Water conservation and production benefits of sprinkling broilers

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Abstract

Maintaining broiler comfort during hot, humid weather is critical to weight gain, FCR, flock welfare and livability. The objective of the current study was to determine effectiveness of sprinkler technology to improve broiler performance and water conservation efforts during hot weather. During a 63-d summer flock (June-August 2019), a commercial sprinkler system (SS) was used in combination with a conventional evaporative cool cell system (CC) in two commercial broiler houses (42 x 400 ft; 13 x 122 m) each housing 16,016 Cobb 700 straight run broilers at Mississippi State University. Two lines of overhead sprinklers above the feed lines spaced evenly 20 ft (6 m) apart and 7ft (2.1 m) above the litter surface were intermittently operated to apply controlled volumes of large water droplets onto the birds. Previously, SS and CC were used in combination at increasingly higher CC set point temps ranging from 82°F (28°C; 2014) to 86°F (30°C; 2018-2019) and finally, 90°F (32°C; 2019). SS was responsible for an increasing amount of cooling as CC set point increased. During the June-August 2019 flock, sprinklers were initiated at 23 d of age. CC initiation was delayed until 45 d and allowed only when house temperature reached 90°F (32°C). Current sprinkler research is based off recent analysis of 1995-2005 University of Arkansas experimental sprinkler data analyzed as a Randomized Complete Block Design indicating a significant reduction in cooling water use (P=0.003) and average daily mortality from d 35 to harvest (P=0.035) for SS vs. CC. Pay per lb increased for SS vs. CC cooling (P=0.064). In the AR study, no differences were found for water intake, FCR, or avg wt. (P>0.05). While more research is needed, our data suggest that 63 d old broilers can maintain performance at 90°F (32°C) house temp and ~65% house humidity with reduced cooling water use when SS is the first line of cooling defense. Maintaining performance at 90°F (32°C) is likely possible only because of lower house humidity levels that SS allows vs. CC; thus assisting in respiratory evaporation. Future research should investigate feasibility of using SS alone to cool broilers and the effects on house environment (temperature, wind speed, and humidity) as well as flock welfare and water conservation.

Introduction

- ✓ Water scarcity is a looming national issue the poultry industry must address.
- ✓ Water conservation related to cooling poultry during summer is a worthwhile goal with potential to reduce peak water demand and groundwater depletion.
- ✓ Heat stress adversely affects growth performance and increases broiler mortality losses.
- ✓ Evaporative cooling systems are ineffective at avoiding production efficiency declines because they saturate the house with moisture (>80% relative humidity), reducing the bird's ability to cool itself through respiratory evaporation.
- ✓ We must find ways to enhance water conservation and increase the supply of nutritious, affordable, and accessible food while increasing sustainable opportunities for American agriculture, keeping in mind societal, behavioral, health, economic, and environmental impacts.
- ✓ Outcomes must promote rural prosperity and enhance quality of life for those involved in food and agricultural value chains.

Materials and Methods

- ✓ Current research was conducted at two commercial-scale broiler houses equipped with a commercial SS and a conventional 6-inch CC system on the Mississippi State University poultry research farm.
- ✓ Work involved using SS and CC in combination at increasingly greater CC set points.
- ✓ CC set points were 82°F (28°C; 2014), 86°F (30°C; 2018 and 2019), or 90°F (32°C; 2019) to assess cooling-water conservation and flock performance.
- ✓ Experimental sprinkler research at University of Arkansas from 1995-2005 provided background data for research at Mississippi State University.
- ✓ Previous sprinkler data from AR were analyzed as a Randomized Complete Block Design to guide current research efforts.

Results and Discussion

Figure 1. Drinking water and cooling water use by SS and CC for 63-day-old flock from July-September 2018 with CC set point at 86°F.

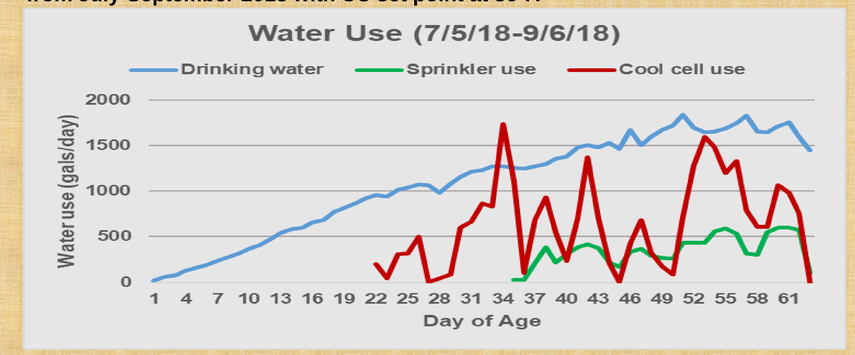


Figure 2. Drinking water and cooling water use by SS and CC for 63-day-old flock from June-August 2019 with CC set point at 90°F.

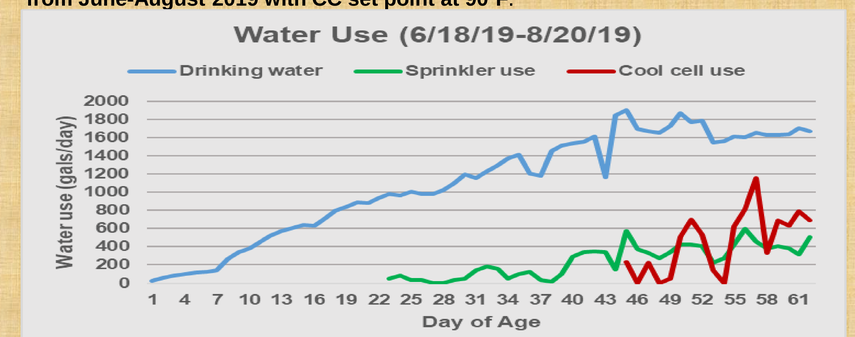


Figure 3. House and ambient minimum and maximum temperatures for 63-day-old flock from June-August 2019.

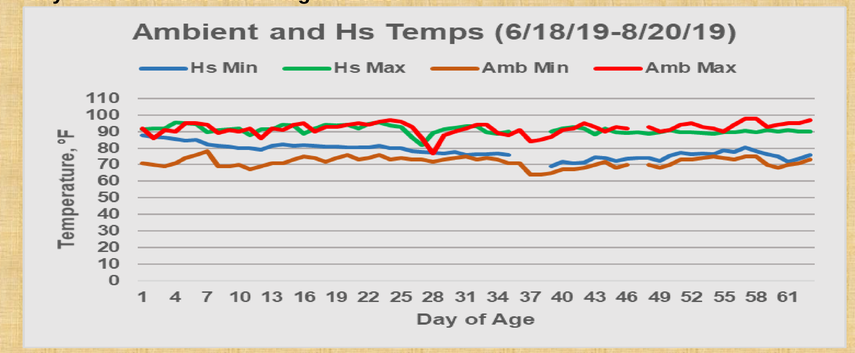


Figure 4. Maximum (morning) and minimum (afternoon) in-house humidity levels for 63-day-old flock in June-August 2019.

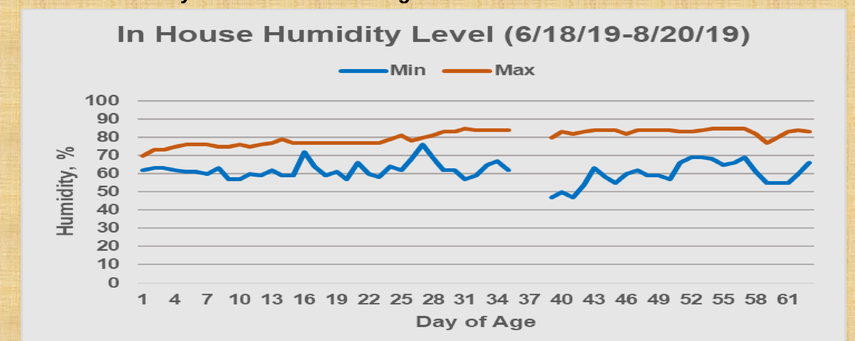


Figure 5. Cooling water results of sprinkler data analysis from University of Arkansas, 1995-2005.

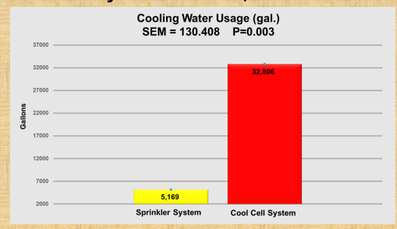


Figure 6. Average daily mortality results of sprinkler data analysis from University of Arkansas, 1995-2005.

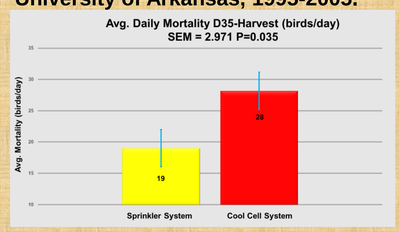
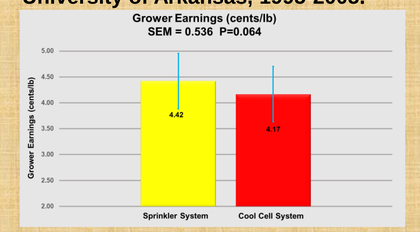


Figure 7. Grower pay results of sprinkler data analysis from University of Arkansas, 1995-2005.



United States Department of Agriculture
National Institute of Food and Agriculture

USDA-NIFA #2019-69012-29905.
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- ✓ Early AR SS research indicated a significant reduction in cooling water use (P=0.003) and average daily mortality from d 35 to harvest (P=0.035) for SS vs. CC.
- ✓ Pay per lb increased for SS vs. CC (P=0.064).
- ✓ No differences were found for water intake, FCR, or avg wt. (P>0.05).
- ✓ Recent MSU SS data suggest that 63 d old broilers can maintain performance at 90°F (32°C) house temp and ~65% humidity with reduced cooling water use when SS is first line of cooling defense.
- ✓ Lower house humidity level that SS allows vs. CC assists with respiratory evaporation, likely making maintaining performance at 90°F (32°C) possible.

Conclusions

- ✓ Broiler production can benefit by combining SS and CC to improve flock performance and conserve cooling water.
- ✓ Sprinkler technology can save over 50% of cooling water usage and reduce relative humidity in the broiler house by 20%.
- ✓ Critical to maintain interval between SS activations that allows birds time to dry off between activations.
- ✓ Allowing house temperatures of near 90°F results in lower humidity, less mortality, enhanced cooling-water conservation, and better performance.
- ✓ Future research should use SS alone to cool broilers, maintain performance, and investigate effects on house environment (temp, wind speed, and humidity) as well as flock welfare and water conservation.

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Acknowledgement

Authors gratefully acknowledge the support of USDA-NIFA, USDA-AFRI,, and Weeden Environments, Inc. (Woodstock, Ontario, Canada) for making this research possible.