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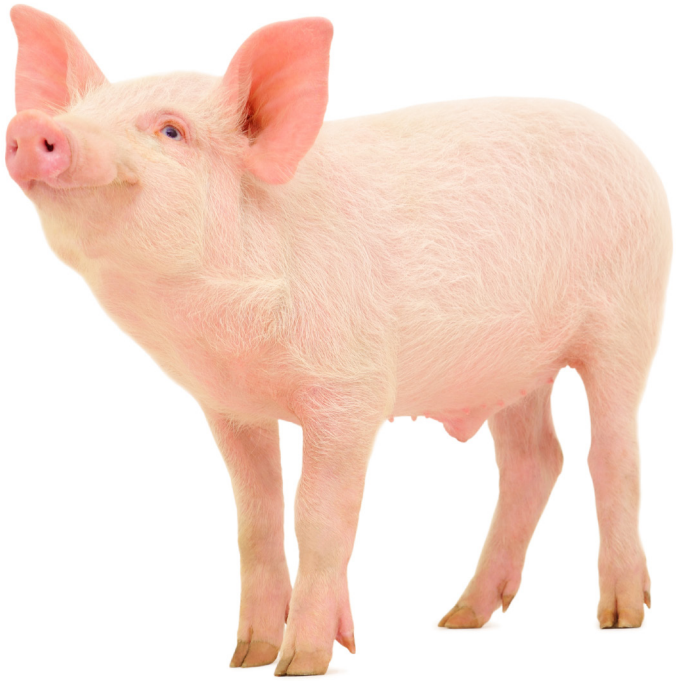
NURSERY & GROW-FINISH MANAGEMENT GUIDE

Products and answers that work®

NURSERY AND GROW-FINISH MANAGEMENT GUIDE

Hubbard Feeds helps swine customers optimize their nursery and grow-finish pig performance by providing cost-effective nutrition programs that meet or exceed customer expectations.

GUIDE SUMMARY



Providing the proper environment for the newly weaned pig improves the health status of the pig, lessens the stress of weaning and improves performance. Outlined below is a list of factors to consider when preparing for a new group of weaned or grow-finish pigs.

Cleaning and Disinfection

It has been well-established that animal performance can improve in a clean environment vs. a dirty one. Numerous studies have shown that when pigs are raised in a clean environment compared to a dirty environment, they can display improvements of 10% in their ADG and 18% in their feed intake. The nursery pig is more susceptible to infections from enteric organisms, so sanitation is especially important for nursery facilities.

- Run the feed lines empty prior to power-washing. This will help remove any excess feed from the facility and limit moldy feed for future groups of pigs.
- Thoroughly clean the room and entryway with a high-pressure washer using hot water and detergent. Thoroughly wash floors, walls, ceilings and curtains. Clean all equipment, including feeders, fans, fan blades, housing, shutters, heaters and floormats. Cleanings should include equipment such as sort boards, rattle paddles, shakers, boots, gruel pans and carts.
- Pay close attention to commonly missed areas during sanitation, such as the gate feet, fan inlets, floor joints and cracks, chutes, syringes, bottle holders, medication totes and hand tools used in the barn.
- Disinfect all exposed areas, such as floors, feeders, mats, walls, ceilings, entryways, loading chutes and storage rooms. Disinfect equipment kept outside the room that pigs can potentially encounter, such as lamps and carts. Disinfectants should be selected based on their label claims and effectiveness, as well as veterinarian recommendations. If possible, when applying a disinfectant, use a foaming applicator. This will help create a visual for the person applying the disinfectant to ensure that all surfaces are covered.
- Flush out the water lines and nipples using a solution of bleach, citric acid or another recommended cleaner. Run water through the lines after using the cleaners. Check screens in the nipples to make sure they are not plugged. Poor water quality can reduce intake, lead to scours and decrease performance.
- The room should be dry and warm before pigs arrive. All equipment, such as feeders and mats, should also be dry. Viruses can survive in wet environments for a long time compared to dry ones. A study found that the PRRS virus could survive in water for 11 days, whereas it died quickly once the environment was dry. Set the temperature according to manufacturer guidelines. All heaters should be fully operational and functioning correctly. Make sure the slats are warm for nursery piglets.
- When needed, place supplemental heat and comfort mats in the pens before the pigs arrive.
- Adjust pit fans to provide enough airflow for minimum ventilation, avoiding excessive airflow that causes chilling or excessive heater operation. Check all air inlets for obstructions and make sure they are fully operational. Set the ventilation rate at the minimum for newly weaned pigs. Seal up any areas that might cause drafts.
- All rooms or buildings should pass a pre-pig inspection prior to pig placement.

Biosecurity Principles

Biosecurity involves implementing preventative measures to avoid the introduction of, and/or to contain the spread of, infections and diseases on farms. With the increased health challenges associated with the transmission of highly infectious pathogens, farm biosecurity is especially critical for farm productivity.

- Pig transportation
  - It is important to recognize that animal movement between farms represents a significant risk for disease spread.
  - Consider taking proactive measures to limit certain pathogens from spreading, both when pigs arrive at and depart from the nursery facility.
- Feed delivery
  - Following the appropriate protocols is necessary during feed delivery, as feed trucks and their drivers may carry pathogens from farm to farm.
- Mortality removal
  - Dead pigs should be removed from the facility as quickly as possible.
  - Consider the placement of dead pig bins and the risk posed by rendering trucks, which have often visited other farms. Consider the use of composting as an alternative.
- People
  - Farm workers and visitors should be considered a potential source of pathogen spread.
  - Implement appropriate strategies to reduce the likelihood that people will spread pathogens.

Pest Control

- Animals, including rodents and birds, are a major vector for disease transmission.
- To control these pests, consider implementing the following measures:
  - Use outside bait stations and have them checked and filled monthly.
  - Maintain a three-foot rock perimeter to minimize vegetation against the building.
  - Weeds and excess vegetation should be routinely mowed, sprayed and maintained below 4 inches.
  - Remove unnecessary clutter or debris to eliminate potential areas of harbor.
  - Put bird netting in place and keep it well-maintained to prevent birds from entering the premises.
- Fly and insect control
  - Some producers consider flies a normal and unavoidable consequence of pig production; however, large insect populations can negatively impact animal health and welfare.
  - Flies can carry pig pathogens, including *E. coli*, *Salmonella*, *Brachyspira* (swine dysentery), *Lawsonia* (ileitis) and tuberculosis.
  - Cockroaches can spread *Brachyspira* and PCV2.
  - The natural tendency of insects to wander — combined with their ability to fly distances of several miles — gives them the potential to spread disease between separate farms.

The objectives of early pig care are to:

- Stimulate and maximize feed intake post-weaning
  - Provide the necessary nutrients during a highly energy-dependent stage
  - Initial diet has an important impact on gut structure
- Achieve optimized production levels relating to losses (1% nursery mortality)
  - Reduce losses due to failure-to-thrive syndrome
  - Control and treat secondary infections
- Accomplish optimized nursery average daily gain (ADG) and feed conversion (F:G) goals
- Improve overall cost of production

Different strategies of care are required for varying health statuses. The following are several factors to consider for highly health-challenged pigs, as well as healthy pigs, based on the results relative to the goals.

- Optimal temperature and humidity
  - Health-challenged pigs require warmer room temperatures and humidity control, resulting in elevated utility costs.
  - Workers should be highly sensitive to humidity and environmental changes within the barn.
- Effective timing and efficient application of critical care
  - Challenged pigs require intensive and frequent husbandry. Be prepared to increase the labor effort and oversight accordingly.
- Use of gruel-feeding strategies and equipment, to which health-challenged pigs respond favorably.
- Facilitation of communication among all levels of the production team. A prompt reaction time is critical to achieving the best results.
  - Weaned pigs' progress can change rapidly, which makes a quick response critical.
  - Include key personnel, such as the veterinarian, field person and producer, in your communications.

Early feeder management

- Avoid overfilling feeders, as doing so may cause the feed to become stale, absorb odors and become unpalatable quickly.
- It is best to provide less than 12 hours' worth of feed per feeding to maintain freshness.
- Use a tube extension or socks to maintain an appropriate quantity of feed in the feeder.

Receiving

Before pigs are received, conduct an audit to ensure the site's cleanliness and biosecurity.

- Recognize that pigs received directly from a single-sow farm will have minimized staging nursery requirements compared to a twice-per-week weaning routine.
  - The basis of this recommendation is that multiple weaning events create added stressors. The goal is to achieve a stable health status within the barn quickly.
- Space requirements:

Age	Wean–50 lbs.	50–75 lbs.	W-F facility
Size (sq ft/pig)	2.8	3.65	6.5

  - For health-challenged pigs, maximize the allotted square footage (+6.5 sq ft/pig in a W-F facility) if possible.
  - This practice can have a significant impact on mortality and morbidity.

- The facility should be fully warmed to the desired room temperature.
    - Health-challenged pigs often require a 5-degree increase in the desired room temperature.
    - If brooders are in use, mats should be dry and set at a temperature of 95°F upon arrival.
    - This process may require reduced minimum ventilation and for heaters and brooders to be activated 4 to 6 hours before arrival.
- Inventory of pens:
    - Consider keeping one to two pens empty to allow ample space to pull pigs from the general population into a specific intensive-care area.
    - The intensive-care area should be near the barn's center, thereby minimizing temperature variations throughout the day.
    - Removals from the general population should take place at different times:
        - At placement, any challenged piglets should immediately be placed in intensive-care pens.
        - During daily observations, animals with compromised body conditions should be moved to the intensive-care area for both treatment and gruel feeding.
- Use a drip nipple to provide clean, clear water for the first three to five days after pig placement. A nipple bar could also be useful in some situations.

Smalls

Sorting lightweight and low-body-conditioned pigs on wean day into a separate hospital pen improves the likelihood that they will succeed. The smaller the average pig's wean weight is, the greater the number of pigs that will need to be sorted.

- Prioritize the most digestible and palatable feed that is part of your feeding program.
- Following the feed budget is key so that smalls pigs do not get skipped or shorted of an early-stage feed while the general population of pigs consumes this diet. Powerstart® Solo eliminates the need for this by providing a single diet for 13–25-lb. pigs.
- The normal stocking density and feeder space parameters still apply.
- Keep gruel pans near the waterer or feeder and away from the sleeping area to ensure that pigs stay dry.
- Wash and clean gruel pans in the alleyway to ensure that the pen space stays dry.
- Ideally, smalls should be placed in an area of the barn that has few drafts and can utilize a supplemental source of heat, like brooders.

Pen Walking

Pens should be walked daily, and the person who does the walking should:

- Look in each feeder to ensure that the feeder has the proper amount of feed and that it is clean.
- Look in the trough of each feeder to ensure that the feeder is adjusted correctly and that there is the correct amount of pan coverage.
- Inspect the floor of the pens for excessive wetness, manure accumulation and signs of diarrhea.
- Inspect each pen for damaged or bent rods that could injure pigs by sticking out into the pen.
- View every pig from snout to tail and head to toe; the rule of thumb is to spend two seconds looking per pig.
    - Identify and pull fall-behinds.
    - Identify, pull and treat sick pigs.
- Check water flow rates.
- Mat feed.

Properly adjusted feeder (meal feed)

Properly adjusted feeder (pellet feed)

Photos provided courtesy of Kansas State University.

Managing Fallback and Sick Pigs

Starting weaned pigs is the most critical task in wean-to-finish production. Pigs that start well tend to experience rapid growth and improved feed conversion unless presented with significant health challenges. Unfortunately, the opposite is true in pigs that start tough, as they tend to be a challenge all the way through to marketing. One of the

most common challenges in hard-starting weaned pigs is identifying sick pigs vs. starve-out pigs. Medications are beneficial for sick pigs but do not provide calories to starve-out pigs. Correctly identifying the root cause allows for proper management.

Identifying Sick Pigs

Observe each pig individually every day. Identify and treat sick pigs at the direction of your veterinarian. The first 14 days post-weaning are a crucial time to identify any pigs that are not transitioning well and are more susceptible to health and performance challenges.

- **Respiratory diseases**
  - Pigs may exhibit coughing, thumping, open-mouthed breathing or depression
- **Scours**
  - Pigs may have loose stool, inflamed rectums or feces staining their back legs
- **Lameness**
  - Pigs may be unwilling or unable to stand up, limp when walking and have swollen joints or swollen legs
- **Strep**
  - Pigs may appear uncoordinated, tilt their heads, walk in circles or be down-paddling

Identifying Fallback Pigs

Sick or starve-out pigs should be moved to a hospital pen upon inspection as needed. These pigs should be restarted provided with additional nutrition, including gruel feeding and mat feeding.

- **Lethargic or depressed looking**
  - Head will be down or droopy
  - Hair coat may have a rough or fuzzy appearance
- **Lost body condition score**
  - Watch for pigs with a visible spine, hip bones or ribs
- **Gut fill**
  - Identify pigs that have sunken-in flanks
  - Hold the pig upside down by its back legs and place your thumb over the pig's back and your fingers over the pig's abdomen, squeezing your fingers toward your thumb to evaluate gut fill.
    - If your fingers easily depress the abdomen, the pig is off feed
    - If the abdomen is full, with plenty of resistance, feed intake is adequate

Interventions for Sick or Fallback Pigs

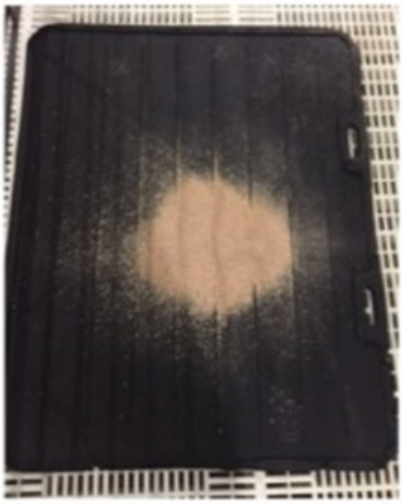
- **Gruel feeding**
  - At placement, it is preferable to supply gruel feed to each weaned pig for the first 2–3 days.
  - Each pen should have a 3-gallon pan per 15 head or utilize a PVC trough, allowing for 3 inches of feed space per pig. For example, a 45-head pen requires a 5½-ft. canoe made from a 4–6-inch PVC tube per pen, the PVC tube should have a diameter of 4–6 inches.
  - The recipe for gruel feeding (per 15 pigs):
    - 24 oz. of water and ½ lb. of feed
  - Gruel feeding should be applied four times per day for maximum results.

- Gruel feed is properly calibrated when the pigs consume the entire mixture within the hour.
- This step is highly labor-intensive but is a positive step in early acclimation to a new environment for an already challenged pig. Field results have shown positive economic and performance results.
- Gruel-feed within intensive-care pens for 7 days.

As intensive-care pigs recover and continue to improve their body condition, an evaluation should be made three times per week. Recovered pigs should be moved to a graduation area free of gruel feeding.

Examples of gruel feeders

- **Mat feeding**
  - The goal of mat feeding is to stimulate the activity level of the pigs and to act as a "dinner bell" prompting them to eat.
  - The transition from a sow's 20 to 24 lactation events per day to an *ad libitum* environment sometimes challenges piglet feed intake.
  - Consider mat feeding for a minimum of 7 days post-weaning.
  - Schedule mat feeding so it takes place:
    - At the beginning of morning chores
    - At the conclusion of morning chores
    - At noon
    - During evening chores



Animal Care Summary

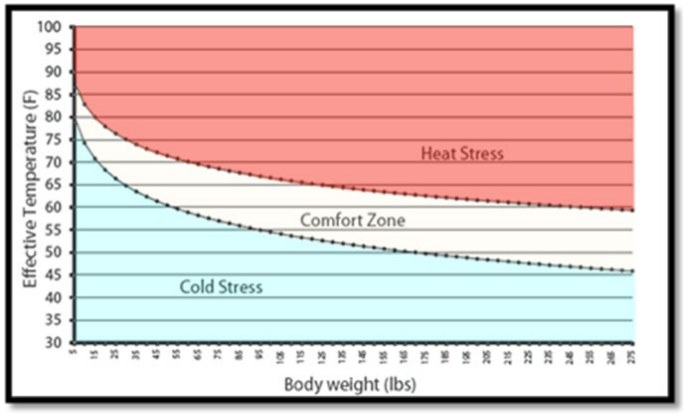
- Make sure you allocate the proper amount of time in your daily routine to accomplish all of the tasks involved in pig care. Walking pens to evaluate the pigs and equipment requires 1½–2 hours per 1,200 head.
  - Workers should be equipped with the tools that support efficient care, including:
    - Syringes, medication and needles
    - Marking devices (aerosol or paint sticks)
    - A pen and notebook
    - A hydrometer and thermometer (to check humidity and temperature)
    - Potentially, a panel (or sorting board) to sort ill or injured pigs

- Evaluations should include the following steps:
    - Identify any ill or injured pigs to treat or remove to a hospital pen
    - Determine whether any adjustments need to be made to produce the proper water flow and feed pan coverage
    - Take note of the daily water consumption and temperature variations (both the highs and lows)
    - Evaluate the humidity and airspeed to determine any necessary modifications to the ventilation strategy
    - Take note of the number of pigs treated, as well as any associated medications and dosages
    - Evaluate the feed inventory and associated intakes to predict upcoming feed orders
    - Ensure that the fans and heaters are appropriately functioning to produce optimal environments
- Evaluate the data daily to understand trends or patterns relating to:
    - Water and feed intake
    - Health changes
    - Utility use (e.g., liquid propane levels, heater run times, temperature probes)
    - Biosecurity and the cleanliness of mortality disposal equipment or compost management
- Every month, evaluate/test/do maintenance on the following:
    - Emergency devices
    - Curtain drops
    - Alarms
    - Back-up heaters and fans
    - Generators, if available
    - Equipment, probes, fan belts, curtains, inlets

The day-to-day management of the pigs and the barn is the single-greatest factor in differentiating highly productive farms from others. If pigs from the same sow farm went to three different farms and were fed the same diets, each farm would still have different performance outcomes. This is due to differences in the environment and the stockmanship at each individual farm. With all other factors being equal, pigs are a product of their environment. Their health, growth and efficiency are dependent on the person taking care of them and the environment within the barn. Careful observation and a timely response can be the difference between a group of pigs meeting performance expectations or falling short.

Optimal Environment

In order to maintain growth and feed efficiency, it is important to ensure that pigs remain within their thermoneutral zone. Once a pig falls outside of that zone, they will become stressed, and setbacks in performance could be observed.



When pigs are kept at temperatures below their comfort zone, they will consume more feed to maintain their body temperature, resulting in decreased feed efficiency. Conversely, pigs housed at temperatures above their comfort zone will decrease their feed intake, and their daily gains will slow down as a result. In today's production systems, pigs are at a greater risk of heat stress than cold stress. Therefore, it is important to ensure that all fans, sprinklers, cool cells and other cooling equipment are maintained so they function properly during the hot summer months.

In conjunction with temperature, it is important that your barn is properly ventilated to provide pigs with an optimal environment. Even if the thermostat reading falls within the pig's comfort zone, it may not actually reflect the environment that they are experiencing.

Ventilation

The critical components of ventilation include:

- Staying within the desired room temperatures
- Considerations for health-challenged pigs (who require a 2–5-degree-warmer barn)
- Humidity control (optimally, below 65%)
- Warm and dry mats

The general recommendation is to maintain 2 cubic feet per minute (CFM)/pig at placement; however, in the case of health-challenged pigs, it may be necessary to remove air at a higher exhaustion rate to achieve less than 65% humidity.

- Brooders should produce temperatures around 95°F directly beneath them. Pigs should remain warm, dry and comfortable.
- To accomplish this, use properly functioning brooders and provide ample mat space (0.4 ft^2/pig).
- An illustration of warm and dry pigs with ample mat space is pictured at right.
- If mats become wet or caked with feed or manure, flip the mats over to reestablish a dry, black surface that will effectively absorb heat.
- Mat temperatures may need to extend beyond 95°F to achieve pig comfort.
- Brooders should be in place and functional for 14 to 21 days, depending on pig comfort and the severity of the disease.
- Brooders should be in place within intensive-care pens throughout the grueling period.

Effective temperature is a concept similar to wind chill and the heat index. For example, 60°F is a favorable temperature for a 125-lb. pig. However, 60°F combined with a high air speed (e.g., 100 ft/min) would be considered cold, and consequently, the pig would be diverting energy away from growth to maintain its body temperature. The chart below describes the effects of wind speed on temperature.

Air speed (ft/min)	Temperature adjustment
0	0
30	-7
90	-13
300	-18

The temperature within the barn needs to be adequately adjusted to account for the additional heat produced by the growing pig. For every 60–80 lbs. of gain, the pig will produce an additional 200 btu/hour of heat. Therefore, CFMs need to be properly adjusted to account for the increased heat production. Using the chart below, a 1,000-head barn averaging 100 lbs. in August would require 75,000 CFM. Conversely, if that same 1,000-head barn in August housed pigs weighing 250 lbs., the required CFM would be 120,000.

Recommended ventilation rates, CFM per pig			
Pig weight, lbs.	**Minimum**	**Mild weather**	**Hot weather**
12–30 lbs.	1.5–2	10	25
30–75 lbs.	3	15	45
75–150 lbs.	7	24	75
150–280 lbs.	10	35	120

Humidity is also an important indicator of proper ventilation. Simply put, humidity is the amount of water vapor in the air. During the winter months, humidity is lower due to cooler air having a lower water-holding capacity. Increasing ventilation rates when the outside temperature drops below the set point is recommended to decrease the humidity within the barn. However, during warmer months, when the outside temperature exceeds the set point, increasing the ventilation rates will not decrease the humidity within the barn. This is due to warm air having a higher water-holding capacity than cooler air. A general guideline is to maintain relative humidity levels between 50-65%. This level of humidity will decrease condensation and wet floors within the barn.

Ventilation is also a key player in keeping gases such as ammonia, hydrogen sulfide and carbon dioxide below the permitted concentrations. At high enough levels, these gases can be detrimental to animal and worker health and productivity. Outlined below are guidelines for the gases typically monitored in swine barns. It is important to note that readings should be taken at the pig level to most accurately reflect what the pig is experiencing.

Ammonia: 10 ppm

Carbon dioxide: 3,000 ppm

Hydrogen sulfide: 5 ppm

Pigs are very adaptable, and as their environment changes, they acclimate by diverting energy away from growth to other biological functions. This makes identifying possible environmental stressors more difficult since the pig may seem to be eating and growing at a normal rate. However, careful evaluation of the pigs and their surrounding environment will help identify potential health and growth problems before they arise.

Dust

The accumulation of dust can create a less-than-ideal environment and could also be a concern for workers. The use of fat or oils (1%) in swine diets can reduce the level of dust in the barns. Cleaning barns in between groups can also reduce dust accumulation. Many farms are using electrostatic particle ionization units, which work by emitting large amounts of negatively charged ions (some 10 million billion negative ions per second) into the air. These ions impart a negative charge to dust particles floating in the air, driving them to positively-charged barn surfaces, where they stick — just like metal filings adhering to a magnet. Now, dust may be collecting on the surface, but at least it is not free-floating in the air, affecting pigs' respiratory systems. Excessive dust accumulation on fan blades, louvres and inlets can greatly decrease the ventilation for a room.

Disinfectants

There is no single disinfectant that will work on every farm. It is important to select a disinfectant that has a label claim against the pathogen that you are trying to kill. Disinfectants are more effective on clean surfaces. It is important to apply the disinfectant according to the label directions. Allow the contact time recommended on the label (usually 10 minutes) to elapse. Dipping objects in disinfectant is not as effective as scrubbing or wiping an object with a disinfectant. Commonly used disinfectants include a phenolic disinfectant (One-Stroke Environ); a quaternary ammonia compound (Roccal-D Plus); a chlorine compound, sodium hypochlorite (household bleach); an oxidizing agent (Virkon S); and a quaternary ammonium/glutaraldehyde combination product (Synergize).

Providing high-quality feed to pigs involves many aspects along the production chain. It starts with ingredients that are of high nutrient value and are free of contaminants. The processing, delivery and storage of the diet components can also affect the quality and final composition of the feeds. Understanding the factors that affect feed quality and implementing a quality-assurance program will help ensure that the best-possible nutrition is delivered to the pigs.

Mycotoxins

Environmental conditions that place stress on grains may also cause those grains to become susceptible to mold growth. However, it is important to remember that it is not the mold itself that causes performance problems; rather, it is the mycotoxins those molds produce that can lead to negative effects. The mycotoxins that are of primary concern in swine diets include aflatoxin, zearalenone, vomitoxin or deoxynivalenol (DON) and fumonisins.

Guidelines for nursery pigs, ppb

Mycotoxin	Lower level	Moderate level	High level	Effects
Aflatoxins	5	10	20	Liver damage, poor reproductive performance, reduced growth
Vomitoxin (DON)	1,000	2,000	3,000	Reduced feed intake, feed refusal, lower gains, diarrhea
Zearalenone	50	100	150	Vagina reddening, prolapse, abortion, infertility
Fumonisins	1,000	1,750	2,500	Reduced feed intake, lower weight gain, increased diarrhea
Ochratoxins	20	35	50	Kidney damage, liver damage, immune suppression

Guidelines for grow-finish pigs, ppb

Mycotoxin	Lower level	Moderate level	High level	Effects
Aflatoxins	25	50	100	Liver damage, poor reproductive performance, reduced growth
Vomitoxin (DON)	1,000	2,000	3,000	Reduced feed intake, feed refusal, lower gains, diarrhea
Zearalenone	75	150	200	Vagina reddening, prolapse, abortion, infertility
Fumonisins	2,500	3,750	5,000	Reduced feed intake, lower weight gain, increased diarrhea
Ochratoxins	20	35	50	Kidney damage, liver damage, immune suppression

Mycotoxins can have an additive effect. The levels of individual mycotoxins may not be high enough to cause concerns; however, the combination of multiple mycotoxins, even at low levels, can have a significant impact. Drying the grain and adding mold inhibitors to mycotoxin-contaminated grains will decrease any further mold growth but will have no effect on the mycotoxins already present.

Particle Size and Grind

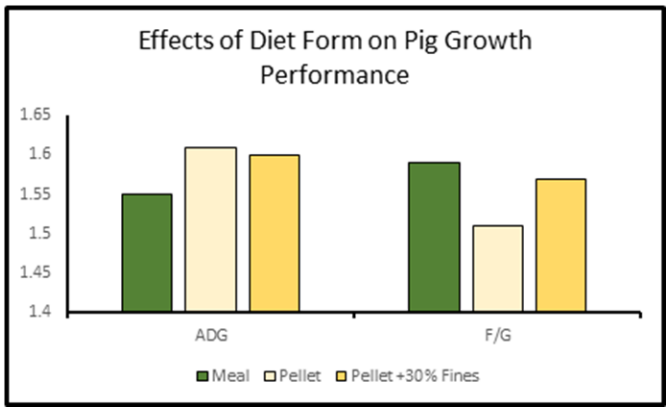
The major health concern associated with feed particle size is gastric ulcers, which are primarily associated with finely ground feed and/or a large percentage of the particles being less than 400 microns. Therefore, the ideal particle size and distribution for the grow-finish herd would be 500–750 microns, with less than 2.1 standard deviations and less than 20% at or just below 400 microns. Farms that struggle with low feed intake or gastric ulcers may consider increasing the particle size to more than 750 microns.

Grinding grains for swine diets improves feed utilization. By reducing the particle size, the surface area of the grain particle is increased, which allows for greater interaction with digestive enzymes. Swine feed efficiency is improved by 1% for each 100-micron reduction in particle size, from 1,000 microns down to 400 microns. As the micron size decreases, the cost of grinding increases and the mill throughput decreases. The ideal micron size may vary based on various economic conditions, feed efficiency, processing costs, the incidence of gastric ulcers and the potential for feed bridging. Understanding how these factors fit the goals of the operation will help determine the ideal micron size and where it falls within the desired range.

Pelleting

Pelleted diets are an effective way of improving feed efficiency in all phases of swine production. In addition to enhancing performance, pelleting decreases diet segregation and reduces dustiness and issues with feed bridging. Multiple studies conducted by Hubbard Feeds have consistently shown a 5% improvement in ADG and a 6% improvement in feed efficiency when healthy nursery pigs were fed pelleted vs. meal diets. To maintain the feed efficiency benefits of feeding pelleted diets, pellet fines must be minimized. Since having zero fines in swine diets is not realistic, Hubbard conducted a study looking at the performance of pigs fed pelleted diets compared to pigs fed pellets that contained fines to determine the level at which fines would be detrimental to performance.

The results of that trial are shown below and indicate that the performance benefits associated with pelleting diets were lost when pigs were fed pelleted diets with more than 30% fines. These findings indicate that some fines can be included in the pellets and not affect performance.



Good Manufacturing Practices (GMP)

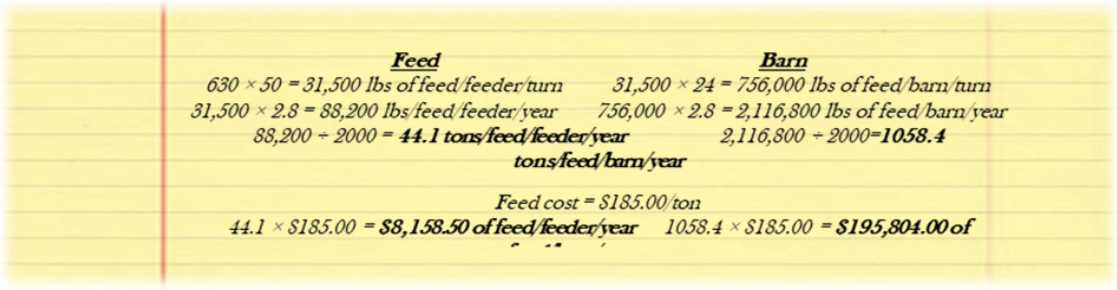
Quality ingredients and manufacturing processes are the key components of any nutrition program. The FDA has established guidelines and standards for Good Manufacturing Practices (GMP) for animal feeds that must be followed by all feed mills. These guidelines are designed to ensure the proper usage of feed additives and prevent feed contamination. Providing a residue-free supply of pork for human consumption is extremely important. The Food Safety Modernization Act (FSMA) provides more direction on manufacturing and producing safe feed for animals intended for human consumption. The American Feed Industry Association (AFIA) also offers several resources for feed manufacturers on their website, www.afia.org.

Sampling ingredients and finished feeds is an integral part of any quality assurance program. Keeping retainer samples of manufactured feeds is a good practice so that, if questions arise, the feed sample can be sent off for analysis. In order to get the most accurate feed analysis, it is important to take multiple samples of a single batch of feed to ensure that you are getting the most representative sample. Taking samples of feed as it is being discharged from the auger to the bulk bin is one of the most convenient ways to obtain samples. Another option would be to take probes from each feeder. Regardless of sample location, subsamples should be combined to create one large sample. A small, representative sample can then be taken and stored for later analysis or sent to a lab.

Feed Delivery

The delivery of finished feeds is an important part of GMP. Bins should be properly cleaned out prior to a new feed being delivered. Sequencing the unloading process to make sure non-medicated feeds are unloaded first can prevent drug residues. Flushing between medicated feeds can also help mitigate residue concerns. The proper identification of bulk bins can reduce the chance of unloading feed into the wrong bin, which could potentially create drug withdrawal concerns for pigs near market weight.

Feed accounts for roughly 65–75% of the cost of production, making it the most expensive input for any swine business. Properly formulated diets are only part of the equation when it comes to feeding pigs. The feeder is the final interface between the pig and its diet, and if we cannot effectively deliver the feed to the pig, we are hurting both their performance and our bottom line.



To fully grasp the importance of feeder management, it is critical to consider the amount of feed that passes through a single feeder. Consider a 1,200-head barn with 48 pens (25 pigs per pen) and 24 fence line feeders. Assuming pigs enter the barn at 55 lbs. and are marketed at 280 lbs. with a 2.8 feed efficiency, they will consume 630 lbs. of feed.

The number of pounds and dollars of feed that pass through each feeder and barn per year is remarkable. Feeder management is a relatively simple way to reduce feed wastage and increase feed efficiency.

The three main components of successful feeder management are:

- Adequate feeder trough space
- Proper feeder adjustment/feeder pan coverage
- Reducing/eliminating out-of-feed events

Trough Space

Providing adequate feeder trough space is a crucial step toward improving overall feeder management. The first step is to determine how many pigs your feeder can handle efficiently. This is dependent on a myriad of factors, including:

- **Feeder design**: Wet/dry feeders can service more pigs than dry feeders because they put feed and water in the same location, enabling pigs to eat more feed in less time.
- **Feed form:** If pelleted diets are provided, the feeder can service more pigs due to an increase in eating speed when pigs are presented with pelleted diets.

Feeder Type	Stocking Density
Dry feeder	8–10 pigs per space*
Wet/dry	12–15 pigs per space**
Tube feeders	11 pigs/drop/side*
*2” of trough space per pig minimum ** 1” of trough space per pig minimum	

Feeder Adjustment

Studies have shown that an improperly adjusted feeder can increase feed wastage by 1.7–5.4%. This could equate to $55–175 in wasted feed per feeder per group.

Due to the variety of feeder types available, there is no single setting recommendation for feeder adjustment. Rather, feeder pan coverage is utilized as a measure of proper feeder adjustment.

Growth performance is optimized when pan coverage is approximately 40–60%

It is also important to remember that feeder adjustment is not a one-time deal when pigs are placed. Feeders should continually be checked and adjusted to maintain the proper feeder pan coverage.

Changes in diet composition (fiber) and form (meal vs. pellet) will affect how the feed flows through the feeder. Therefore, feeders should be checked and readjusted if there is a significant change in the diet.

Adjusting feeders is one of those barn chores that often gets overlooked or preemptively marked off the to-do list. However, taking a little more time to evaluate feeder pan coverage can pay dividends through increased ADG and decreased feed wastage.

Out-of-Feed Events

An out-of-feed event can be defined as a period of time in which the pigs do not have access to feed because of:

- Late feed delivery
- Bridging bulk bins, feed lines or feeders
- Clogged feeders
- Equipment errors
- Blocked feed access
- Sick pigs

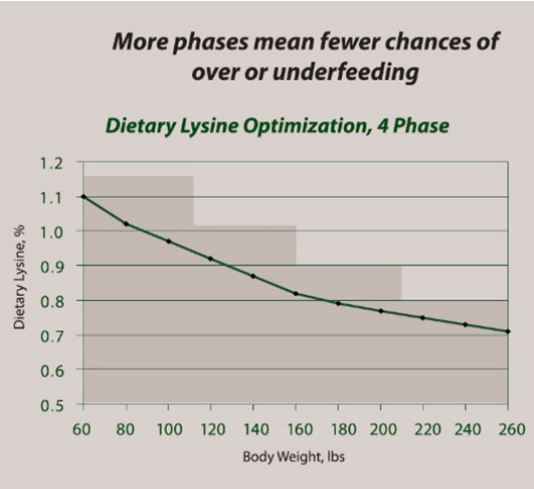
Regardless of the cause of the out-of-feed event, its impact on the pig is always the same. Following an out-of-feed event, aggression and fighting may be observed, along with an increase in the incidence of ulcers and HBS and a reduction in daily gains. A potential increase in mortalities, lighter pigs or more days on feed will occur, which will subsequently have an economic impact on the producer.

FEED BUDGET

Feed budget management is an important part of delivering proper nutrition throughout a pig's growth cycle. Following a well-designed feed budget serves two purposes: it reduces both the chance of underfeeding important diets and overfeeding higher-cost diets.

Phase Feeding and Nutrition

The purpose of phase feeding is to accurately deliver the right nutrients at the right time throughout a pig's growth cycle. As a pig's body weight and feed intake increase, its requirements for digestible amino acids, phosphorus and other key nutrients decrease. Phase feeding allows diets to be formulated based on a pig's specific weight range and nutritional needs while minimizing the under- and over-feeding of nutrients, as depicted in the graph below.



Benchmarking

The following chart offers guidelines on the expected performance for pigs in a broad range of health and management scenarios.

Weight range, lbs.	Gain, lb./d	Intake, lb./d	Feed:Gain
10–13	0.25–0.40	0.35–0.50	1.00–1.20
13–16	0.40–0.65	0.65–0.78	1.10–1.30
16–25	0.60–0.85	0.95–1.20	1.20–1.40
25–50	0.80–1.20	1.45–1.80	1.50–1.80
50–80	1.20–1.40	2.20–2.90	1.80–2.30
80–130	1.40–1.60	2.90–4.00	2.30–2.50
130–180	1.60–1.80	4.00–5.00	2.50–2.70
180–230	1.80–2.00	5.00–6.50	2.70–2.90
230–280	2.00–2.20	6.50–8.00	2.90–3.30

Hubbard Feeds Nursery Programs

The Hubbard nursery program provides several proven technologies from Alltech® that are designed to maintain gut health and integrity and support overall performance. The two-stage feeding program for pigs weighing between 13 to 25 pounds includes the POWERSTART 19/13 and POWERSTART 25/16 products.

POWERSTART Solo is a unique, single-phase diet formulated for pigs weighing a minimum of 13 pounds and is meant to be fed until pigs reach 25 pounds.

First Course and POWERSTART Launch are formulated for younger pigs that require a more highly digestible ration.

POWERSTART Multi-Stage Nursery Program

Diet	Initial weight	Final weight	ADG	F:G	Feed/pig (lbs.)	Days on feed
POWERSTART Launch	11	13	.3	1	2	7
POWERSTART 19/13	13	16	.4	1	3	7
POWERSTART 25/16	16	25	.75	1.33	12	12
POWERSTART Nursery Premix	25	50	1.35	1.75	42	18

POWERSTART Solo Single-Phase Nursery Program

Diet	Initial weight	Final weight	ADG	F:G	Feed/pig (lbs.)	Days on feed
POWERSTART Solo	13	25	.53	1.25	15	23
POWERSTART Nursery Premix	25	50	1.35	1.75	42	18

Finishing Phase: Feed Budget Development

A feed budget is a practical tool used to manage the amount of feed pigs receive during each phase of growth. Feed budgets eliminate the need for weighing pigs to determine when it is time to switch to the next diet. Instead, feed budgets use consumption data that estimates how much feed each pig consumes within a certain weight range. Every production system is different, so it is important to develop a feed budget based on your pig's genetics, target market weight and performance history. This will help ensure the accuracy of delivering the right feed at the right time during the pig's growth cycle.

Utilizing the pigs' performance history, dietary phases are ordered and delivered based on an estimated feed intake per pig. The table below shows an example of a feed budget. You can see that a 25-to-50-lb. pig is projected to consume an average of 45 lbs. of feed. Therefore, if you have a 1,000-head barn, you would order 22.5 tons of the N#3 diet. When the 22.5 tons of N#3 has been delivered, you would then switch to the next phase of your program — which, in this case, is GF#1. This group of pigs would require 46 tons of this stage of feed.

Example Finishing Budget

Diet #	Pig weight	ADG	Est. days	F:G	Lbs. per pig	Tons per 1,000 hd.
N#3	25–50	1.2	21	1.8	45	22.5
GF#1	50–80	1.4	29	2.3	92	46
GF#2	80–130	1.6	25	2.5	100	50
GF#3	130–180	1.8	28	2.7	135	67.5
GF#4	180–230	2.0	25	2.9	145	72.5
GF#5	230–280	2.2	23	3.3	165	82.5

Total feed usage per hd. (lbs.)	682
Total feed usage per 1,000 hd. (tons)	341
Total weight gained per hd. (lbs.)	255
Total days on feed	**151**

Using Feed Budgets to Determine a First Cut

Feed consumption is the best indicator of live body weight. After a careful analysis of the historical close-out data, protocols can be developed for determining when to take the first cut of pigs to market. For example, let's assume, based on the historical farm data, that when a group of 50-lb. feeder pigs consumes an average of 505 lbs. per pig, the average group weight will be 230 lbs. Given this average group weight of 230 lbs., the top 15% will have an average weight of 270 lbs. and can be marketed.

Feed Budget Compliance

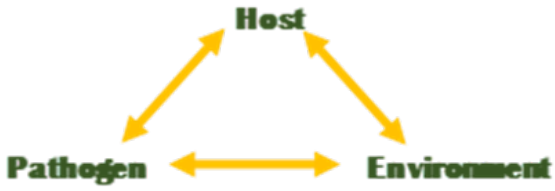
Conducting a feed budget compliance analysis is an important process that measures how closely a feed budget is being followed. If too many or too few pounds of one diet are fed, then the subsequent diet's budgeted amount needs to be adjusted to stay compliant with the budget. Factors such as rounding and split truckloads can also influence the accuracy of the feed budget. Adjustments to the budget should be made as necessary. Conducting a retrospective analysis of the feed deliveries is an important exercise that gives insight into what is being fed to a group of pigs, rather than what is assumed to be fed.

“A healthy gut will enable a pig to better cope with stress and fight off pathogens.”

The topic of gut health is commonly associated with nursery pigs. However, all pigs need a healthy and properly functioning gut to perform at their best. Gut health should not become an afterthought once the pigs exit the nursery; it should be a priority all the time. Fighting, out-of-feed events, marketing and temperature fluctuations are all examples of some of the stressors a pig will encounter during their time in the finishing barn. How a pig responds to various stressors can be attributed to their gastrointestinal tract's health status.

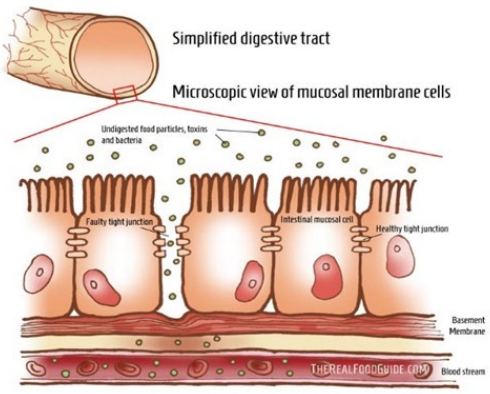
A single layer of cells, called enterocytes, lines the wall of the intestine. Those cells are responsible for aiding with digestion, nutrient uptake and water absorption and for preventing pathogens and toxins from crossing the epithelium and gaining access to the body and bloodstream. A robust and properly functioning gastrointestinal tract is imperative to optimizing pig growth and performance and feed efficiency.

Figure 1. The disease triangle



This point is illustrated through the disease triangle concept, which states that disease requires interactions between the pathogen, the host and the environment (ex. stress; Figure 1). Therefore, stressful situations, such as out-of-feed events, can have a negative impact on a pig’s GI tract, consequently decreasing its barrier functions and increasing the pig’s susceptibility to disease. “Barrier function” refers to the tight junctions between the intestinal epithelium. These tight junctions and the enterocytes can be thought of in the same way as tile and grout. Grout is applied between tiles to protect the tile from water and other substances that could get behind the tile and create damage. The same concept applies to the GI tract: If the tight junctions between the enterocytes remain closed, pathogens cannot pass through and enter the body. However, if these tight junctions open and become “leaky,” pathogens and toxins can pass through and enter the body, eliciting an immune and inflammatory response. Subsequently, diverting nutrients away from growth will decrease performance.

Figure 2. Example of tight junctions and leaky gut.



There are several ways that we can positively influence gut health on the farm, including those listed below:

- **Adding fiber to the diets** — such as wheat midds, DDGS or soy hulls — at inclusion rates as low as 1–5% may positively impact gut health. Fiber has a prebiotic effect, whereby it acts as a substrate for the bacteria, improving the gut's micro-environment and immune system.
- **Eliminating out-of-feed and water events** is one of the easiest ways to improve gut health. When pigs do not have access to water or experience an out-of-feed event, several stressors are being placed on them. Pigs become more aggressive towards their pen mates. They do not have enough nutrients to sustain efficient growth. Once pigs do get access to feed or water, they may overconsume it and predispose themselves to a twisted gut.
- **Use supplemental, natural, plant-based products**, such as polyphenols, the building blocks of cellular repair in plants. Polyphenols promote rapid tissue healing by blocking the attachment of toxins and pathogenic bacteria to cells, lowering inflammation and swelling and promoting the healing and repair of damaged mucosal cells.
- **Feed additives** such as copper chloride, yeast products and essential oils can aid in creating and maintaining a healthy gut environment. Additional information can be found in the Feed Additives section of this guide.
- **Avoid feeding pellets**, since pelleting raises the risk of stomach ulcers and usually decreases feed intake among pigs that are coping with health challenges. The feed conversion improvements gained by feeding pellets to health-challenged pigs in the grow-finish stage will be completely negated by the expected increase in death and sort losses.

Finally, no gut health discussion is complete without covering hemorrhagic bowel syndrome (HBS) and ileitis.

- **Hemorrhagic bowel syndrome (HBS)** is an elusive condition in the finisher that often strikes sporadically in seemingly healthy 4-to-6-month-old finishing pigs. Pigs are diagnosed with HBS postmortem when the pig dies suddenly without any indication of illness. The pig will present with pale skin, a distended abdomen, a thin-walled small intestine with both clotted and unclotted blood present, tarry fecal material in the large intestine, and no lesions or ulcerations of the gastrointestinal tract. Little is known about what causes the onset of HBS, but several nutritional and management strategies — such as the inclusion of fiber, reducing out-of-feed events and maintaining consistent access to feed — may prove helpful in the face of or for preventing an HBS outbreak. Other factors, such as appropriately stocking the barn, properly ventilating facilities and providing sufficient feeder access, can help diminish the occurrence of HBS.
- **Ileitis** is a gastrointestinal disease caused by the bacteria *Lawsonia intracellularis*. Some common symptoms of ileitis are diarrhea, reduced average daily gains and decreased feed efficiency. However, the symptoms that manifest are dependent on the type of ileitis: subclinical, clinical/chronic or acute.
    - **Subclinical**: There are no discernable symptoms with subclinical ileitis, aside from decreasing average daily gains and feed efficiency in the affected pigs. Additionally, environmental stressors, such as weather or commingling, could progress the disease from subclinical to clinical.
    - **Clinical/chronic**: This type of ileitis usually affects growing pigs and can result in pasty/watery diarrhea, along with reductions in weight gain and feed efficiency in affected pigs, resulting in an uneven weight distribution among a flow of pigs.
    - **Acute**: Acute ileitis appears in finishing pigs and is marked by bloody/black diarrhea, lethargy and weakness. Sudden death may also be a result of acute ileitis.

Pictured to the right are intestine samples from a pig infected with ileitis and a healthy pig. The intestine sample on the left is much thicker and indicative of ileitis, while the sample in the middle from a normal/healthy pig shows the finger through the lining.

Tail Biting

Vice behavior in swine production facilities is both a welfare concern and an economic problem for producers. Tail biting is one of the top vice behavioral problems in grow-finish pigs, leading to producer losses due to reductions in gains, secondary infections, death or carcass condemnations. Tail biting can sporadically affect either a single pig or the whole pen of pigs or can be a pervasive problem facing entire flows of pigs. Numerous factors — such as the environment, animal husbandry and nutrition — can play a role in triggering this negative behavior.

Anyone who has walked through a pig pen has observed individual pigs or even certain genetic lines exhibiting more aggressive behaviors than others. Studies have shown that pigs are naturally attracted to the taste and sight of blood. However, natural behavior is only a piece of the puzzle, and as previously stated, numerous other factors can increase the prevalence of tail biting, such as:

- Tail docking (too long and inconsistent)
- Barn management
- Nutrition (out-of-feed events, salt deficiency, etc.)
- Increased stocking density and overcrowding
- Extreme temperatures
- Poor ventilation (poor air quality, drafts, humidity)
- Light (too dim/too bright, less than 6 hours of darkness per day)
- Health challenges

Tail Docking

Properly docking tails is one of the best methods for reducing the incidence of tail biting. However, docked tails should be uniform in length, as it has been reported that herds with variable tail lengths have more incidences of tail biting.

Nutrition

Inadequate access to both quality feed and water can act as a trigger for tail biting. Some common feed quality issues associated with tail biting can include mycotoxins, low salt levels or improperly balanced diets.

Stocking Density

As the stocking density increases, so does competition at the feeder and waterer, which can result in increased ear and tail biting. In addition to higher stocking densities, mixing pigs or pens with greater size variations may also increase the risk of tail biting.

Environment

Several environmental factors within a barn can influence the incidence of tail biting, such as excessive heat or cold, improper ventilation, lighting, dust or noxious gases. In most current production systems, heat stress during the warm summer months is of greater concern than cold stress during the winter months. When pigs reach their upper critical temperature, they begin to experience heat stress, which can trigger negative behaviors, such as tail biting. It has been observed in some cases that misting pigs during hot weather has reduced tail biting. Greater daily temperature variations can result in increased tail biting compared to a consistent temperature outside of the pig's thermoneutral zone.

Drafts and increased humidity caused by improper ventilation can increase pig stress and tail-biting. Barn lighting — both when the barn is too bright or is dimly lit — or not enough hours of darkness may also impact the occurrence of tail biting. It is recommended that fluorescent lights emit 0.2 watts/ft^2, whereas incandescent lights should emit around 0.8 watts/ft^2, with at least 6 hours of darkness provided. Maintaining an optimal living environment through proper ventilation, lighting and temperature control will positively impact pig welfare and tail biting.

A Solutions Checklist

1. Properly Dock Tails

- Maintain a consistent mature length of 2–3 inches.

2. Nutrition

- Formulate to the proper digestible lysine levels in weight-appropriate phases.
- Budget for the correct pounds per pig with each diet.
- Manage mycotoxin ingestion by formulating diets with ingredients containing low levels of mycotoxins and by implementing toxin-mitigation products. Use 5–8 lbs. of magnesium oxide per ton.
- Add an additional 2–4 lbs. of salt.
- Add an additional 2–3 lbs. of potassium chloride.
- Ensure adequate access to good-quality water.

3. Stocking Density

- Do not exceed a pig density of less than 7.5 square ft. per pig.
- Evenly remove pigs from every pen during the initial marketing period.

4. Barn and Environmental Management

- Eliminate out-of-feed events.

- Adjust feeder settings so that the feeder will be more open during late finishing, when feeder competition is the highest.
- Consider increasing the minimum ventilation in the late finishing phase.
- Consider decreasing the set point in the late finishing phase.
- Provide environmental enrichment as needed.

5. Implement New Technology

- The AllBite vice mitigation block is a proven technology designed to combat tail biting. AllBite is a poured block containing biologically active ingredients that decrease aggression in pigs while providing a social stimulus. The AllBite block provides an enrichment tool that satisfies all four conditions for a good enrichment product: it is edible, chewable, destructive and manipulable. AllBite is a convenient and immediate solution for producers to combat vice behaviors.

FEED ADDITIVES

While the goal of a nutrition program is to provide the proper level of nutrients to meet a pig's needs for growth and performance, there are times when additional nutrients can be beneficial. The amount of feed additives and their intended purposes are many and far-ranging. The information below will focus on the general use and potential benefits of the most commonly used feed additives.

- **Copper chloride**

  Copper chloride has been shown to have a growth-promoting quality in nursery and growing pigs. Generally, levels between 125–250 ppm of copper act as an anti-microbial and help to decrease the growth of disease-causing bacteria in the gut. Higher levels of copper are effective in improving ADG and feed efficiency in growing pigs. The use of copper at high levels (above 250 ppm) can increase the risk of toxicity and can have negative effects on pig performance.

- **Essential oils**

  Essential oils are aromatic, oily liquids derived from materials such as flowers, leaves, fruits and roots. Essential oils can act as antimicrobials and antioxidants, enhancing the immune response and reducing diarrhea in pigs. Interest in essential oils continues to grow, especially with antibiotic-free nutrition programs. Individual essential oils have different specificities, which has led to inconsistent results. The value of a multiple-oil product is a more consistent response given the diversity of gut bacterial populations at different farm locations and at various times. Encapsulating essential oils protects them, improves palatability and make them heat stable.

Nursery

- **Zinc oxide**

  Research has shown improvements in nursery pig growth rates and a reduction in diarrhea when pigs are fed therapeutic levels of zinc oxide (up to 3,000 ppm).

Finishing

- **Magnesium oxide**

  Most cereal grains and plant protein products contain high levels of magnesium, so with proper care and a carefully formulated diet, a magnesium deficiency should not be a concern. However, some studies have shown that supplementary levels of magnesium can reduce stress and aggressive behavior in pigs. Magnesium oxide can be added to swine diets at a rate of 5–10 lbs. per ton to reduce stress and cannibalism.

- **Potassium chloride**

  Potassium chloride can be added to late finishing diets to help reduce shrink during marketing. The typical inclusion rate is 1–2 lbs. per complete ton of feed.

Feed Additives for Consideration

Hubbard Feeds offers several products that we recommend when additional nutritional support is needed. These products are collectively known as our OptiCare line of feeds. A few of the more popular products are highlighted below:

- **Assist** is a combination of copper chloride and a yeast culture product designed to be used in grow-finish pigs. Copper chloride has been shown to improve average daily gains. The yeast culture product helps pigs manage stress caused by specific disease challenges and is a tool to reduce the mortality associated with hemorrhagic bowel syndrome (HBS).
- **Opti-Remedy** is a blend of essential oils that reduces harmful bacteria in the gut. The combination of essential oils from oregano, thyme, cinnamon, capsicum and citrus fruit extract also promotes the growth of beneficial bacteria in the gastrointestinal tract. Opti-Remedy can be used in all stages of pig production.
- **Opti-Pak Efficiency** is a nutrition fortification pack formulated for the last 40–80 lbs. of gain in finishing pigs. Opti-Pak Efficiency improves average daily gains and feed conversion by increasing the digestibility of the diet.
- **AllBite** blocks are a great alternative to discourage vice behaviors, such as tail biting. AllBite blocks add a new stimulus to the environment, allowing pigs to exhibit foraging behaviors and to bite and chew on the block instead of their pen-mates. AllBite also contains nutritional ingredients that have a calming effect on pigs.

WATER QUALITY

The quality of the water and the amount consumed are extremely important in pork production — but unfortunately, these can also be two of the most overlooked aspects of an operation. Pigs that do not drink water will not consume feed. Signs of water-quality issues include those listed below:

- Off-color or unclear water or visually seeing sediment in the water are problematic. In addition, heavy discoloration of the equipment and walls around water sources can indicate a high manganese or iron content.
- Poor-quality water can have a foul odor. This can indicate high bacterial counts or elevated levels of sulfur and nitrates.
- Pigs scouring without any pathogens present indicates poor-quality water.

Methods to improve water quality

- Flushing the water lines upon the entry of new pigs to a site should be followed with every turn.
- Adding chlorine to the water decreases the bacterial counts in the water and has been shown to increase water intake.
- Using low-cost acidifiers like citric acid lowers the water pH and inhibits bacterial growth.
    - Acid-Pak 4-Way can be used during times of low intake or health challenges to help support gut microbial populations and maintain optimal conditions for digestion in the stomach and small intestines. Acid-Pak 4-Way is a unique combination of buffered acidifiers, lactic acid-producing bacteria, enzymes and electrolytes. Adding it to drinking water is an effective approach to acidification and promotes gut health, especially when intake is low or variable.
- Utilizing a rural water system may be a good option if it is available.

Water Intake Considerations

- Water is the first limiting nutrient, far above energy, amino acids, vitamins and minerals.
- The cost of water acquisition, along with the storage and disposal of wasted water, has led to the need for a better understanding of the water availability needs of pigs.
- Water consumption has a distinct pattern based on the feeding period when nose-operated drinkers are used.
    - Water consumption peaks two hours after the morning feeding period and one hour after the afternoon feeding period.
    - The greatest amount of water usage occurs in the late afternoon and early evening.
    - Having an adequate number of drinkers, along with sufficient water pressure, is key for proper water intake.
- The type of drinker affects water usage and wastage.
    - A 14% decrease in manure volume has been observed with a swinging drinker vs. a gate-mounted nipple drinker.
    - A 25% decrease in water usage has been observed with a steel bowl drinker vs. a swinging drinker.
- The general recommendation is to limit water pressure to 20 psi in drinking supply lines.
    - Keeping water pressure below 20 psi reduces wastage and makes delivery devices (e.g., paddles, nipples) easier to use.
- Daily water usage amounts are a good indicator of pig health.
    - When water usage drops for three continuous days or drops by more than 30% in one day, this may indicate that a potential health challenge is occurring.

Water Quality Guidelines

Outlined below is a table listing the most common components evaluated in a water-quality test and the acceptable guidelines for levels of those components.

Component	Caution Level
Calcium	150 ppm
Chloride	500 ppm
Hardness	20 grains/gal
Iron	0.3 ppm
Magnesium	80 ppm
Manganese	0.5 ppm
Nitrate	50 ppm
pH	<6.5, >9.0
Sodium	150 ppm
Sulfate	300 ppm
Total dissolved solids	**1,000 ppm**

Water Requirements

Included below are guidelines for the proper drinker height, flow rate and daily water consumption for wean to finish pigs.

Pig weight	<12 lbs.	12–30 lbs.	30–75 bs.	75–150 lbs.	150–Market
Nipple height (in.)	4 to 6	6 to 12	12 to 18	18 to 24	24 to 30
Pigs/nipple	10	10	10	12 to 15	12 to 15
Flow rate (cups/min.)	2/3	1	1½	2	3
Daily intake (qts.)	0.2 to 0.5	2 to 4	4 to 6 (1–1½ gal)	5 to 10 (1/1½–2½ gal)	6 to 18 (1½–4½ gal)

Marketing management can be defined as selecting the correct pig or group of pigs that best meet a packer's specifications for weight and body composition. Marketing pigs is both an art and a science and requires a combination of population statistics and the skillful selection of the correct pigs from a group. Improper marketing management leaves money on the table; as such, the goal should be to increase the number of pigs that meet the specifications of a particular packer.

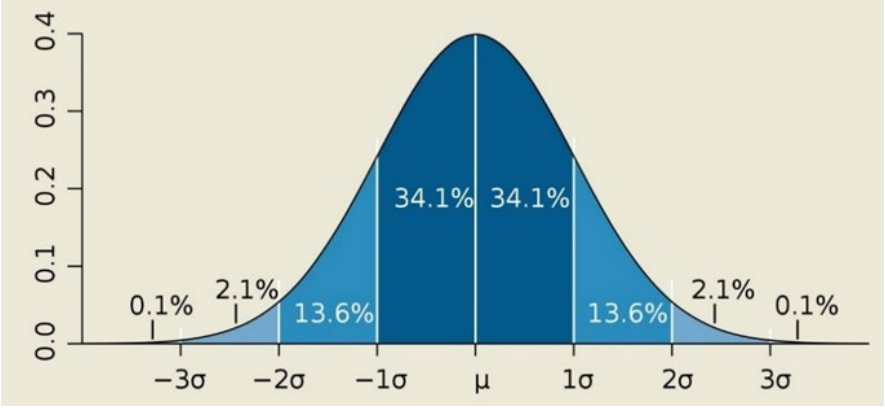
Population Statistics

The following section will give some insights into and explanations of the population statistics needed to estimate individual pig weights and marketing metrics. To fully understand population statistics, it is important to be familiar with the following terms:

***Mean**: The average of a group of numbers (i.e., pig weights).*
***Standard deviation**: A measure of how far data points are from the mean.*
***Normalized bell curve**: Depicts the distribution of numbers within a data set using the mean and standard deviation.*

For example, the mean (average, μ) weight of one group of pigs is 240 lbs. and the standard deviation is 22 lbs. This means that 68.2% of the pigs in the group weigh between 218 lbs. and 262 lbs. or within one standard deviation (σ) (± 22 lbs.) of the average weight of 240 lbs. Of the remaining pigs, half will weigh more than 262 lbs. (15.1%) and half (15.1%) will weigh less than 218 lbs.

The chart on the right shows a typical bell curve or population distribution. The dark blue area represents the pigs that fall within one standard deviation of the group. The lighter blue areas represent pigs that are more than one standard deviation from the average.



Optimizing Market Weight to Improve Profits

Selling more pigs in the highest-paid category will increase the net profit per pig. Since selection variation affects the number of pigs in each category, reducing the standard deviation will reduce the variation. The lower the standard deviation of the load and the closer the average weight of the load is to the optimal marketing weight, the greater the return will be on a per-pig basis. An excellent carcass weight standard deviation of a load is approximately 13 pounds. This means that 68.2% of the pigs in the load are within 13 lbs. of the average load weight. Conversely, a standard deviation of 19 lbs. is poor. Reducing the carcass standard deviation of a load from 19 to 13 pounds can increase revenue by up to $3.50 per pig.

As a history of the operation's marketing performance is compiled, techniques to reduce marketing variations can be implemented to decrease load variations. These techniques include:

- Consistently measuring the load standard deviation and making goals to improve it.
- Using feed consumption and the feed budget to guide when the first cut should be made. Feed consumption is the best predictor of weight.

Build enough time into a flow of pigs so that pigs are not forced out of the barn before they can reach their target market weight.

Marketing at a Lighter Target Weight

- At times, it makes sense to take the first cut of pigs out of the barn at a lighter weight if the barn is overstocked. Removing pigs from the barn sooner will increase the growth rate of the remaining pigs in the barn. An increase in the performance of the remaining pigs in the barn can offset the lost profits from selling the first cut at a lighter weight. In addition, selling the first cut at a lower target weight helps prevent producers from getting behind on marketing and being forced to sell later groups at weights that are too heavy for the best premium.

Understanding the Cost of Production

The first step to setting up a margin management plan is to understand all the costs that go into raising a pig. The two types of costs that need to be calculated are fixed and variable costs.

- *Fixed Costs*

Fixed costs are comprised of the ongoing costs that are incurred whether or not pigs are being produced. These costs include facility costs, equipment depreciation and interest on assets.

- *Variable Costs*

Variable costs consist of any costs that are incurred only when pigs are being produced. These costs include feed, transportation, labor, genetic fees and veterinary expenses.

Fixed Time vs. Fixed Weight

Understanding whether a system is marketing pigs on a fixed-time or a fixed-weight basis is a crucial aspect to consider when creating diets for a particular production system and its economic impact on the producer. "Fixed time" means that a system does not have flexible space in the production flow to keep pigs after a certain number of days. Fixed-weight programs have some flexible amount of space in their barn, allowing pigs to be kept in the barn until they achieve an ideal weight for the processing plant's specific carcass value payout structure. The difference between these two scenarios is important because it changes the relative value of the growth rate. The value of weight gain is higher in a fixed-time system, due to the limited growing days; however, in a fixed-weight system, pigs can stay in the barn at a fixed cost, so the economic value of weight gain through a given nutritional or management strategy is lower than in a fixed-time scenario.

Most producers believe that the initial marketing groups from a barn should be valued using a fixed-weight scenario while the remaining pigs should be offered as fixed time, with a growth pace being more crucial. To take advantage of the often-higher summer market prices, however, producers usually want all pigs to develop more quickly, effectively increasing the margin over feed. Fixed time vs. fixed weight illustrates the range of economic optimums and comparing them can be a useful tool for determining how economically sensitive dietary modifications are.

Determining a Desired Profit Per Pig

There are so many different marketing contracts, blends and cash-basis variations that it can become difficult to project profits or losses for a specific farm. A number of profit projection tools are available through universities and public organizations. Utilizing a model with specific farm inputs can help producers more accurately forecast their inputs and expenses with the goal of locking in some costs, managing risks and estimating profits.