Heat stress reconsidered with recent swine research findings

By **SUE SINN***

THE topic of heat stress, its impact on swine productivity and methods to ameliorate its impact were widely reported at the American Society of Animal Science Midwest meetings this year.

Heat stress occurs when the "increasing ambient temperature overwhelms thermoregulatory mechanisms, creating a negative balance between thermal energy flowing into and out of an organism" (Johnson and Baumgard, 2018).

Heat stress costs the U.S. swine industry more than $300 million per year, conservatively calculated using only estimates of additional non-pregnant days in sows and decreased growth performance in pigs (Lugar et al., 2018). When including the postnatal productivity and animal losses, the estimated losses jump to more than $900 million per year for the U.S. industry and $50 billion per year globally (Johnson and Baumgard, 2018).

Heat stress can affect pigs at any stage of production and can add greater stress during typical production events such as weaning, transportation and mixing. All of these stresses increase energy costs for maintenance, thus reducing energy available for growth. Heat stress increases animal morbidity due to increased core body temperature. In addition, heat stress negatively affects feed efficiency, meat quality and yield due to changes in body composition (Johnson and Baumgard, 2018).

Boars

Due to the negative effects of heat stress on semen quality and cryopreservation during the summer months, boar stud facilities are required to maintain a larger boar inventory year-round (Grusenmeyer et al., 2018).

In boars that experience heat stress *in utero*, there was a loss of approximately 4.5-7.5 doses of semen per boar per ejaculate, or 234-390 doses per boar per year if collected weekly. *In utero* heat-stressed boars may be more tolerant of postnatal heat stress compared to boars that did not experience *in utero* heat stress (Lugar et al., 2018).

In addition, when boars were subjected to heat abatement via evaporative cooling, they had significantly lower testicular temperatures and a significantly greater percentage of morphologically normal spermatozoa compared to boars with no heat abatement during heat stress (Grusenmeyer et al., 2018).

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Sows

Gestating sows experiencing heat stress may farrow early while having an increased number of stillborns, lower progesterone levels, greater embryonic death and decreased milk production (Johnson and Baumgard, 2018). Sows that farrow during the summer months have smaller litters, lighter weaning weights and increased preweaning mortality compared to sows that farrow during cooler months (Omtvedt et al., 1971).

Heat stress in sows can be reduced by using several different types of cooling systems. Evaporative cooling is commonly used, but traditional systems require airflow and low humidity to be most efficient (Johnson and Baumgard, 2018), which may limit their effectiveness in practice.

In a trial evaluating a cooling pad using conductive heat exchange technology that does not require water cooling, Maskal et al. (2018) compared lactating sows subjected to mild (peak temperature of 81°F) or moderate (peak temperature of 90°F) heat stress. The results showed significantly reduced respiration rates and rectal temperatures for sows subjected to moderate heat stress and no differences for the sows subjected to mild heat stress.

Grow/finish

The impact of organic and inorganic zinc sources and the dietary addition of a live yeast were evaluated for their potential to ameliorate heat stress in grow/finish pigs.

Mills et al. (2018) investigated the optimum level of inorganic and organic zinc blends for heat-stressed grow/finish pigs. The group conducted a 70-day trial with three heat stress events (peak temperatures were 91.7°F or 90°F for day 42 and later), and temperatures were similar to summer conditions in the intervals. The group reported that increasing levels of zinc (organic or inorganic) improved growth rates, but 130 parts per million of an organic blend (50 ppm inorganic/80 ppm organic zinc) provided the greatest growth rate.

From the heat stress intervals, feed intake and average daily gain (ADG) decreased by 8.0% and 8.5%, respectively, compared to the thermoneutral group. Also, 110 ppm of another organic blend (50 ppm inorganic/60 ppm organic zinc) or 130 ppm of the inorganic zinc provided the greatest growth rate during the heat stress events.

The level or source of zinc did not produce significant benefits in fresh pork carcass quality for heat-stressed versus thermoneutral pigs (Feldpausch et al., 2018).

Mayorga et al. (2018) evaluated growth performance, metabolism and inflammation in finishing pigs subjected to thermoneutral or heat stress conditions when fed *ad libitum* or using pair-fed strategies with or without live yeast supplementation. There were no differences in final bodyweights for the main effect of live yeast, but importantly, the researchers noted that pair-fed, heat-stressed pigs were approximately 7% lighter than the thermoneutral pigs.

This finding suggests that feed intake *per se* does not drive the growth depression of heat stress. Heat-stressed pigs did have an increase in circulating insulin and decreased plasma glucose, nonesterified fatty acids and the thyroid hormones T3 and T4. Live yeast supplementation did not ameliorate the negative growth consequences of heat stress but did decrease the circulating TNF-alpha levels in heat-stressed pigs.

Kpodo et al. (2018) evaluated thermoregulation and performance for different pen locations with high or low levels of airflow throughout two grow/finish barns. There was an 11% difference in airflow between the high and low levels. Although there were no differences in ADG or average daily feed intake in pigs between the two groups, pigs in pens with low airflow had significantly poorer feed efficiency and greater body temperatures (Kpodo et al., 2018).

Wiegert et al. (2018) evaluated finishing performance during summer months with cooling by evaporative pad cooling technology or tunnel ventilation. During the daytime, the cool cell barns were 3.4°F cooler, on average, with 12.8% greater humidity compared to the tunnel-ventilated barns. There were no significant differences in ADG or feed efficiency between the two barn types. Medication costs per pig were significantly lower in the summer for the cool cell barns than the tunnel barns.

The Bottom Line

Heat stress is a serious condition that will affect the producer's bottom line if not managed well at all stages of production. Plenty of research has been reported that documents the decreased growth performance and altered metabolism and meat quality for pigs subjected to heat stress.

This area will continue to be under further research as the swine industry advances in this ever-changing global climate. Solutions for treating heat-stressed pigs, whether environmental or dietary, should consider both the animal's wellbeing and the producer's bottom line.

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