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LIMITING SWINE STRESS WITH EVAPORATIVE COOLING IN KENTUCKY

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INTRODUCTION:

During the summer, temperatures in swine buildings often rise to levels that adversely affect animal performance and the profitability of these operations. Heat stress reduces reproductive efficiency in the breeding herd, affecting both the boar and sow. During extended hot weather periods, death of farrowing sows may result.

Evaporative cooling systems have been used in the less humid parts of the United States to reduce heat stress because of low initial and operating costs. However, their use in warm humid regions, such as Kentucky, has been limited because of their reported reduced effectiveness. Nevertheless, due to their inherent advantages, many producers who desire cooling in their swine facilities remain interested in these systems.

SWINE HEAT LOSS:

Swine lose heat by four different modes: radiation, convection, conduction, and
evaporation. Pig size has little effect on the percentage of total heat lost by each method; however, ambient air temperature has a significant effect. Cooling of the body surface and lungs by evaporation becomes much more important in the control of body temperature as the environmental temperature increases above 80°F. If the environmental temperature is the same as the body temperature, the animal cannot lose heat by convection, or conduction and must lose all body heat by evaporation. When a pig attempts to increase its heat loss by increasing the evaporation rate from the lungs, its respiration rate is increased.

Researchers have investigated the effects of high humidity and high temperature on the performance of swine. At 90°F there was little difference in the response of 200 lb hogs to relative humidities of 30 and 94% except that the respiration rate increased at the higher humidity. At 35°C and 30% relative humidity the hogs lost weight but were able to survive over a long period of time. When the relative humidity was increased to 94%, with an ambient temperature of 95°F, the pigs were severely stressed. The body temperature increased 2.5°F and the respiration rate more than doubled.

The effects of dry bulb and dew point temperatures on the reproductive performance of 240 gilts have been studied. Average daily gain and daily feed consumption were significantly influenced by the dry bulb temperature, dew point temperature, and the interaction of these two parameters. The rectal temperature and ovulation rate were influenced only by the dry bulb temperature.

Several investigators have worked toward relating air temperature and relative humidity into a single variable or comfort index. To evaluate how effective evaporative cooling is on reducing swine stress some stress index must be used. Many different environmental stress indicator have been used with animals such as respiration rate, respiratory volume, pulse rate, skin temperature, body temperature, activity level, hair coat characteristics, and other physiological characteristics.
Body temperature, respiration rate, and respiratory volume are most commonly used, either separately or in combination.

Use of a wet bulb, dry bulb index as a single indicator of the effect of the thermal environment imposed on swine has been proposed. The figures presented in research literature would indicate that a wet bulb, dry bulb index has no effect on swine rectal temperature, respiration rate, and pulse rate when the index is below 80. In addition, data would indicate little effect on swine with an index of 85.

A field study conducted in Kentucky during extreme dry bulb temperatures, 96 to 102°F, showed that an evaporative pad cooling system could reduce inlet air temperatures to 80°F or lower. The data also showed that the time of occurrence of high dry bulb temperature was associated with the lowest relative humidity of the day. This resulted in an increased evaporative pad cooling potential during the extreme dry bulb temperatures.

COOLING POTENTIAL IN KENTUCKY:

Weather data was evaluated using a stress index reflecting conditions inside a swine facility to determine the hour's a stress index of 85 would be exceeded with and without evaporative cooling. A stress index of 85 was chosen because it allows for swine to show some response to thermal stress but at a level where other possible adverse effects should be limited.

A stress index equation was modified to reflect both the actual wet bulb and dry bulb temperatures surrounding the animal, in a facility and evaporative cooling. An 80% efficient evaporative cooling system was chosen because it is easily obtainable in swine facilities using commercially available equipment.

Data were obtained from the National Climatic Center which gave the hours occurrence of dry bulb temperatures in 5°F increments divided into 6 relative humidity ranges; under 30%, 30-49%, 50-69%, 70-79%, 80-89%, and 90-100%, for a ten-year period from 1951 to 1960.
The climate data for the ten-year period was tabularized for Lexington as shown in Table 1. The table gives an example of the average hours of occurrence of each temperature and humidity range shown for the ten-year period of observation.

Using a constant stress index of 85 without and with evaporative cooling the percentage of each dry bulb temperature and relative humidity range during which a stress index of 85 would be exceeded with and without evaporative cooling was developed, Table 2. Then the number of hours per year a stress index of 85 is exceeded with and without evaporative cooling was determined using Tables 1 and 2.

RESULTS:

In Lexington the percentage reduction in hours the stress index exceeded 85 was over 95%. Although evaporative cooling did not eliminate all the hours that the stress index exceeded 85, it did reduce their frequency of occurrence from 313 hours without evaporative cooling to 15 hours with evaporative cooling.

At the extreme levels of temperature and humidity ranges, shown in Table 1, the stress index could approach 100 without evaporative cooling. With evaporative cooling the index could be reduced by 8%. Stress index levels of 90-93 were calculated at the extremes with evaporative cooling. Although the reduction in the stress index does not provide conditions in which no stress may occur, any reduction in the stress index at these extremes may be valuable to the animal.

CONCLUSIONS:

1. Evaporative cooling is effective at reducing the number of hours a swine will be in thermal stress in Kentucky.
2. Evaporative cooling can be used in Kentucky to reduce thermal stress in swine facilities.
3. Peak stress index levels may be reduced only 6 to 10% at temperature and humidity extremes with evaporative cooling.