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# Thermal Imaging and Smart Cooling for Laying Hens in Cage-Free Houses

Lilong Chai, Ph.D.

Assistant Professor & Engineering Specialist

Department of Poultry Science, University of Georgia

## Introduction

Heat stress is the primary concern for laying hen production in the summer as heat waves may significantly increase flock mortality and reduce egg production in laying hen houses. Mechanical ventilation and cooling cell are popular cooling methods used in the US South such as Georgia. However, most of layer farms in the US Midwest (where produces over 50% of US table eggs), where most farms don't have evaporative cooling systems due to consideration of heat loss and energy cost in cold winter. Evaporative cooling cell and foggers are common cooling methods used in the poultry houses in US South, but those methods may not efficient in cooling the birds during the hot and humid weather, when the dry bulb temperature and wet bulb temperature tend are close to each other. Therefore, other cooling strategies should be considered. Surface wetting (water sprinkling/spraying) one of methods that has been proven effective to cool birds and reduce mortality in poultry housing during hot and humid summer days. Most previous projects regarding poultry cooling were for broilers. There is a lack of research on bird cooling through surface wetting for laying hens. This article will introduce a sprinkling cooling method tested for cage-free laying hens.

### Sprinkling System and Heat Stress Relief Monitoring

We installed the sprinkling system and tested it for the summer cooling in a commercial aviary cage-free henhouse in Iowa (**Fig. 1**). The body surface temperature of hens was monitored with thermal cameras for quantifying heat stress and relief efficiency. Two thermal cameras (FLIR T440, FLIR Systems Inc., Wilsonville, OR) were installed (**Fig. 2**) at height of 6.6 ft above litter floor to monitor variation of hen's surface body temperature before and after water sprinkling. We used FLIR Tool, a program developed by FLIR company (FLIR Systems Inc., Wilsonville, OR), to analyze surface temperature of the hens. The tap water would be sprinkled at the dosage of 0.72 gal. per 1000 $ft^2$ (20 sec) when the CF hen house air temperature was higher than 95$^o$F.

Figure 1. The sprinkling system: (a) water spray control system and (b) sprinklers installed above litter floor at 6.6 ft high. (The henhouse had 50,000 hens and was measured as 505 L × 70 W × 10 H ft).

Figure 2. Thermal cameras setup at 6.6 ft above litter floor in the cage-free house.

## Heat Stress Relief Evaluation

**Figure 3** shows the hens in thermal images took before, during, and after water spray for 20 sec or 30 mL m-2 at around 15:00h when indoor air temperature was about 95ºF and relative humidity was around 32%. Before spray, hens body surface (back) were in red or bright color, corresponding to the high end of temperature in the IR thermograph scale (fig. 3-a). The bright area on hen's back reflects the area of no feather coverage. During or immediately after spray (fig. 3-b and fig. 3-c), the wetted birds were in green or blue color due to reduced body surface temperature. Birds started to huddle in the area right under the sprinkler due to dripping water (fig.3-d). This floor distribution pattern is an important indicator for farm staff to consider waterline flushing for providing colder water for birds.

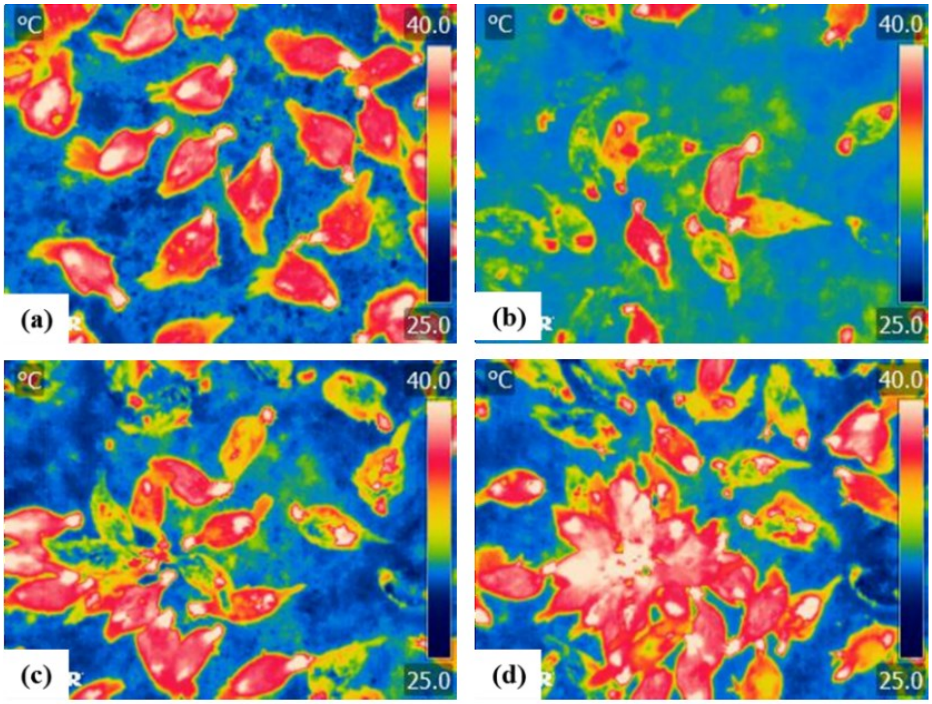


Figure 3. Thermal images (25 ~ 40 ºC = 77 ~ 104 ºF) of laying hens before and after water-spray cooling when house temperature was 95 ºF: (a) 15 sec before spray; (b) during spray; (c) 15 sec after spray; (d) 3 min after spray.

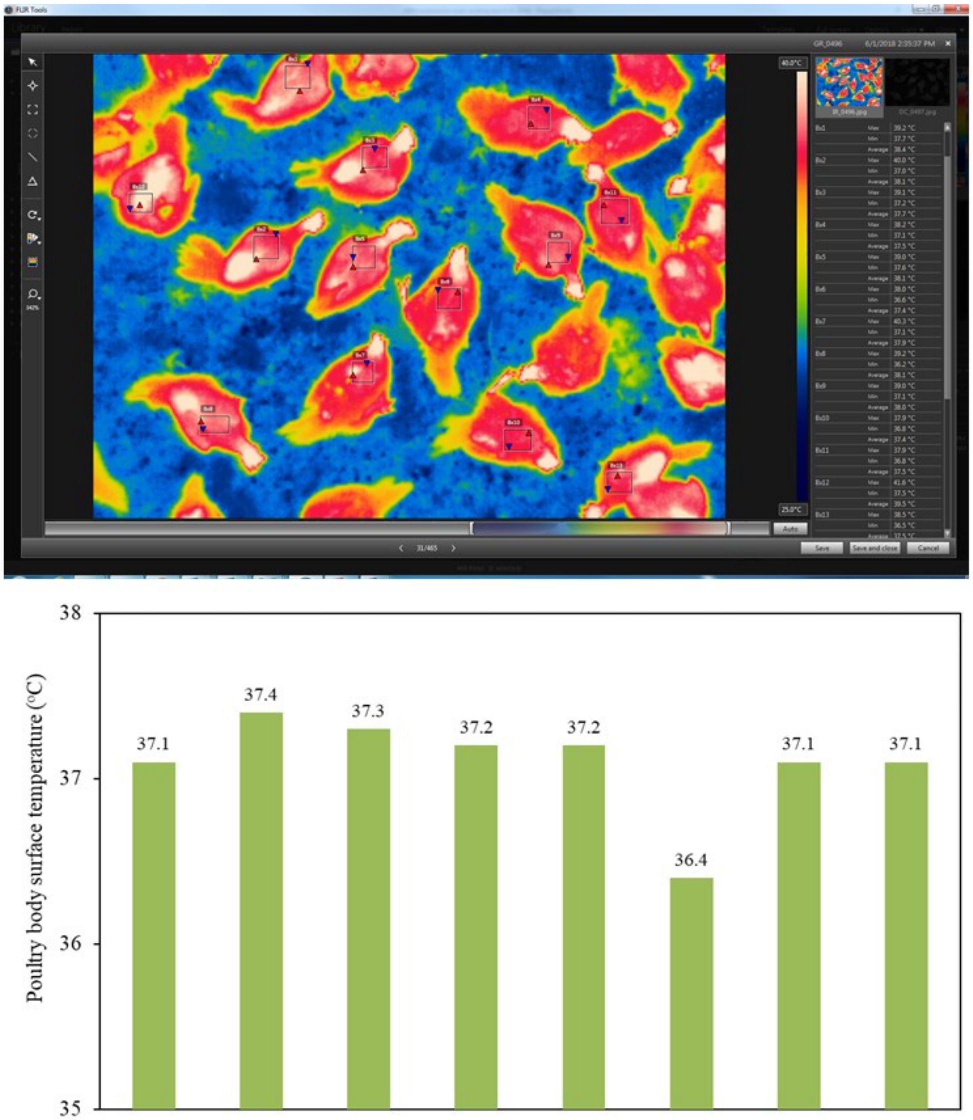


**Figure 4. Body surface temperature analysis**

For assessing body surface temperature, 12 hens before spray, 16 hens (8 dry and 8 wetted) 15 sec after spray, and 14 hens (7 dry and 7 wetted) 3 min after the spray were randomly selected and analyzed with the FLIR tools for quantifying hens' body (back) surface temperature, as shown in **Figure 4**. The body surface (back) temperature (excluding the head and area without feather covering on the back) of wetted hen was 11-12 ºF lower than temperature of dry hens 15 sec after water spray (i.e., 98.8 ºF for dry hens vs. 86.9 ºF for wetted hens). The body surface (back) temperature of wetted hens were still 9 ºF cooler than dry ones after 3 min. The cooling effect for some birds lasted up to 10 min, but most of them dried out within 10 min according to thermal images (**Figure 5**). In addition, the water spray just covered the hens on litter floor but not the hens stayed in or beneath the aviary system. Therefore, spraying water intermediately is necessary to reduce heat stress continuously and cover more hens, especially the ones from the system or beneath it. University of Arkansas and University of Georgia Poultry Extension have conducted related analysis and concluded that sprinkling cooling could save over 50% water for the similar cooling effect. However, cautions should be taken to prevent hens from piling, which was observed for birds beneath some sprinklers with slightly dripping issue.

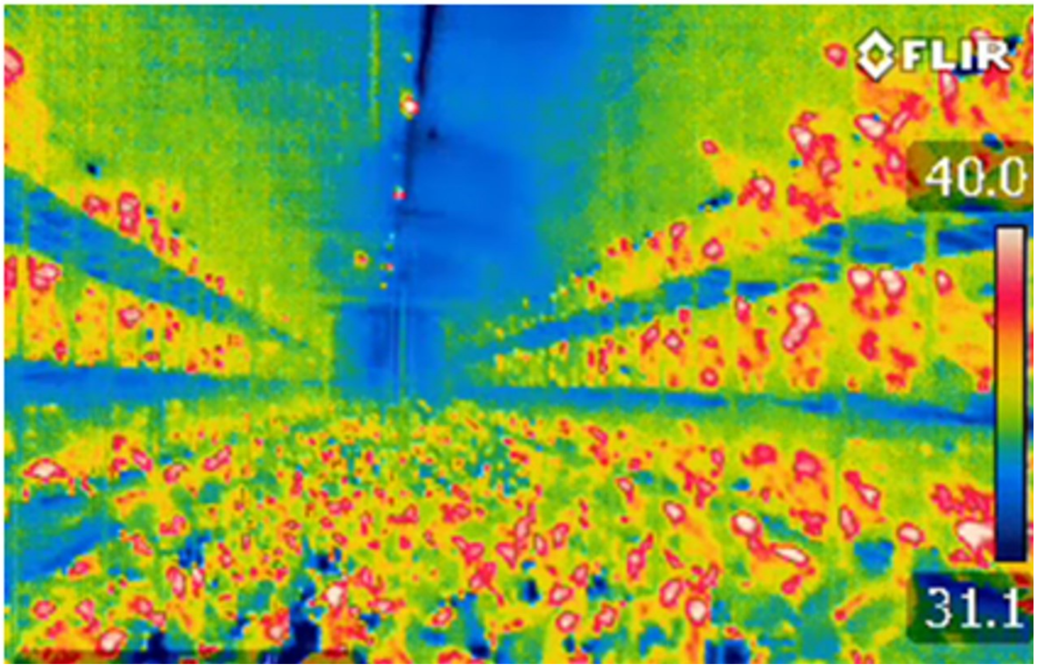

Figure 5. Sprinkling cooling for the whole house.

**Summary**

Surface wetting has been proven effective to cool birds and reduce mortality in poultry production. A cage-free hen house case study shows that sprinkled hens had up to 12 ºF lower body surface temperature than non-sprinkled ones immediately after a 20-sec or 0.72 gal. per 1000 $ft^2$ water spray. The sprinkled hens were still 9 ºF cooler than the non-sprinkled ones 3 min after water sprinkling. The cooling effect for some birds lasted for up to 10 min, but most would dry out soon under the testing conditions (temperature of 95 ºF and relative humidity of 32%). It has been reported that sprinkling cooling could save over 50% water for the similar cooling effect. However, cautions should be taken to prevent hens from piling, which was observed for birds beneath some sprinklers with slightly dripping issue. Besides, floor distribution pattern as observed by thermal images is an important indicator for farm staff to consider waterline flushing for providing colder water for birds.

**Further readings**

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