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Fogging Systems in Curtain-Sided Poultry Houses

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Though air movement is a grower's most important tool in combating summertime heat stress, the value of a fogging system cannot be over emphasized. Air movement is most effective in removing excess heat from a bird when the temperature of the air is kept below 90°F. As air temperature increases, less and less heat is removed from a bird. Studies have shown that air temperatures of 95°F and above severely limit a circulation fan's ability to remove excess heat from a bird In fact, for temperatures of 100°F and above, a circulation fan does little if any good in relieving heat stress. This is not to say that circulation fans should be turned off when it gets extremely hot, but rather, emphasizes that fogging systems should be used to keep these excessive house temperatures from ever occurring.

Fogging systems reduce air temperature through the evaporation of water. As water evaporates, heat is removed from the air, reducing its temperature. The actual temperature of the water makes no significant difference in the cooling produced. For example, the evaporation of 20 gals./hr. removes the same amount of heat from the air as a typical furnace adds to a house in an hour (180,000 Btu's/hr.). By making the water 20°F cooler, only two percent more cooling would be produced. As you can see, the key to producing maximum cooling is to evaporate as much water as possible as quickly as possible.

There are a few things to keep in mind when designing a system for a poultry house to ensure maximum evaporation of water. These include droplet size, nozzle placement, and fogging system flexibility.

It is important that the water droplets produced by a fogging system be kept aloft as long as possible to ensure maximum air temperature reduction in a poultry house. The longer a droplet floats around a house the greater the amount of water which evaporates off the droplet. If the droplet stays suspended long enough, it will totally evaporate before coming in contact with the floor. It is important to note that once a droplet hits the floor, very little additional reduction in house temperature will occur.

One of the keys in keeping droplets aloft is to make them as small as possible. The smaller the water droplet the more it is affected by air movement created by the circulation fans. Generally speaking the lower the nozzle flow rate, the finer the mist produced. The magnitude of the difference varies with manufacturer. The 2 gal./hr. nozzles of some manufacturers put out nearly a 30 percent larger droplet than their 1 gal./hr. nozzles.

Another factor that affects droplet size is water pressure. With most nozzles the greater the water pressure the finer the mist produced. At 40 psi the typical misting nozzle produces a 72 micron droplet. To give you an idea of how small a droplet we're talking about, the period at the end of this sentence is 500 microns in diameter. At 200 psi the droplet size is decreased to 32 microns. At either pressure we're talking about a very small droplet; however, there is a substantial difference between the two. The smaller droplet stays aloft much longer than the larger droplet and it evaporates more than twice as fast as the larger droplet. Theoretically there are advantages to increasing water pressure above 200 psi, but the cost of specialized fittings, pipe, and pumps usually limits most fogging systems to 200 psi and below.

The other factor that determines how long a droplet will stay aloft is air movement. Without air movement a droplet emitted from a nozzle will stay suspended only a few seconds before hitting the ground. This suspension time can be increased dramatically by air currents created by circulation fans. In addition, the circulation fans help mix the droplets with all the air in the house, not just that air in the immediate vicinity of the misting nozzles. It is important to note that the larger the water droplet the more crucial it is to have good air movement to keep the droplets suspended.

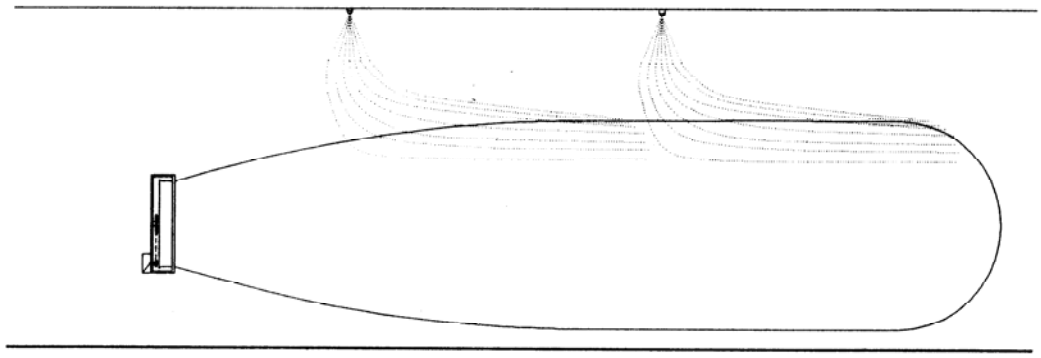

Figure 1. Droplets falling into fan air stream.

To get maximum suspension time it is best to deposit the droplets into the top of an air stream. This would mean that the droplets would have to pass through the air stream before they could reach the floor (Figure 1). For instance, let's say a house had a row of 36" circulation fans on 50' centers blowing down the center of the house. The fans would produce a significant amount of air movement within 7' of either side of the fans. To get maximum suspension time, nozzles should be installed near the ceiling within the area between the two feed lines (Figure 2). Nozzles placed outside this area would be more likely to cause floor wetting. If two rows of paired fans were used, the nozzles could be placed in a wider area (Figure 3).

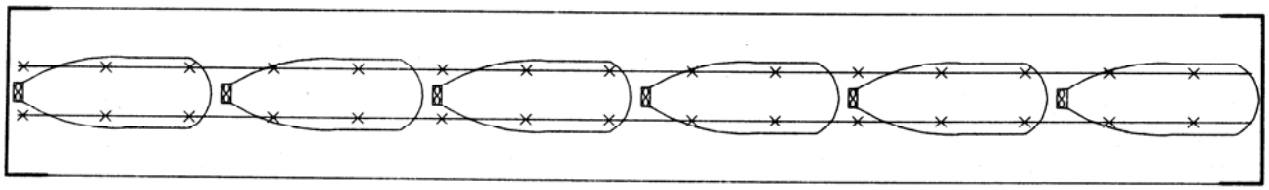

Figure 2. Nozzle positioning with single row of fans.

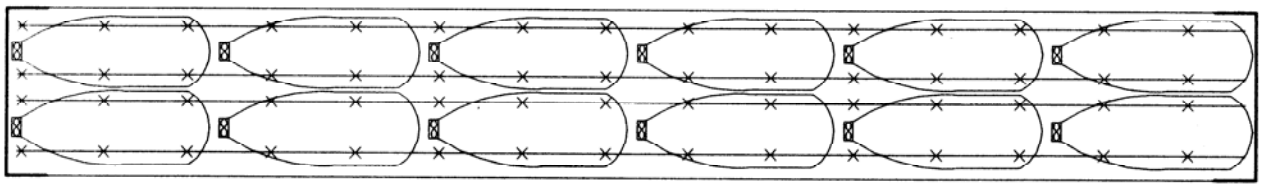

Figure 3. Nozzle positioning with double row of fans.

Care must be taken not to place nozzles directly in front of or behind a circulation fan (Figure 4). The air velocity leaving a fan can disturb the cone of water droplets emitted from a nozzle, leading to the formation of large water drops that quickly fall to the floor. Nozzles placed too close to the intake side of a fan can lead to the wetting of a fan, increasing the collection of dust and feathers on screens and fan blades and the chance of an electrical short. Most of these problems can be avoided if nozzles are place at least 15' away from any circulation fan.

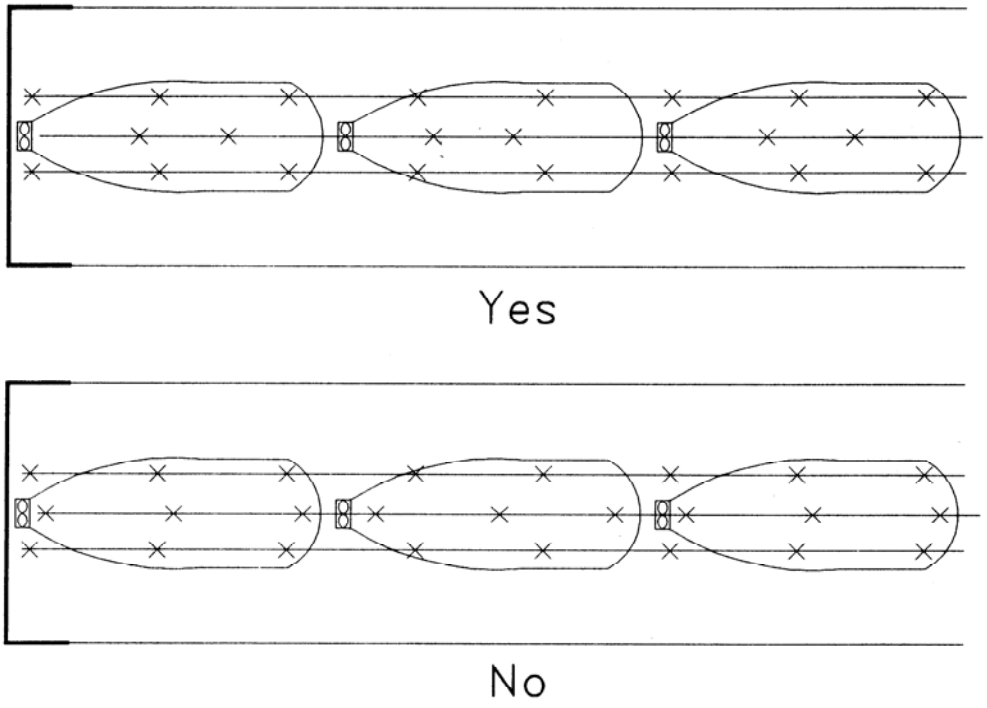

Figure 4. Nozzle directly in front of fans.

In order to maximize cooling that a fogging system can produce while at the same time minimizing floor wetting that takes place, the amount of moisture added to the air should be matched with the relative humidity in the house. The lower the relative humidity, the greater the amount of water which can be added and the more cooling that can be produced. On the other hand, only a limited amount of water can be added on very humid days. Ideally, a system would monitor house temperature as well as relative humidity and then turn on enough fogging nozzles to cool the air but not so many as to wet the house. Though this is not practical in most instances, it is possible to design a system that has at least some flexibility in this area.

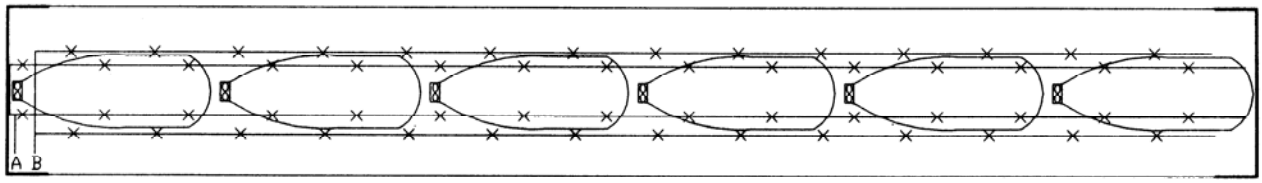

Figure 5. Two stage fogging system.

A two or three stage fogging system can offer a wide degree of flexibility at minimal cost. For instance, two lines of 1 gal./hr. nozzles on 20' centers could produce the initial cooling at 83°F or on humid days. On warmer days, above 85°F, two additional lines of 2 gal./hr. nozzles, situated near the other two lines, could also be turned on (Figure 5). It is even possible to employ a third system to be used during the hottest days of a summertime growout. With proper management and air movement, it is possible to have a system that can add as much as 10 gals./hr. per 1,000 square feet without causing excessive floor wetting.

A properly designed fogging system greatly enhances a grower's ability to maintain cool temperatures for his birds during periods of hot weather. The keys to an effective system are droplet size, suspension time, air movement, nozzle placement, and flexibility through fogger staging. The cost of designing a system with these features is not great and will be repaid many times over in decreased mortality and increased broiler performance.

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