Department of Animal Science

SPRINKLER COOLING OF BROILERS HIGHLIGHTS SUSTAINABLITY AND WATER CONSERVATION POTENTIAL

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Agricultural production depends on freshwater availability. Water is the lifeblood of ecosystems on which our present and future food security depends. Global food security requires a resilient agricultural system, which, in turn, requires a consistent and adequate freshwater supply. Freshwater scarcity is increasing rapidly in many regions of the world and is one of the most critical and hotly debated topics from societal survival perspectives (Bayart et al., 2010; Hoekstra et al., 2012). The simple truth is without freshwater there would be no food. And without water and food, there would soon be no people. The agriculture sector, more than most, understands this fact. Globally, water use is anticipated to increase by 55 percent by 2055 (Wada et al., 2015), while at the same time surface and groundwater resources for both agriculture use and human consumption will dramatically decrease in the coming decades due to climate change (Abdoulaye et al., 2019).

Globally, agriculture is the largest consumer of water, accounting for approximately 70 percent of total water withdrawals (Johnson et al., 2001; FAO, 2011). To feed the country's seemingly insatiable appetite for meat protein, the poultry industry is a major user of freshwater in the U.S. In 2022, per capita consumption of broiler products in the U.S. reached 44.1 kg (97.2 lbs.), nearly double the consumption of beef or pork (USDA, 2022). To meet this demand, the industry produced approximately 60 billion pounds of live broilers (USDA, 2023). According to Mekonnen and Hoekstra (2010), it takes 518 gallons of water to produce one pound of chicken. If we multiply that figure by 60 billion pounds, that's a massive amount of water used by the poultry industry each year. This poses a difficult question for the future of commercial poultry production. Can the poultry industry reduce water use and maintain production and performance in a sustainable manner?

Water scarcity

In the U.S., drought and water scarcity are serious concerns to the agriculture community. The agricultural sector contributes greatly to the U.S. economy in many ways, from promoting food and energy security to providing jobs for millions of people in rural communities.

In 2015, farms contributed $136.7 billion to the U.S. economy and accounted for 2.6 billion jobs, with approximately half of farm revenue coming from livestock production. However, prolonged drought and water shortages have considerable negative effects on crops and livestock, including decreased livestock production, reduced crop yields, destruction of property, livestock deaths and sell-offs. Drought ranks third among environmental phenomena associated with billion-dollar weather-related disasters since 1980, behind only tropical cyclones and severe storms (Drought.gov, 2024).

Competition for water is increasing around the globe, as water scarcity increasingly becomes a source of conflict. Freshwater resources per person have dropped 20 percent over the past two decades, while water availability and quality are deteriorating rapidly due to decades of misuse, lack of coordinated management, over-extraction of groundwater, pollution and climate change (Li, 2023). Extreme weather events such as droughts and floods cause additional stress on ecosystems with serious consequences for global food production and security. Water scarcity and food security are closely intertwined. Food security is defined in terms of food availability, access, utilization and stability, such that all people, at all times, have physical and economic access to sufficient quantities of safe and nutritious food that meets their dietary needs and food preferences.

Water scarcity, however, affects not only the quantity but also the quality, variety and seasonal availability of foods that can be produced and consumed (Michel, 2023). Therefore, on a global scale, water scarcity (e.g., droughts in grain-producing nations) may contribute to grain shortages around the world that increase food insecurity for hundreds of millions of people in numerous countries. Drought conditions in the U.S. during the summer of 2012 were a wake-up call for many producers and poultry integrators across the country regarding the need to better conserve water yet maintain good bird performance (Liang et al., 2012). At the local household level, scarce or polluted water can prevent a family from growing a backyard garden, raising livestock or preparing available foods and perhaps shifting their diets to less water-intensive but also less nutritious foods.

Water scarcity has been a concern in developing countries for decades. Today, however, water scarcity is rapidly becoming a major global issue (Beekman, 1998; Casani et al., 2005; Hoekstra, 2014; Liu et al., 2017) in both developed and developing countries. Shiklomanov (1998) estimated that the agricultural sector accounted for two-thirds of the total global water withdrawals and almost 90 percent of total global water consumption. Multiple factors, including climate change, population growth, increasing dietary shifts toward animal protein as developing nations become more affluent, irrigated agriculture, seawater intrusion and greater competition and demands for domestic and industrial water all contribute to this worsening issue (Meneses et al., 2017).

Water scarcity resulting from physical, economic or institutional constraints is currently a problem for one-third of the world's population (Molden et al., 2007). About 1.2 billion people suffer physical water scarcity, meaning they lack enough water to satisfy daily demands. Symptoms of physical water scarcity include severe environmental degradation, pollution, declining groundwater supplies and water allocations in which some groups win at the expense of others (International Water Management Institute, 2007). Another 1.5 billion people are affected by economic water scarcity, where human and/or financial resources are likely insufficient to develop local water systems, even though the supply might be adequate if it could be exploited (Molden et al., 2007). Symptoms of economic water scarcity include insufficient infrastructure development, meaning there is little to no distribution system (pumping stations, supply lines, piping or canals) to get water to the people and where infrastructure does exist, the distribution of water may be inequitable.

The rapid **rise in global meat production is putting increased pressure on water resources**. Livestock production is very water-intensive with about one-third of the total water that is utilized in global agricultural production assigned to animal production (El Sabry, 2023). In addition, from 1998 to 2008 water use in the food industry increased by approximately 40 percent and has continued to grow (Klemes et al., 2008; Meneses et al., 2017). For example, in conventional poultry processing systems, access to water is particularly critical for the cleaning, maintenance and disinfection of the processing areas as well as in processing operations such as scalding, chilling and carcass washing (Micciche et al., 2018). In addition, poultry's universal acceptability, high nutritional value and recognized health benefits have **propelled it to the top position of animal protein** in the world, accounting for 35 percent of global animal protein production according to FAO (2022). The continuing growth in global population and the recent African Swine Fever outbreak across various Asian and African countries has put additional pressure on the poultry industry to increase capacity and output to fill the animal protein void.

Water has become a limiting factor for economic growth in China and India (Klemes et al., 2008). Furthermore, in 2010, the **U.S. alone used 1.1 trillion liters (L) of potable fresh water each day**, or 3,000 L per capita each day (Maupin et al., 2014). The water footprint (WF) is a water metric measurement that has been used to accurately calculate water use in relation to final product output. It includes blue (surface and groundwater), green (rainwater) and grey (freshwater that is required to assimilate the load of pollutants given natural background concentrations and existing ambient water quality standards) water sectors. According to Mekonnen and Hoekstra (2010; 2012), animal products have a larger WF per kg of product than crop products (Table 1). Much of this water footprint for animal products is related to growing rainfed and irrigated crops to produce food for the livestock.

Table 1. Water footprint of selected food products from vegetable and animal origin[1].

Water footprint (liters/kg of product)

Food item	Green	Blue	Grey	Total
Sugar crops	130	52	15	197
Vegetables	194	43	85	322
Starchy roots	327	16	43	387
Fruits	726	147	89	962
Cereals	1,232	228	184	1,644
Oil crops	2,023	220	121	2,364
Pulses	3,180	141	734	4,055
Nuts	7,016	1,367	680	9,063
Milk	863	86	72	1,020
Eggs	**2,592**	**244**	**429**	**3,265**
Chicken	**3,545**	**313**	**467**	**4,325**
Butter	4,695	465	393	5,553
Pork	4,907	459	622	5,988

Sheep/goat meat	8,253	457	53	8,763
Beef	14,414	550	451	15,415

[1]Adapted from Mekonnen and Hoekstra (2012).

Sprinkler cooling of broilers highlights water conservation/sustainability potential

Today's broilers grow at a remarkably rapid rate and convert feed to meat with exceptional efficiency. However, these fast-growing highly efficient birds are subject to heat stress during summertime conditions including high environmental temperatures and relative humidities. While a number of genetic, nutritional, feeding and environmental strategies have been investigated, much of the burden for dealing with heat stress during the summer falls to the producer, and in turn, the housing environment (Linn et al., 2006) where the birds are raised. In years past, evaporative cooling pads, fogger pads and even fogger nozzles were used to deal with heat and its effects in broiler houses (Weaver, 2002). Evaporative cooling pads are still a popular option today despite challenges associated with 1) their use of massive amounts of water, and 2) creation of extremely high in-house humidity levels (>70 percent), which is counterproductive to the bird's own physiological ability to cool itself by hyperventilation (evaporative respiration heat loss) (Liang et al., 2020), to manage summertime temperatures in commercial poultry houses. In general, until recently, poultry production personnel (live operations managers, broiler managers, service technicians, etc.) have tended to avoid cooling systems that sprinkle water directly onto birds. The fear has always been that sprinkling water in the house would wet the floors, creating wet litter which could become a welfare issue and increase the risk of footpad dermatitis. However, when sprinkler cooling is done correctly, this is not the case; and today, that way of thinking is slowly changing, and with good reason. Cattle and hogs are often cooled by sprinkling with water and in years past, many broiler growers sprayed their flocks with garden hoses during the summer to avoid catastrophic heat losses. In practice, the effectiveness of low-pressure sprinkling systems in broiler houses today depends on the deposition of water droplets directly onto the chickens and then taking advantage of the wind chill effect created by the tunnel fans to make the chickens think that conditions are better than they actually are.

It's a similar analogy to someone jumping in the creek to cool off on a hot summer afternoon. It may be 100° F, but if there is any breeze blowing when you get out of the creek, the wind chill effect on your wet skin makes you think the temperature is much lower than 100° F, at least until the water evaporates and it's time to jump in the creek again. Sprinkler cooling of broiler chickens works much the same way. The birds are intermittently sprinkled, and airflow down the house from the tunnel fans creates wind chill and evaporates the sprinkled water from the surface of the birds. Then they are sprinkled again. Sprinkler cooling, used as the first line of defense (in combination with evaporative pads to prevent extreme conditions), is a very simple, common-sense concept that works extremely well with excellent flock production results while also **saving >60 percent of the cooling water** that a pad cooling system alone uses. Pad systems can maintain moderate house temperatures (82 to 85° F) during extreme summer conditions but doing so requires massive amounts of water use and simultaneously increases house humidity levels (perhaps to 85 percent or higher) making it difficult for the birds to use their own evaporative respiration cooling mechanism to remove excess body heat. In addition, high in-house humidity in a cool cell house leads to wet litter which is the leading cause of footpad dermatitis, creating a flock welfare issue and resulting in downgraded paw quality at the processing plant. Furthermore, the large volumes of water required by evaporative cooling systems raise sustainability concerns amid current water scarcity issues.

Sprinkler cooling history

Sprinkling is not the same as fogging or misting. Sprinkling uses large, coarse water droplets to put controlled amounts of water directly on the birds at precise intervals and then utilizes tunnel fans and airflow down the house to create a wind chill effect on the birds and evaporate the sprinkled water from the birds' surface before the next sprinkling cycle begins. Sprinkling chickens with water is not a new concept. Sprinkling broiler chickens with controlled amounts of water on a regular basis was tested in 1989 in a laboratory study with promising results (Berry et al., 1990). In that study, the amount of water to apply was determined by the following equation:

$$HL = 5.0 \frac{(TA - 80)}{(TS - 80)} \qquad (1)$$

where HL = rate of water application, in latent heat units of Btu/hr/lb bird,
TA = room temperature, °F
and TS = chicken wetted-surface temperature, assumed to be 92°F during study.

The control algorithm was based on data from Reece and Lott (1982), who found that the sensible heat production of broiler chickens at 80° F was nearly constant at 5.0 Btu/hr/lb after four weeks of age. The equation assumes that the heat transfer from the chicken body core remains at a constant 5.0 Btu/hr/lb if the wetted surface is cooled to 92°F by the addition of water with increasing air temperature.

A few years later, an experimental sprinkler system was compared against a cool cell system in a 10-year study of summer flocks from 1995 to 2005 (Tabler et al., 2008). Results are presented in Table 2.

Table 2. Production figures, water intake, and cooling water use for House 2 (sprinkler) and House 4 (cool cell) on 17 summer broiler chicken flocks at the University of Arkansas between 1995 and 2005.

Flock No.	Feed Conversion		Avg. Wt. (lbs)		Pay/lb/ (cents)		Water intake/flk (gals)		Cooling water (gals)	
	House No.		House No.		House No.		House No.		House No.	
	2	4	2	4	2	4	2	4	2	4
27	1.81	1.90	3.80	3.70	4.92	4.21	32,955	35,378	18,289	42,950
33	1.84	1.91	3.80	3.81	4.93	4.42	34,589	37,453	1,599	6,193
34	1.91	1.95	3.83	3.80	4.45	4.15	35,321	37,488	2,905	12,834
39	2.05	2.06	4.99	5.04	4.12	4.05	41,931	45,735	4,828	62,945
43	2.03	2.09	4.89	5.10	4.07	3.99	36,655	40,046	1,200	33,425
44	2.08	2.02	5.15	5.46	4.62	4.60	40,737	41,069	13,224	133,349
49	2.22	2.32	6.29	6.02	5.23	4.37	55,193	51,705	9,653	114,337
50	2.13	2.11	6.26	6.08	3.57	3.60	55,924	52,711	128	2,320
54	2.08	2.18	6.24	5.77	4.71	3.81	54,389	53,569	5,271	35,510
55	2.07	2.04	5.75	5.59	3.88	3.88	55,207	53,348	13,578	33,604
60	1.80	1.92	4.37	3.94	4.42	3.36	42,699	40,926	142	4,567

61	1.86	1.86	4.31	4.43	4.19	4.33	46,833	49,252	4,996	40,010
67	1.93	2.04	4.64	4.39	4.94	4.15	48,190	51,994	2,677	12,800
73	1.86	1.79	4.17	4.60	3.88	4.56	34,688	36,458	1,731	18,337
79	1.95	1.94	4.63	4.44	4.04	3.65	38,621	35,717	1,064	12,222
80	1.72	1.66	4.79	4.93	4.93	5.32	42,913	42,574	0	5,895
85	1.80	1.78	4.09	3.92	4.26	4.12	36,028	35,767	2,456	6,706
Avg.	**1.95**	**1.97**	**4.82**	**4.77**	**4.42**	**4.15**	**43,108**	**43,599**	**4,926**	**34,000**

Source: Tabler et al. (2008).

The study included 17 summer flocks of broilers over a 10-year period and was conducted at a four-house commercial broiler farm in northwest Arkansas owned by the University of Arkansas. House 2 was cooled only by an experimental sprinkler system during the study while House 4 was cooled by an evaporative cool cell system. Houses 2 and 4 were each tunnel ventilated houses. Results indicated that over the 10-year period of summer flocks, House 2 (sprinkler cooled house) averaged two points better feed conversion (1.95 vs. 1.97), five points better average weight (4.82 vs. 4.77 lbs.), and 0.27 cents per lb. better average pay (4.42 vs. 4.15 cents per lb.). Even though the sprinkler house operated at a higher temperature (and therefore, a lower humidity) during the day, water intake per flock (drinking water) was similar for the sprinkler and cool cell houses, averaging 43,108 gallons and 43,599 gallons, respectively. However, there was a large difference in summer cooling water use between the sprinkler and cool cell house. The sprinkler house (House 2) averaged 4,926 gallons of cooling water per flock over the 17 summer flocks from 1995 through 2005 while the cool cell house (House 4) averaged 34,000 gallons of cooling water per flock, approximately seven times as much as the sprinkler house.

Liang et al (2012) reported that a single 40 by 400-foot broiler barn with 120 feet of cool cell pads used as much as 2,500 gallons of cooling water per day with 38-day-old birds present and 95° F outside temperatures. This figure could be even greater depending on outside conditions and the age of the birds. Liang and Tabler (2018) reported the amount of water used by evaporative cooling pads is dependent on three factors – **amount of air being drawn through the pads, outside temperature and outside humidity**. The drier the air (lower the humidity) the more water that the pads evaporate in the inlet air the more cooling they produce (larger temperature reduction and humidity increase inside the broiler house) and more overall cooling water used (Table 3).

Table 3. Cooling water usage (gals per minute) by evaporative cooling pads for a 40' x 400' broiler house with 160,000 cfm fan capacity under various outdoor conditions.

Temperature	**Relative Humidity**						
	30%	40%	50%	60%	70%	80%	90%
70°F	-	-	-	2.6	1.9	1.2	0.6
75°F	-	4.4	3.6	2.8	2.0	1.3	0.6
80°F	5.3	4.8	3.9	3.0	2.1	1.4	0.7
85°F	5.7	5.3	4.2	3.2	2.3	1.4	-
90°F	6.1	5.7	4.4	3.3	2.3	-	-
95°F	6.5	6.1	4.7	3.5	-	-	-
100°F	6.9	6.5	5.0	-	-	-	-
105°F	7.2	6.9	-	-	-	-	-

Source: Liang and Tabler (2018).

Humid air evaporates very little water, and dry air is needed for water to evaporate. However, in most cases, drier air is hotter air, and hot air in a chicken house full of big chickens frightens most growers. However, when managed properly, sprinklers will maintain in-house humidity in the 50 to 70 percent range, allowing you to operate at a little higher house temperature and still maintain optimum flock performance because you have lowered the humidity level by 20 percent or more over a cool cell only system. It is this lower humidity that makes all the difference. High temperatures alone do not kill big chickens in hot weather. It's the combination of high temperatures and high humidity that kills chickens. Chickens can tolerate some pretty high temperatures if the humidity can be maintained below 70 percent, allowing them to use their own evaporative respiration to remove excess body heat and cool themselves. When the in-house air is saturated with 85 to 95 percent humidity from the cool cell system, the birds' own evaporative respiration system becomes practically useless because the air the birds breathe in is almost as saturated as the air they breathe out and they can remove very little excess body heat. However, if they breathe in <70 percent humidity air (sprinkler house) instead of 95 percent humidity air (cool cell house), their own evaporative respiration system becomes much more efficient, and they can remove much more excess body heat with each breath because the drier air they breathe in is able to absorb more moisture that can then be exhaled out, preventing a rise in body temperature which could threaten their survival.

Therefore, there is no need to panic if you see the in-house temperature approach 88° F or 90° F in a sprinkler-cooled house. What that tells you is that the humidity in the house is low, and that is a good thing. Cool air is moist air. Hot air is dry air. Dry air is beneficial from the standpoint of lower house humidity, drier litter, improved welfare conditions, greater environmental respiration potential from the birds and a better in-house environment for the birds. Granted, the higher temperatures in a sprinkler house (88° F to 90° F) does take some getting used to, especially if you are conditioned to the lower temperatures often seen in a cool cell house (82° F to 85°F). However, it's at this higher temperature (and accompanying lower humidity) when the sprinkler system is most efficient, and bird performance will not suffer. In fact, with the tunnel fans providing adequate air flow down the house, the lower humidity coupled with the wind chill effect may make the chickens more comfortable at 90° F and 70 percent humidity than at 82° F and 90 percent humidity, thereby improving performance. As a bonus, the higher house temperature and lower humidity will help maintain drier litter, which lessens the risk of footpad dermatitis, improves flock welfare conditions, and makes it easier for the birds to dissipate heat by using their own evaporative respiration system more efficiently to cool themselves.

Recent sprinkler data

Moon et al. (2023) investigated a commercial sprinkler system combined with a cool cell system compared to a cool cell-only system for cooling heavy broilers over two summer flocks. The sprinkler/cool cell combination system exhibited a higher house temperature, lower relative humidity and a 64 percent reduction in average cooling water use. This cooling water savings is in close agreement with Liang et al. (2014) where savings of 67 percent were reported and Dunlop and McAuley (2021) where savings of 58 percent were reported. Moon et al. (2023) saw no significant effect of sprinklers on litter moisture at either week seven or week nine. This was expected even though some might think that applying water directly to the birds will increase litter moisture content. However, the amount of water from the sprinklers that reaches the litter is generally much less than the amount of water added by the birds in the form of manure (Moon, 2022). The amount of water added by the sprinklers (including onto the birds) (median 0.07

L/m^2/day, maximum 1.04 L/m^2/day) is less than the amount of water added to the litter by the birds in the manure (estimated to be 1.6 L/m^2/day to 3.3 L/m^2/day) (Dunlop et al., 2015).

A collection of seven broiler trial data from across the U.S. during 2022-2024 comparing a commercial sprinkler system (Weeden Sprinkler Systems, Woodstock, ON, Canada) combined with a cool cell system and a cool cell-only system is presented in Table 4. The trials represent a variety of house sizes from various integrators with different available wind speeds and different trial lengths conducted in various months during the summer throughout different geographic regions of the country. Water savings associated with using sprinklers varied widely from 15.8 percent to 65.6 percent, in part dependent on the comfort level of the producer to take advantage of sprinkler cooling, with an average savings of 38.9 percent. Some producers were more hesitant than others in allowing the house to operate warmer than usual, a necessity with sprinkler cooling. Cooling water use across the seven trials averaged 52,344 gallons for the cool cell-only houses and 34,140 gallons for the sprinkler/cool cell combination houses, for an average water savings of 18,199 gallons/house/summer flock. With an average of two summer flocks/year, that is an eye-opening figure for any complex concerned with water conservation efforts and sustainability reports. **Saving 18,199 gallons/house/flock x two summer flocks is 36,398 gallons saved/house/summer**. **For a six-house farm, that is 628,128 gallons of cooling water typically used by the cool cells, and potentially 218,388 gallons of cooling water saved each summer by using sprinkler cooling**. For a complex with 300 broiler houses, **that is 10,919,400 gallons of water saved** each summer at a savings rate of 38.9 percent using sprinkler cooling. If this savings rate were increased to the approximately 60 to 70 percent level reported by Liang et al. (2014) (67 percent), Dunlop and McAuley (2021) (58 percent), and Moon et al. (2023) (64 percent), the savings per complex in cooling water would be even greater than the potential 11 million gallons estimated above.

Table 4. Performance trial results and water savings comparing a sprinkler/cool cell combination house with a cool cell only house for cooling broilers in hot weather in various commercial settings across the U.S. from 2020-2024.

House Size W x L (ft)	Trial Length (days)	H_2O use CC[1] only	H_2O use WSS[2]&CC	H_2O saved (gals)	% H_2O savings	Avg Wt.[3] CC only	Avg Wt. WSS&CC
50 x 500	10	58,182	48,972	9,180	15.8	6.51	6.57
50 x 500	30	100,569	69,702	30,867	30.7	6.98	6.73
40 x 380	21	31,042	18,079	12,963	41.8	4.97	4.72
40 x 380	21	48,716	30,540	18,176	37.3	4.55	4.72
60 x 550	38	20,826	9,996	10,830	52.0	9.89	10.61
42 x 400	24	38,596	13,278	25,318	65.6	7.44	8.06
50 x 575	32	68,475	48,414	20,061	29.3	---	---
	Avg.	**52,344**	**34,140**	**18,199**	**38.9**		

[1]CC = cool cell
[2]WWS = Weeden Sprinkler System
[3]Avg. wt. is listed as pounds/bird

While common on drinking water lines, virtually no growers have water meters on their cool cell lines. As a result, the poultry industry has no idea of the staggering amount of water that cool cell systems use on a hot summer day with big chickens in the house. The amount can equal and even surpass what the birds will drink in a day (Liang and Tabler, 2018). With the increasing concerns associated with water scarcity and the growing pressure from consumers for poultry companies to focus more attention on sustainability, their environmental footprint, and water conservation practices, sprinkler cooling offers a path to drastically cut cooling water usage while maintaining and perhaps enhancing flock performance. Sprinkler technology also can improve litter quality, reduce in-house humidity levels and increase the activity level of the flock, as the birds stand up when sprinkled with many regularly moving to the feeders and drinkers after each sprinkling episode.

However, sprinkler cooling is not without its challenges. Sprinkler cooling is still new to some integrators, and sprinklers do take some getting used to. To be most effective and achieve the desired goals, you must run the house a few degrees hotter than you would a cool cell-only house (88 to 90° F instead of 82 to 85° F that most growers are comfortable with). This can be a little challenging to get used to, especially with big birds in the house, but there is no reason to panic. That slightly higher temperature comes with a lower humidity (65 to 70 percent instead of the 90 to 95 percent that is present in the cool cell only house). This lower humidity is why sprinkler cooling works. The lower humidity allows the birds to more effectively use their own evaporative respiration system to remove excess body heat more efficiently. The sprinklers deliver controlled amounts of water on the birds at specific intervals and the wind chill effect from the tunnel fans moving air across the birds evaporates the water the sprinklers have deposited on the birds.

Again, the effect is like you jumping in the creek to cool off on a hot 100° F summer afternoon discussed earlier. When you get out of the creek, it is still 100° F, but if there is any breeze blowing, the wind chill effect on your wet skin makes you think it is much cooler than that. That is what sprinklers do in the chicken house. They take advantage of wind chill and lower humidity levels to improve conditions for the chickens. In the process, the litter stays drier because of the slightly higher air temperature and the approximately 20 percent lower humidity. Drier litter, in turn, leads to better paw quality for the birds, an improved in-house environment, and enhanced welfare conditions for the flock.

However, as a grower, you must allow the house temperature to increase slightly more than you might be comfortable with in the beginning. Running the cool cells before the house temperature reaches 88° F or 90° F will not allow the sprinklers to perform properly. The cool cells will keep the humidity in the house too high and the temperature will stay too low to evaporate the water from the sprinklers in a timely manner. It is much better to run the cool cells only when the house temperature reaches 88° F or 90° F, and then only for a few seconds (15 to 20 seconds, at most). And run the cool cells on temperature, not on a timer. You do not want to saturate the pads with water. You do not want to cool the house temperature down very much and raise the humidity. You just don’t want the temperature to go above 88° F or 90° F. If the house temperature gets to 88° F, and the cool cells come on for 15 to 20 seconds and it takes 30 minutes or an hour for the temperature to get back to 88° F to trigger the cool cells again, that’s great. Think of all the water the cool cells didn’t use. You are using the sprinklers as your first line of cooling defense and using the cool cells only as a safety device/guardrail to prevent conditions from becoming too extreme or getting out of hand. This saves massive amounts of cooling water while allowing the birds to maintain or enhance performance with improved welfare conditions.

One more thing to be aware of. The sprinkler has its own control box (Figure 1). It operates independently of your chicken house controller. It has its own standard default set of operating instructions managing the age at which sprinkling begins, the time of day in which the sprinklers can operate and, operating the house by temperature zones, sprinkling only as much water as needed by each zone. Any grower can operate the spinner heads (Figure 2) on the appropriate schedule based on the age of the birds. However, you will need to raise the setpoint of your cool cells up to 88° F or 90° F on your house controller. You do not want the house controller and the sprinkler controller fighting each other. Neither controller will know that the other is there so you must program both controllers to work together effectively. Also, consider installing water meters on your cool cell lines as an excellent way to track how much cooling water your cool cell systems use.

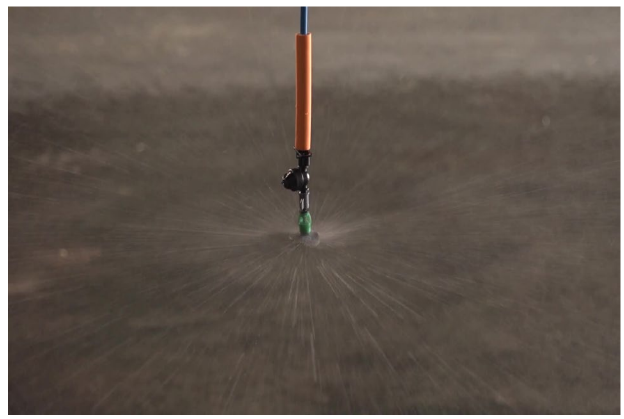

Figure 1. Sprinkler controller. *Figure 2. Activated sprinkler head operating.*

Summary

Water scarcity is an increasing threat to U.S. agricultural production. In addition, consumers are demanding that poultry integrators do more to decrease their environmental footprint and operate in a more environmentally sustainable manner. Sprinkler cooling of broiler chickens offers an opportunity to meet consumer demands while maintaining and perhaps even enhancing flock performance. Poultry production is quite water-intensive, and the large volumes of water used for cooling broiler flocks during the summer is one high-profile example of the increased pressure being put on water resources. Combining sprinkler cooling with cool cells to reduce cooling water use while maintaining flock performance is an opportunity to save >60 percent of the cooling water that an evaporative pad system alone uses. This provides the poultry industry an opportunity to highlight its commitment to water conservation and sustainability goals and showcase efforts to reduce the industry's environmental footprint in response to consumer demands while maintaining or enhancing flock performance and providing affordable, high quality meat protein to consumers across the U.S. and around the world.

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