system would operate in stimulation mode (10 seconds per hour) from 8 am to 8 pm starting at 14 days of age (Adjustments to the hours of operation were occasionally made as the birds got older.) If house temperatures became excessive, 12°F above target temperature, the sprinkling system would start to operate in cooling mode, sprinkling the birds for 20 seconds every 30 minutes. The higher the house temperature became the more often the sprinkler system would operate (+15°F, once every 15 minutes. +19°F, once every 5 minutes.) The house's evaporative cooling pads were set to operate 22°F above the house set temperature. Ideally, the pad system would have only operated if the house temperature exceeded the high eighties, but due to limitations of the houses' environmental controller systems, during roughly the last 10 days of the flock, the pad system operated when house temperatures were in the low to mid eighties.

Commonly when conducting a field study there is a test house and a control house. The problem with this method of testing is it assumes that not only are the two houses perfectly identical, but the birds are identical as well. Every farmer knows that though all their houses appear identical and have the "same" birds, rarely is bird activity/performance identical. To account for the "house effect," the sprinkler system in each of the two houses operated on an alternating three-day basis. Specifically, the sprinkler system was operated in one house for three days and turned off in the second house. At the end of the three-day period, the operation of the sprinkler systems in the two houses would be swapped. Comparisons in bird water usage could then be compared not only between the houses but also within the same house between sprinkler and nonsprinkler days.

Figures 4 and 5 illustrate average subcutaneous breast temperatures along with both bird and sprinkler water usage rates on a minute-to-minute basis for each of the two study houses over the 11-day study. Though it is difficult to discern precise breast temperature patterns from the long-term graph, it is clear to that the highest breast temperatures occur during the dark period (10 pm to 4 am) when the birds stop drinking and sit down.

Figures 6 and 7 provides a view of individual subcutaneous breast temperatures, and house temperatures, along with bird and sprinkler system water usage on a fairly typical study day (August, 8). Because the evaporative cooling pads were set to operate at a temperature of 82°F in both houses, air temperatures were very similar in both houses. As noted previously, in the more typical sprinkler system operation scenario the pads would have been set to turn on closer to 90°F and only the

sprinkler system would have been operating in a cooling mode in the low eighties. Since the sprinkler system is only capable of decreasing the house temperature a couple of degrees, house temperatures would have been significantly higher in the house where the sprinkler system was active compared to the house where only the evaporative cooling pads were being used. In Figure 6 the operation of the sprinkler system can be seen over the course of a day, starting with a stimulation mode (sprinkling once an hour), then progressing to a low cooling mode at 9:30 am (sprinkling once every 15 minutes), to a high cooling mode a little after 5 pm (once every five minutes).

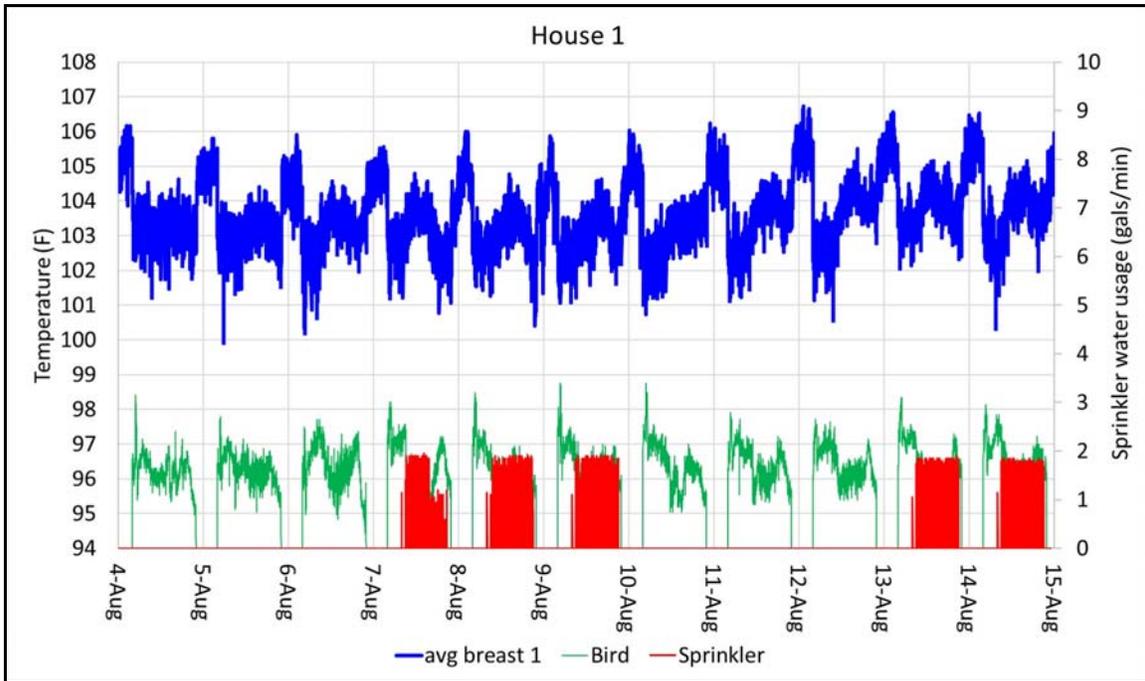


Figure 4. Avg. subcutaneous breast temperature, bird and sprinkler system water usage (House 1).

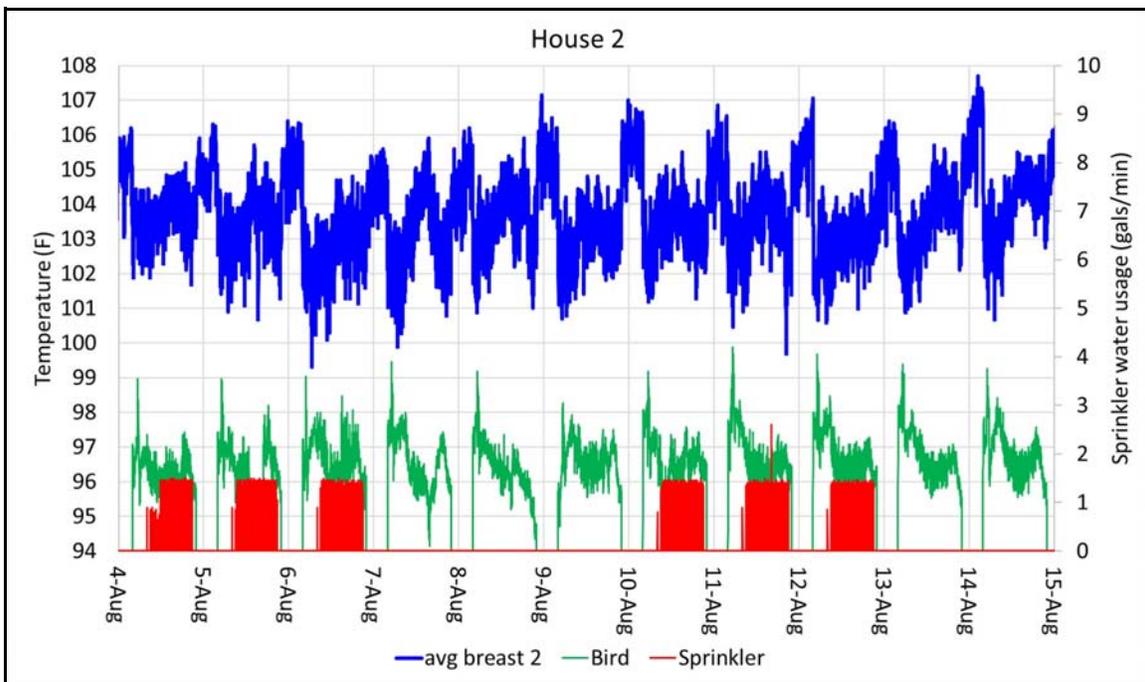


Figure 5. Avg. subcutaneous breast temperature, bird and sprinkler system water usage (House 2).

Figures 8 and 9 provide a view of individual subcutaneous breast temperature measurements, along with bird and sprinkler system water usage over a six-hour period on the afternoon of August 8. In the house with the active sprinkler system there appears to be slightly more variation in bird water usage from minute to minute in the mid afternoon when the sprinkler system was operating in a low cooling mode (once every 15 minutes) compared to the house where the sprinkler system was inactive. The slight peaks in water usage occasionally correspond with sprinkler operation.

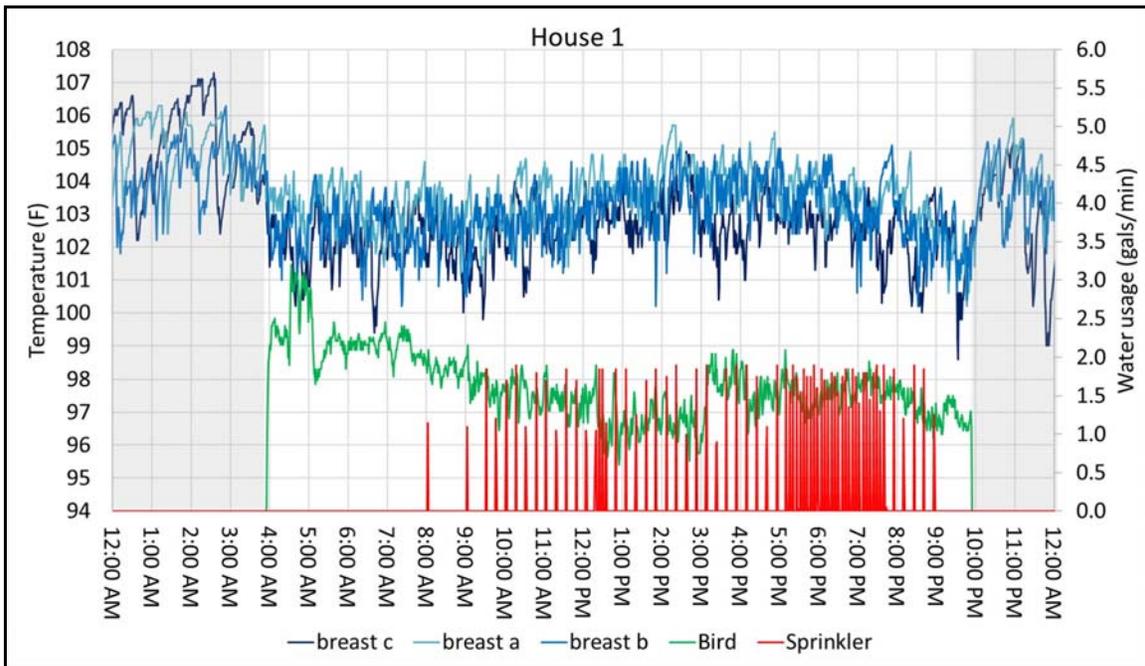


Figure 6. House and subcutaneous breast temperatures, along with bird and sprinkler system water usage - sprinkler system active (August 8, shaded areas lights are off, House 1).



Figure 7. House and subcutaneous breast temperatures along with bird and sprinkler system water usage - sprinkler system inactive (August 8, shaded areas lights are off, House 2).

Subcutaneous breast temperatures were very similar in both the houses ranging from roughly 102 to 106°F. At times the subcutaneous breast temperature of individual birds (i.e., Bird a @ 1:50 pm, and 2:05 pm - Figure 8) decreased as the bird stood up in apparent response to the sprinkler operation but other times the birds did not apparently respond to being sprinkled. Though there appears to be slightly more variation in subcutaneous breast temperatures when the sprinkler system was active, there was no meaningful decrease in overall breast temperature when compared to the birds in the house with the inactive sprinkler system.

Figures 10 and 11 provides a view of bird temperatures, along with bird and sprinkler system water usage on the evening of August, 8. In both houses breast temperatures tended to rise when the lights turned off at 10 pm and the birds became less active. There were differences between the level of apparent activity of the birds when the lights went off. The breast temperatures of some birds (ie. Birds d and e) indicate that the bird stood up just a couple of times between 10 pm and

midnight whereas others (i.e. Birds a and b) stood up a little more often and appeared more restless when they sat down as indicated by small fluctuations in breast temperature. The precise level of activity of individual birds at night changed from day to day and did not appear to be associated with the use of the sprinkler system during the day. But, what becomes clear when looking at these graphs is that the birds in both houses were similarly active during the daylight hours and similarly inactive during the dark hours. There may have been slightly more variation in subcutaneous breast temperature, possibly indicating more bird movement, when the sprinkler was active but the sprinkler system did not apparently cause a significant decrease in breast temperatures.

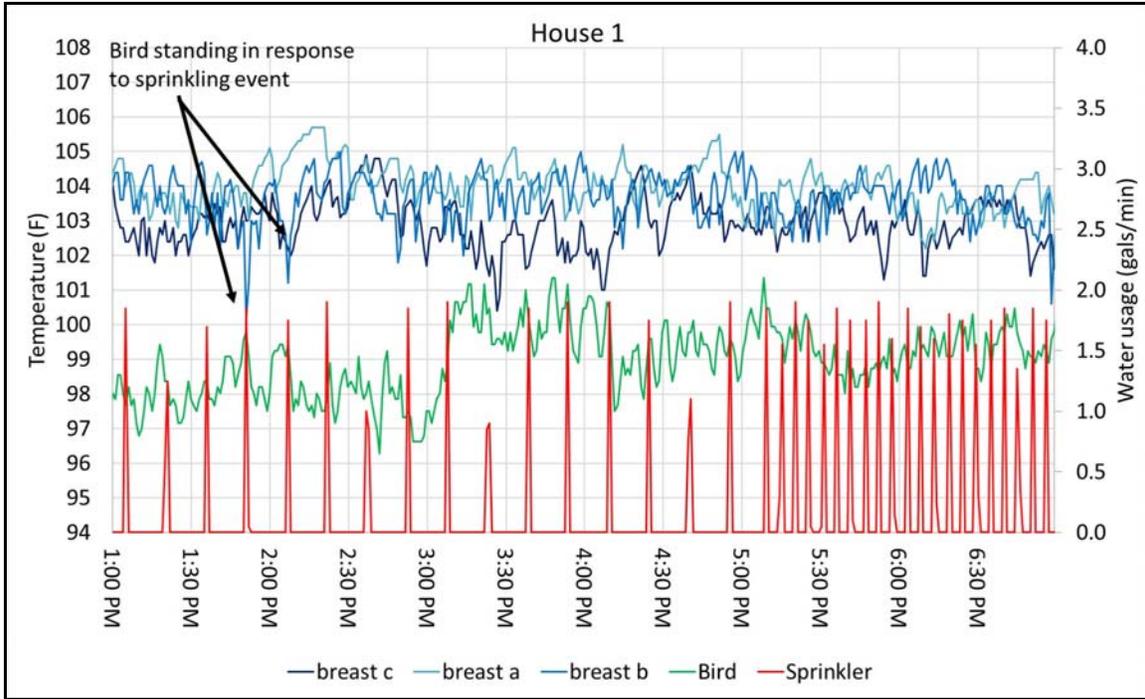


Figure 8. House and subcutaneous breast temperatures along with bird and sprinkler system water usage - sprinkler system active (August 8 - afternoon, House 1).

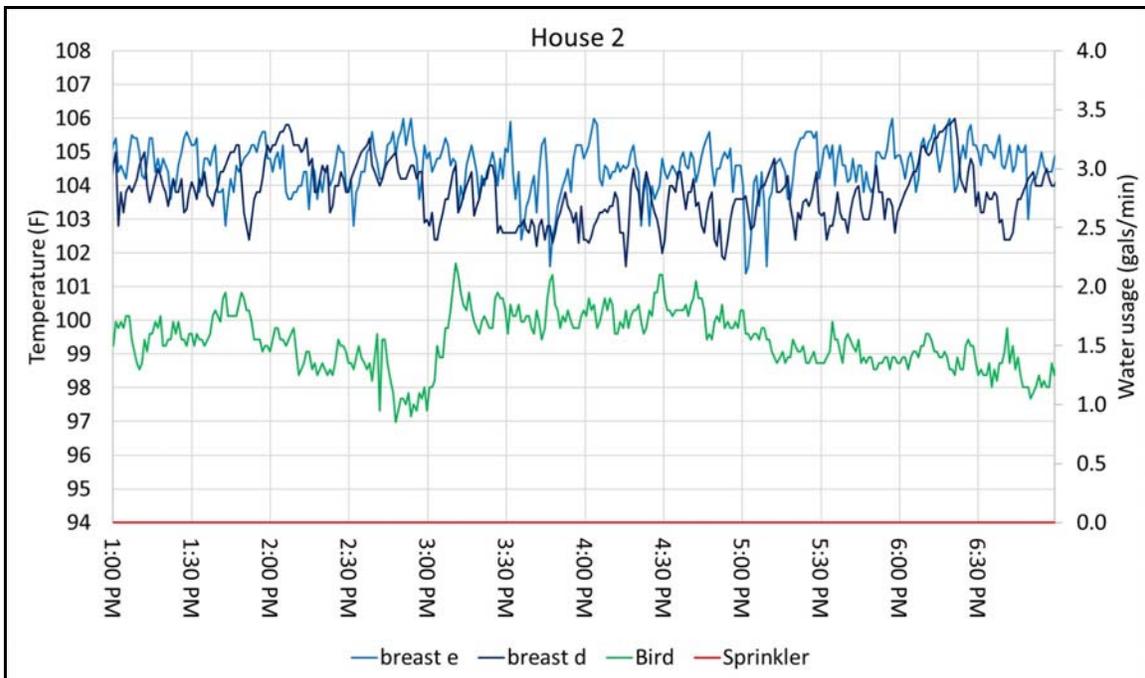


Figure 9. House and subcutaneous breast temperatures along with bird and sprinkler system water usage - sprinkler system inactive (August 8 - afternoon, House 2)

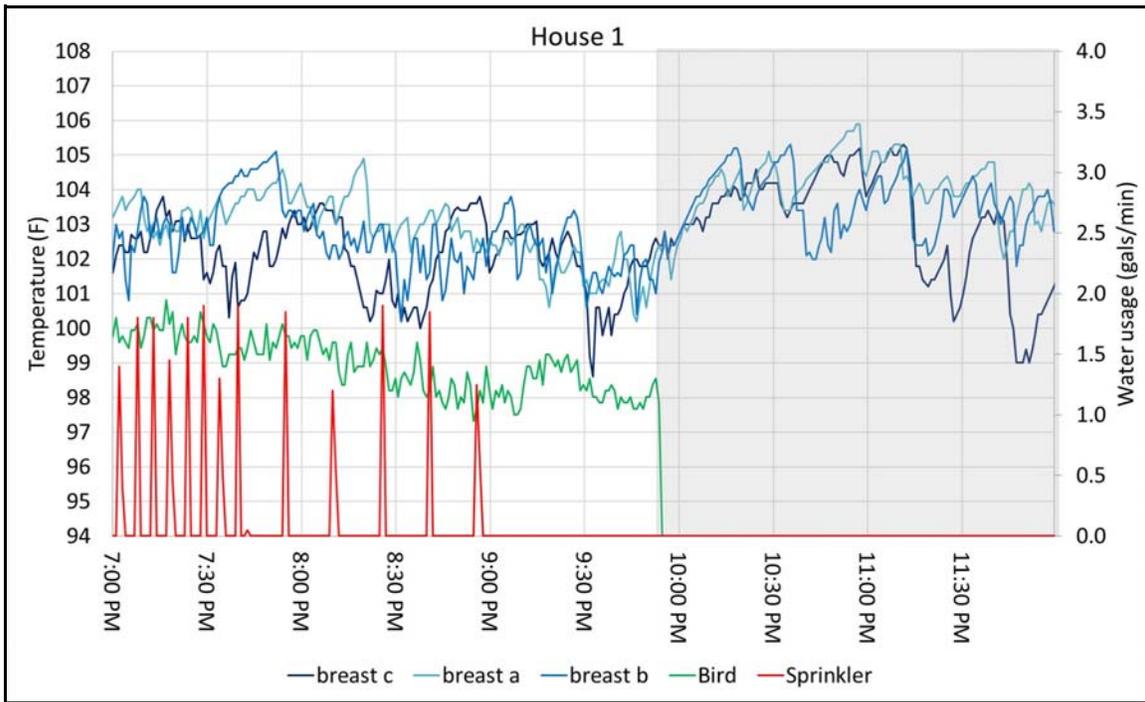


Figure 10. House and subcutaneous breast temperatures along with bird and sprinkler system water usage - sprinkler system active (August 8 - afternoon/evening, shaded area lights are off, House 1)

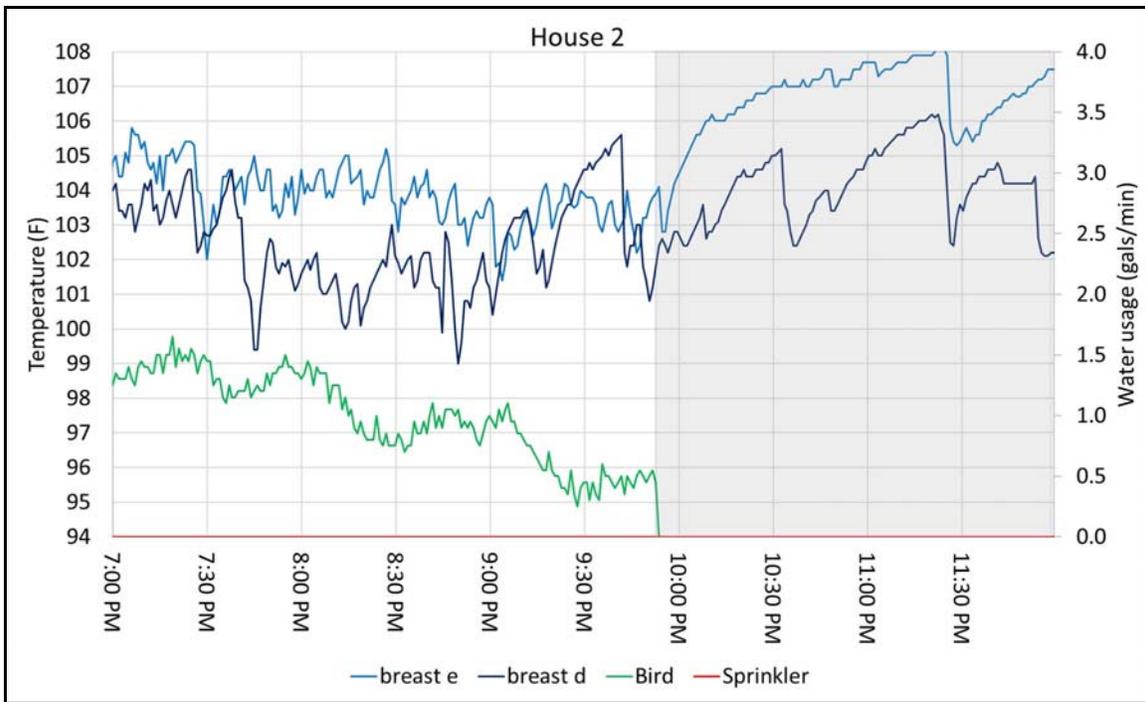


Figure 11. House and subcutaneous breast temperatures along with bird and sprinkler system water usage - sprinkler system inactive (August 8 - afternoon/evening, shaded areas lights are off, House 2)

Figures 12 and 13 show the average daily daytime (8 am - 9 pm) subcutaneous breast temperatures for each of the birds in the two houses over the course of the study. The shaded days are those when the sprinkler system was being used. From these graphs it is difficult to observe any significant effect the sprinklers had on the lowering of breast temperatures. In both houses, breast temperatures were similar on days when the sprinkler system was operating compared to those days when the sprinkler system was not operating. Yes, the use of sprinklers may affect the level of bird activity/movement, but this doesn't appear to result in a significant cooling of the bird's breast during hot weather. The reason for the lack of a significant difference is likely due to the fact that broilers are more active than they may appear, even on a hot summer day. Though it might look like

the birds are sitting around for hours, this study found that they are getting up and moving around multiple times each hour. Each time they stand, breast temperatures decreases. The primary time that birds do sit down for long periods, and breast temperatures approach deep body temperature, is at night when the lights go off for a long periods.

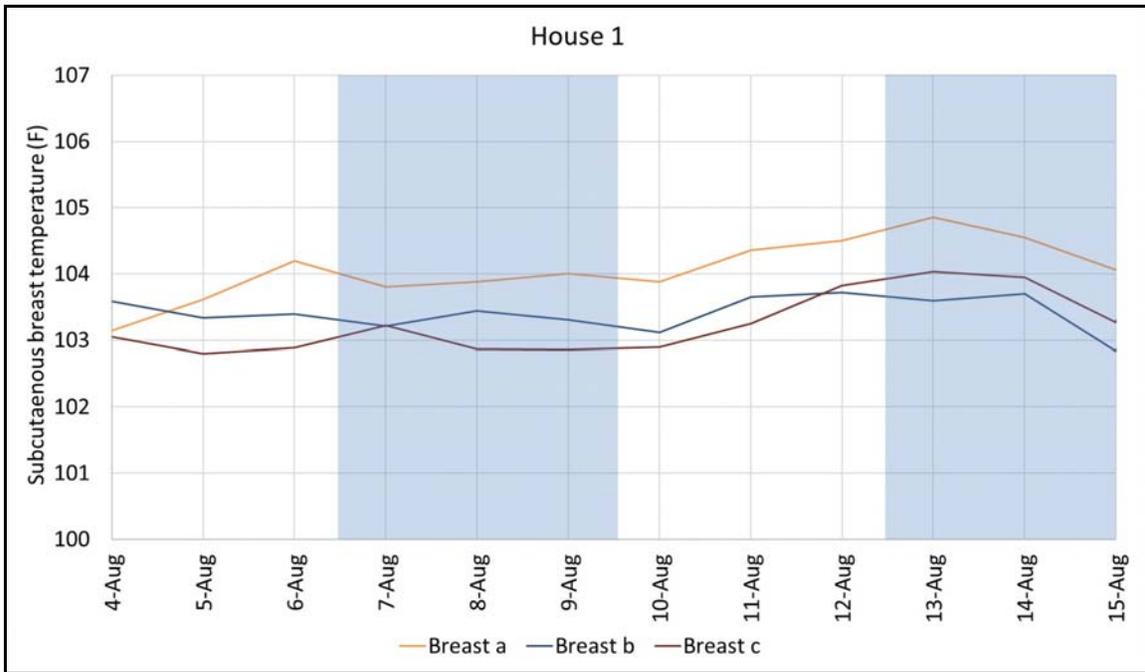


Figure 12. Average “daytime” subcutaneous breast temperatures (House 1 - shaded areas denote days where the sprinkler system was in use).

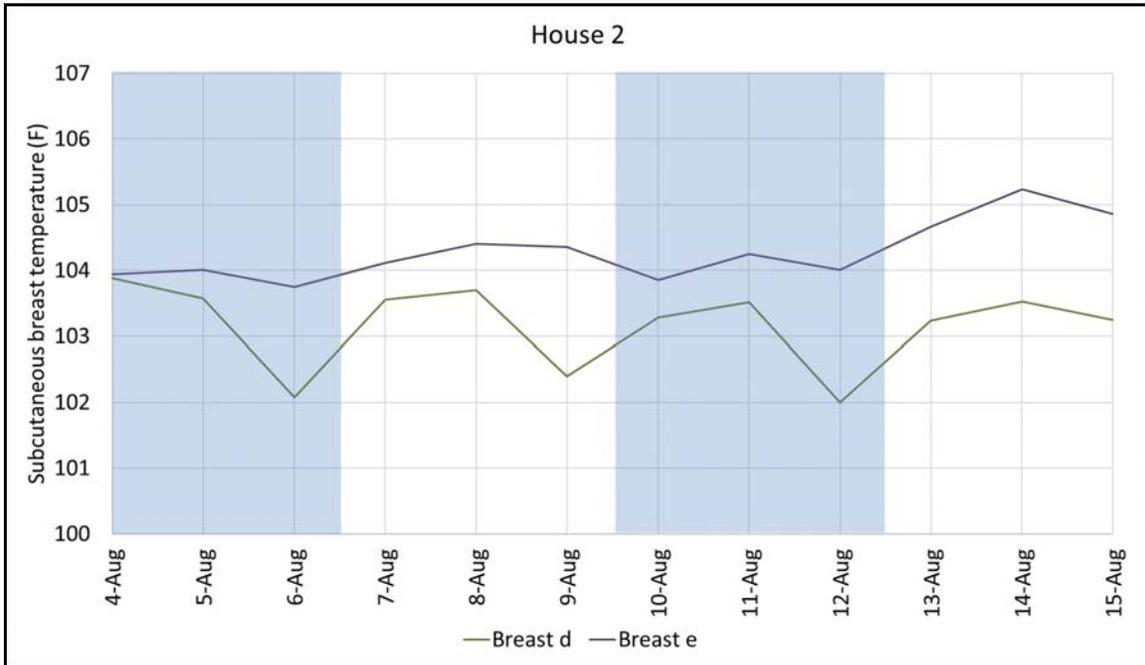
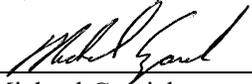
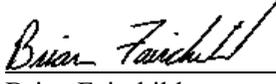


Figure 13. Average “daytime” subcutaneous breast temperatures (House 2 - shaded areas denote days where the sprinkler system was in use).


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