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Management strategies to improve finishing pig performance during "HOT" weather

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Introduction

The summer season sometimes offers additional challenges in regard to the management of finishing pigs. Heat stress can occur in all classes of pigs under a wide variety of situations and production systems. If pigs and facilities are not management properly, hot weather has a tendency to result in adverse effects in relation to finishing pig performance. Finishing pigs may begin to feel heat stress at approximately 70°F. In addition, temperatures above 85°F will have an impact on animal performance and the welfare of finishing pigs.

Thermal Environment

Pigs can modify their behavior to adapt to a wide range in temperatures. Although dry bulb temperature is a good place to start this is seldom the temperature that the pig may be experiencing. There are many factors that may influence what the pig may be experiencing as far as temperature is concerned. These factors may include: air speed, humidity, group size, surface temperature, building materials, etc. The Effective Environmental Temperature (EET) of the pig involves all factors that affect the energy exchange between the pig and its environment. To have a better understanding of the EET of pigs it is imperative to first understand the methods in which pigs transfer heat.

Four Methods of Energy Exchange in the form of Heat Transfer

1. Conduction = transfer of heat which occurs as a result of the pig being in physical contact with another surface with a temperature that is different from the core temperature of the pig. This can cause 10 to 15% of heat loss.

2. Convection = transfer of heat that occurs as a result of the pig being in physical contact with air, mud or water that is at a different temperature than that of the pig. This can cause 35% of total heat loss.

3. Radiation = transfer of heat to a surface without direct contact. 30 to 50% of total heat loss. For example (Thaler 2006), consider the difference between a 6" un-insulated concrete sidewall compared to a 6" insulated concrete sidewall. Indoor temperature is 80°F and outdoor temperature is 95° in both cases. Heat flow will be migrating from outside the barn to the inside. The 6", un-insulated concrete sidewall has an R value of 1.33, which results in a 90°F inside surface temperature of the concrete sidewall. In contrast the 6" insulated

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What's Inside ...

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concrete sidewall equipped with a 1" piece of rigid Styrofoam insulation will have an R value of 6.33 which results in an 82°F inside surface temperature of the concrete sidewall. Therefore, the insulated wall decreased the rate of heat gain by 8° whereas the un-insulated wall is 10° warmer than room temperature and may act like a radiator which in turn will make the pig feel hotter.

4. Evaporation = transfer of heat by water conversion to vapor. This could be classified as direct cooling in the manner of wetting the pig and then allowing the moisture to evaporate which provides substantial cooling. An increase of respiration rate of finishing pigs may start at 72°F.

Although we cannot control what mother nature deals to us as far as weather conditions are concerned, there are a few management strategies that can be implemented to help keep finishing pigs performing and to avoid the summer "stall out".

Diet Modifications

Finishing pigs are particularly susceptible to heat stress due to their limited ability to dissipate heat. One strategy that may be implemented during periods of heat stress is to make modifications to the diet. Finishing pigs will respond to heat stress immediately by altering feed intake. Le Bellego et al., (2002) confirmed that an increased ambient temperature (84.2°F) reduces the appetite of pigs. Signs of decreased feed intake may be seen when temperatures reach approximately 77°F. In turn, nutrient levels need to be adjusted. Below is an example given by Thaler (2006).

Example: If a 220 lb barrow eats 7.2 lbs of a diet containing .62% lysine, it is meeting its gram per day lysine requirement (20.4 g/d). However, if feed intake is reduced 11% by heat stress to 6.4 lbs of feed/day, the pig is now only consuming 18.1 grams of lysine per day. This lysine deficiency results in a reduction in growth. To get 20.4 g of lysine per day with a 6.4 lb/day feed intake, the dietary lysine level needs to be increased to .70%.

Dietary Fat and Crude Protein

Spencer et al. (2005) used 196 late finishing barrows to compare two levels of fat addition to diets (1 or 8% added fat) and two levels of dietary crude protein (11.3 or 13.6%). Barrows were exposed to temperatures cycling between 80.6° and 95°F. As a result, the hot environment severely reduced late finishing growth performance (Table 1). However, the modifications to the diet improved these negative effects when considering lowering the crude protein percentage or fat level was increased. Consequently, the addition of fat to the diet may increase carcass fatness and can also cause bridging of feed within the feeding system.

Table 1. Growth performance of barrows reared in a cycling hot environment and fed different levels of crude protein and fat.

Added fat, %	1		8	
CP, %	11.3	13.6	11.3	13.6
Starting weight, lbs.	192.7	193.6	192.7	193.8
Final weight, lbs.	244.4	241.8	246.0	248.8
ADFI, lbs.	5.04	4.71	4.53	4.75
ADG, lbs.	1.28	1.19	1.30	1.36
Gain:feed	0.25	0.25	0.29	0.29

Source: Spencer et al., 2005

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Synthetic Amino Acids

The inclusion of synthetic amino acids associated with the reduction of dietary protein content have been shown reduce the energy losses as heat in growing pigs (Le Bellego et al., 2001). Essentially, the idea is that synthetic amino acids will produce less heat during the digestion process when compared to the intact protein of soybean meal. In addition, low crude protein diets can be considered as low-heat increment diets, especially when fat has been added to the diet (Le Bellego et al., 2002).

Dietary adjustments are one method to help maintain growth performance in summer months and will help in moderate heat stress situations. However, once the heat stress exceeds moderate levels, the primary strategy switches to helping the pig lose heat and feel cooler. Furthermore, it is also important to evaluate the economics of diet modifications when attempting to manage heat stress.

Ventilation Cooling

The purpose of hot weather ventilation is to replace hot air with cooler air, remove high humidity respired air from around the animal, increase air velocity around the animal which increases evaporative and convective cooling from the skin, and create an evaporative cooling effect by using heat from the air to evaporate moisture from the building and animal surfaces (MWPS – 34).

Recommended ventilation rates are stated in Table 2. Note that the minimum ventilation rate refers to and is used interchangeably with cold weather ventilation. One important note to consider in regard to your ventilation system is that if the air temperature is higher than the pig temperature, higher air speeds will make the pig more heat stressed.

Table 2. Recommended Ventilation Rates.

	Minimum	Hot Weather
Growing 75 - 150 lbs.	7 cfm/pig	75 cfm/pig
Finishing 150 – 250 lbs.	10 cfm/pig	120 cfm/pig

Sourc e: MWPS 32

When evaluating your ventilation system for hot weather, the pigs will give you signs that they are too hot. Some of the signs stated by Bates (2005) include:

1. A high proportion of pigs lying on their sides
2. Many pigs trying to lie around the drinker
3. Many pigs at the drinker playing with water
4. Pigs panting
5. Many pigs may look wet

In addition to hot weather ventilation helping to prevent excessive room air temperature increases, there are several other ways to further increase animal comfort such as spraying water on animals to increase evaporative heat loss (sprinklers), circulating air to increase air velocity past animals (stir fans), evaporative cooling of ventilating air (evaporative cooling pads) and checking the stocking density of the barn.

Sprinklers

Sprinkler cooling is an effective way to cool pigs in periods of heat stress. A sprinkler system that wets the animal and then allows the moisture to evaporate is preferred. Therefore, once the pigs are wet, stop sprinkling and allow the water to evaporate. If continual wetting takes place the relative humidity will rise and heat transfer through the evaporation method decreases which in turn defeats the purpose of the sprinkling system and may actually raise the temperature within the barn. For this reason, foggers should be avoided. Foggers will cool the air but may also raise the relative humidity level and decrease the evaporation process.

An appropriate goal would be to start sprinkling at 80°F to wet all pigs with a 2 minute on-time (Table 3) that provides 60% pen coverage (Thaler 2006).

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Table 3. Recommended flow rates for sprinkling systems.

Pigs/Pen	2 minutes/10 minutes		1 minute/30 minutes	
	gal/min.	gal/hr.	gal/min.	gal/hr.
10	0.017	1	0.10	6
20	0.033	2	0.20	12
30	0.050	3	0.30	18

Source: PIH - 87

When evaluating sprinkling cooling systems for finishing pigs you will want a combination of interval + nozzle size to equal 1 gal of water/hr/10 pigs (0.1 gal/pig/hr). Appropriate sizing the sprinkler system is extremely important especially for large facilities where the total flow (gallons per minute) at one time may be an issue. Sprinkler nozzle size recommendations are listed in Table 4. In addition, the general recommendation is to select non-corrosive nozzles that provide a solid cone of water droplets which is placed approximately 6 feet above the dunging area.

Table 4. Recommended sprinkler nozzle sizes for swine groups.

Pigs/Pen	Nozzle size, gpm
10	.20
20	.40
30	.60
40	2 nozzles at .40
50	2 nozzles at .50

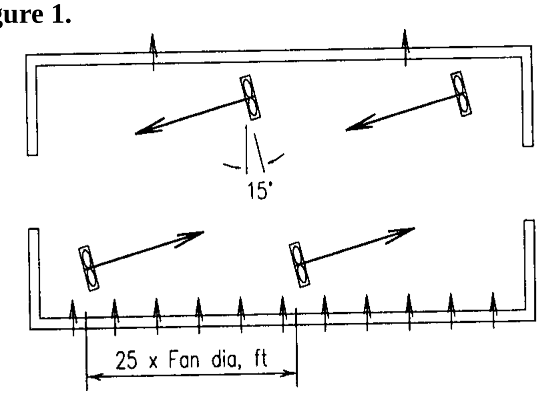
Source: MWPS 34

Air Circulation - Stir Fans

In order to get the best air distribution throughout the entire barn, circulation fans need to be at a 15 degree angle (Figure 1). If they are perpendicular to the barn, a "race-track" effect occurs and the center of the barn is not adequately ventilated (Thaler 2006). In addition, there needs to be an adequate number of fans. Circulation fans should be placed no more than 25 fan diameters apart (MWPS – 34). To determine the right number/spacing of fans, multiply the fan diameter (ft) times 25 and that will tell you how far the fans need to be apart. Consider the following example: if your fans are 2 ft. in diameter, then you need to have a fan every 50 feet (25 * 2 ft).

Another aspect to consider when dealing with circulation fans is to tilt the fans downward at 15°. Installed in this manner, the fans may ensure that evaporative cooling (drying) is maximized by increasing airflow when the pig is wet.

Figure 1.



Source: MWPS - 34

However, installing fans for air circulation will not replace a good ventilation system. Therefore, it would be appropriate to evaluate the ventilation system in each respective barn before installing air circulation fans.

Evaporative Cooling Pads

Evaporative cooling pads are also another option in the management of heat stress of finishing pigs. Evaporative cooling pads use the heat from air to vaporize water. In turn, air temperature is decreased but moisture is also increased. Cool cell pads can be effective in the hottest part of the day decreasing air temperature by up to 20° F. However, temperature will decrease until the relative humidity nears 85%. When the incoming air is humid (RH > 70%) air temperature may only decrease by 5 - 10°F (Thaler 2006). However, there are a few issues when dealing with evaporative pad coolers such as uneven wetting, water quality related to algae growth, mineral deposits and the need for cover pads with insulated doors in the winter. To

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reduce algae growth on the pad you can stop the pump several minutes before the fans to dry the pads after each use. To reduce mineral deposits routinely drain 10 – 15%.

Stocking Density

The stocking density of a facility may contribute to the heat stresses of pigs for two reasons. First, if stocking densities are too high the temperature inside the barn may rise as more metabolic heat is added to the barn and the ventilation system may not have the capacity to function properly. Secondly, the pig will be unable to adopt its extended posture which would eliminate the possibility of increasing conductive heat loss. Keeping this in mind, pigs fail to lose maximum heat if any of its skin is in contact with other pigs. The general recommendation for space allocation of finishing pigs is 8 square feet. However, the industry norm is somewhere between 7 to 8 square feet per pig. Therefore, it is important to evaluate the ventilation system and make sure that the ventilation rate matches the size of pig and stocking density when dealing with pigs that are hot. In turn, the evaluation of the ventilation system and stocking density in the summer months may play a role in identifying any additional heat stresses that pigs in your barn may encounter.

Conclusion

The optimal goal when dealing with heat stress in finishing pigs would be to minimize the amount of energy a pig spends to maintain its core temperature. Therefore, reducing the amount of feed energy used for adaptive responses to the pig's environment will increase the energy available to be used for growth. Producers can not rely simply on dry bulb temperatures and LED controller read-outs to assess whether pigs are in heat stress. There are many confounding factors such as humidity and air speed that complicate what appears to be an acceptable air temperature may still be a heat stress situation for the pig. Daily observations of the behavior of your pigs may be the most telling in regard to the management of heat stress in finishing pigs.

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Oxytocin: Management Tool or Obstacle

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Introduction

Many swine farms use controlled farrowing as a management practice. This practice can result in higher labor efficiency, minimized dystocia, decreased prewean mortality and result in heavier weaning weights. In order to achieve the potential benefits of controlled farrowings, certain practices should be in place. Some of those practices include attending/observing the birthing process, which can result in 0.5 more pigs per litter and one more pig/sow/year, induced farrowings, using Lutalyse™, and assisting with difficult births. When assisting with difficult farrowings typically manual assistance and the use of oxytocin are needed.

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The Purpose

In the farrowing barn, there are many management practices that are unquestionably part of the farrowing crew's routine. On such practice is the use of oxytocin to aid in the farrowing process. The 1995 National Animal Health Monitoring System study showed that approximately 8.2% of producers utilized oxytocin for every farrowing sow. This is a decline from the 1990 study that stated 20.0% of producers were administering oxytocin to every farrowing female. Producers use oxytocin to shorten farrowing time, minimize the interval between the birth of each pig and to aid milk letdown. Oxytocin is a hormone produced in the hypothalamus and excreted by the pituitary gland, it occurs naturally in sows and gilts. An injection of oxytocin causes the release of uterine prostaglandins and facilitates smooth muscle contractions. Although the use of the hormone oxytocin is extremely common in the farrowing barn, it is also a drug that can easily be misused by employees.

The Obstacles

It is not uncommon for producers and herdsmen to overuse oxytocin in an effort to speed up the farrowing process. When oxytocin is correctly given, the total farrowing time and interval between piglet births can be reduced. Administering ocytocin before the cervix is fully dilated or the first pig is born can cause complications. Improper use of oxytocin has been shown to increase the number of stillbirths. If oxytocin is given too early in the birth process, it can cause the sow to have contractions before the piglets are ready to be born, which causes ruptured umbilical cords and leads to oxygen deprivation of piglets before birth.

Research by Lucia et all (2002)[a] concluded that the percentage of stillborns in litters of sows given oxytocin anytime during the birthing process increased on each of the farms studied. The timing and dosage amount of oxytocin that is given can also have adverse effects on the farrowing process. In the study by Lucia et al (2002) it showed that 75% of the stillborns were recorded after the 8th pig was born among sows that were allowed to farrow without assistance or oxytocin stimulation. On the other hand, during this same study when the sows received one treatment of oxytocin after the first pig was farrowed, 88% of the stillborns were delivered before the 5th pig was born.

Doses greater then 10 I.U. have been reported to cause stoppage of births and increased number of stillborn pigs. Large amounts of oxytocin, 30 I.U. and above can over stimulate the uterus with fatigue as a result.

The Positive

Oxytocin, when used properly, can be a great management tool in the farrowing barn. Utilizing this hormone on older parity sows and sows with a previous history of high numbers of stillborns can help to reduce the number of stillborn pigs. A dosage level of ½ cc or 10 I.U. will stimulate uterine contraction. Make sure that all employees on your farm understand the standard operation procedures for oxytocin administration by following these recommendations:

- Give oxytoxin only after milk letdown has begun and the cervix is fully dilated
- During a normal farrowing, only give oxytocin after the 6th pig has been born
- Only utilize two dosages (1dose= 1/2 cc or 10 IU) of oxytocin during the farrowing process
- Keep track of all piglet births so that proper interval time is maintained
- If 30 minutes have passed between piglet births, then use oxytocin to induce uterine contractions
- Try not to administer oxytocin to gilts, fatigue is not likely to occur and farrowing difficulty is more likely a result of inadequate space in the birth canal and manual assistance is needed to pull the pig out.

[a]Lucia, T. et al. 2002. Prev. Vet. Med. 53:285-292.

Thinking About Space?

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Introduction

Pig farm owners build new buildings whose size is based on the expected inventory. The size of a building is determined by the amount of space needed for each pig which is multiplied by the number of pigs expected to be in inventory. The space allocated per pig is the perceived spaced needed for the pig by the end of the phase for that particular building not the space needed for the pig as it is first placed into the building. For instance, in wean-to-finish buildings the space allocation per pig is what is believed to be needed as the pig completes the finishing phase, not the space needed for a weaned pig. In essence pigs grow into the space allocated within a facility.

New Recommendations

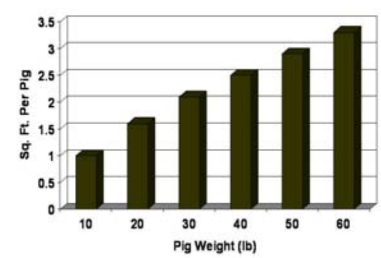
Much has been written recently of using allometric relationships to determine the space needs for the growing pig. This methodology provides a better understanding for how a changing three-dimensional shape (i.e. the pig) relates to a two-dimensional shape (i.e. the floor). A pig's changing weight is then related to the allocated floor space with the resulting information referred to as a "k" value. This k value is defined as; k= floor area/(pig weight$^{.667}$). The calculations are typically done in metric units.

In animal experiments, pigs are allocated to different floor space treatments based on their expected final weight. After the experiments, the pig's growth performance, feed intake and feed efficiency are related to the calculated k values to determine what floor space recommendations are necessary to optimize performance.

Recently a report was published that summarized several research studies that had studied the impact of floor space allocations on pig growth (Gonyou et al., 2006[a]). The results were used to calculate the k values that would optimize pig growth. These k values can then be used to develop recommendations regarding the floor space needs for growing pigs.

In Figure 1 is the recommendation for space of pigs housed in traditional nursery facilities. The study did not find an interaction of the critical value for space requirement and floor type. The values in Figure 1 can be used across different floor types. The recommendations do vary dramatically depending on the average final weight pigs will be leaving the building. For traditional nursery facilities, if pigs leave the nursery at an average weight of 40 lb, their recommended space requirement is 2.5 sq. ft. per pig (Figure 1). However, if pigs are to average 50 lb, the recommended space allocation would be 2.9 sq. ft. while pigs leaving the nursery at an average weight of 60 lb would need 3.3 sq. ft. per pig. For nursery pigs, for every 10 lb increase over 40, the space allocation needed increases by 0.4 sq. ft. This is a 16% and 32% increase in space needed for a 50 and 60 lb pig, compared to a 40 lb pig, respectively.

Figure 1. Nursery Pig Space Recommendations



Adapted from Gonyou et al, 2006

Space recommendations for finishing pigs are located in Figure 2. The study did not find an interaction between different floor types and the critical value for space requirements. The information provided in Figure 2 can be used across different finishing floor types (e.g, total slatted, partial slatted, etc). For some time now the space recommendation for finishing pigs has been 8.0 sq.ft. per pig. However the new recommendations suggest that for 250 lb pigs the former recommendation is a bit short. The new recommendation suggests that 250 lb pigs should be allocated 8.4 sq. ft. per pig. It should be note though, that these space recommendations are based on the average weight of pigs when marketings begin, not average market weight.

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[a]Gonyou, H.W., M.C. Brumm, E. Bush, J. Deen, S.A. Edwards, T. Fangman, J.J. McGlone, M. Meunier-Salaun, R.B. Morrison, H. Spoolder, P.L. Sundberg and A.K. Johnson. 2006. Application of broken-line analysis to assess floor space requirements of nursery and grower-finisher pigs expressed on an allometric basis. J. Anim. Sci. 84:229-235.

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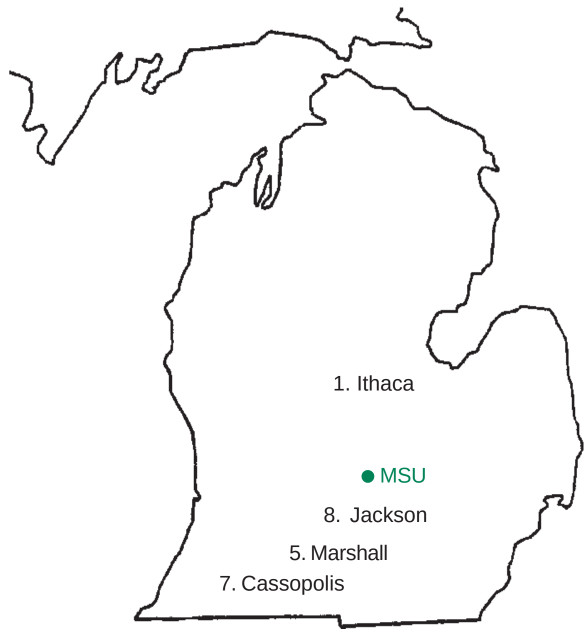
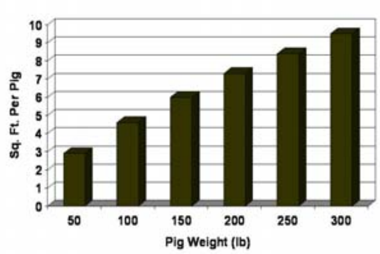


Figure 2. Grow-Finish Pig Space Recommendations



Adapted from Gonyou et al, 2006

One thought to consider though is that average market pig weight has been rising over the last several decades with a current average market pig weight of 271 lb reported by USDA. Depending on the average weight of pigs within a barn when marketings begin, the traditional recommendations for finishing pig floor space allocations may not be adequate. For example, if the first pigs marketed from a barn weigh an average of 300 lb, the pigs within the barn can average 260 lb at that point. If that is the case then growth rate in the barn has been reduced by approximately 2%. This can lead to less than optimum performance when pigs are marketed at heavier weights. Typically when pigs are crowded they grow slower, which will lead to either reduced market pig weight than expected or taking longer for pigs within a facility to reach market weight. These reasons by themselves may not be cause for major changes within the production system. However, when pigs are crowded other stressors such as increased ambient temperature or compromised health status may lead to further reductions in pig performance and viability.

Conclusion

As pork producers evaluate their system, space allocations within the nursery and grow-finish phase need to be considered. If crowding is occurring an analysis can be completed to determine its impact on production system operation and ultimately profitability.