Feeding Systems for Swine

Introduction

Feeding systems for swine involve feed type and form, as well as how it is supplied to the pigs. The main type of feed for swine in the United States is in dry form, where the cereal grain has been ground and mixed with other dry ingredients to form a complete feed. Delivering feed via a liquid feed application system is not common in the United States, but is far more popular in other areas of the world, particularly in Europe. Other producers utilize a blend of both types, where a liquid feedstuff, such as whey, is provided along with a complete dry feed. All of these systems have their merits and challenges, which will be discussed in this paper.

Complete feed is typically delivered via feed auger line to individual pens or sows from a storage bin. However, new technology, such as computerized feeding systems, have been developed to allow for continual changes in delivered diet composition to the pigs to better match their growth curves and changing nutrient requirements.

For the vast majority of producers utilizing dry complete feeds, there are a variety of feeder design options. Producers can utilize traditional dry feeders, wet-dry feeders, round feeders, or tube feeders in all phases of production. Each feeder type must be managed differently, and has its own advantages and disadvantages.

Objectives:

• Describe the forms of feed delivered to pigs for consumption
• Describe the types of self-fed feeders utilized in swine production
• Describe feeding practices for lactating and gestating sows

Forms of feed delivered to pigs

Traditional dry, grind and mix rations

While feeding systems for swine around the world are very diverse, within the United States, they have historically been unchanged from the traditional dry feeding, grind and mix applications for the majority of producers. The reason for this widespread application is the abundant supply of inexpensive cereal grains throughout the United States. There are four basic methods of supplying feed nutrients to pigs: 1) purchased complete feed; 2) grain combined with a concentrate or supplement; 3) grain blended with an amino acid source(s) and basemix; or 4) grain, an amino acid source(s), salt, calcium and phosphorus source(s) and vitamin and trace mineral premixes and are outlined in PIG Factsheet 07-04-03 (Methods of Supplying Nutrients to Swine).

Many small producers first grind cereal grains raised on the farm and mix it with a purchased supplement containing the protein source(s), vitamins and minerals to form a complete diet. This diet is then augured
Most of today’s swine industry utilizes a more flexible and sophisticated feeding system that utilizes many individual ingredients and vitamin and trace mineral premixes, mixed together to make a complete feed that is delivered to the pigs through a mechanical auger delivery system and self feeders at the barns. Many swine producers still make complete diets on farm today in this premix type manor, however, more centralized feed mills now produce complete feeds for producers and deliver them directly to the barns for feeding. The delivery of complete feeds for producers allows them to shift the feed processing responsibility to a professional feed mill to maintain quality control while freeing up labor for other needs on the farm. This delivery of complete diets by feed mills creates another unique issue of sizing feed storage at the barn sites to maximize feed delivery efficiency by the large feed mill delivery trucks.

Compared to liquid feeding systems, feeding a dry complete ration has the advantage of offering the pig a consistent complete feed with less management oversight and labor on farm for feed preparation and delivery. Since the majority of ingredients used in swine diets are in dry form when purchased, this eliminates the need for increasing the moisture level to mix and feed in a liquid application system. The risk of mold growth and spoilage should also be less in a dry feeding system.

Liquid feeding systems – complete diet

Feeding complete diets in a liquid form is not a common method of feeding pigs in the United States. However, in other areas of the world, liquid feeding is a frequently utilized system to deliver complete rations to all phases of swine. Generally the feed provided in liquid form is approximately 20 – 30% dry matter [1], and typically contains very inexpensive by-products. Care must be given to provide the correct environment for liquid ingredients and liquid feeds. Liquid feeding systems require unique management to prevent feed ingredients and/or complete liquid feed from spoiling. Additionally, liquid feeding systems may increase manure volume over traditional dry feeding systems. There are three main types of liquid feeding systems: 1) Mixing high moisture ingredients to create a complete diet; 2) Remixing a dry complete diet with water; and 3) Feeding a liquid ingredient in addition to a dry complete feed.

The first type of liquid feeding system involves producers receiving and mixing a variety of liquid ingredients from food, fermentation, or other industries into a single complete feed. Producers who utilize this feeding system are often in close proximity to these manufacturing facilities to minimize cost of transportation of water, which is the primary ingredient in many of the liquid ingredients. Once on-farm or at a centralized feed mill, these ingredients are stored separately and then mixed in the proper ratios with vitamin and mineral sources to achieve the desired level of nutrients to be delivered to the pigs. Once mixed, the slurry is then pumped via feed lines to troughs in the pens for consumption. These systems can allow for the use of wet ingredients (i.e. dairy products, brewers grain, corn distiller solubles, high moisture corn, bakery waste, etc.) that potentially can be purchased more economically on a dry matter basis so the manufacturer does not have the expense to dry the ingredient. However, consistency is very important when liquid products are utilized, so that the dry matter content is consistent for accurate mixing and diet nutrient content. Also, depending on the product used, salt levels should be monitored so they don’t get too high. On farm data have shown that there can be considerable variation in nutrient content of liquid ingredients, thus sampling protocols must be established [1]. In corn based diets, research has shown no benefits in growth performance of nursery and finishing pigs fed liquid versus traditional dry diets, unlike benefits seen in wheat or barley based liquid diets [2].

The second type of liquid application is mixing of a complete dry diet with water to create a slurry of similar consistency to a traditional liquid feeding system. Once mixed, the complete slurry diet can be immediately pumped for feeding, or the slurry can have a mixture of microbes added and then be stored for a period of time to allow for fermentation prior to feeding. The advantage of this type of liquid feeding system is the producer does not need storage for both dry and liquid ingredients on site. The disadvantage of remixing a complete dry feed with water is extra labor and expense of recreating the slurry from a dry complete feed. While this is a less common system, producers who do not have liquid ingredients available but want to utilize a slurry as the final feed form can implement this type of system.

Lastly, producers can utilize a mixture of dry complete feed delivered to pigs as well as a liquid ingredient(s) separately. In this case, liquid ingredients are delivered on farm and pumped directly to pigs as a water and nutrient source. This can be done via existing water lines or separate lines. However,
a complete diet is also fed that is formulated based on the expected dry matter intake of the liquid feedstuff fed daily and then is adjusted for nutrient content of the liquid feed ingredient. Also, salt content of the liquid ingredient should be evaluated and adjusted for in the complete ration that is fed. This scenario allows a producer to utilize a liquid ingredient, such as liquid whey or spent ice cream that may be purchased economically without having to remix the entire diet into a liquid form. This practice allows for lower equipment and initial input costs compared to the first two options. The first two options will require feeding troughs (often split PVC pipe) placed around the perimeter of the pen to allow all pigs to eat at one time when the liquid diet is delivered. The feeding trough for liquid systems for grow-finish pigs should be sized at 12 linear inches per pig.

**Dry Feeding Systems**

**Self fed feeders utilized in swine production**

**Conventional dry feeder**
The most common feeder design used in nursery, growing and finishing pigs is a conventional dry feeder (Figure 1). This feeder type has storage capacity of dry feed before it flows via gravity into the feeder opening for consumption. Most feeders have adjustment plates so that feed flow ability into the feeder pan can be regulated to allow ad libitum feed intake without excessive feed wastage. More recent designs have increased the pan depth and size to offer more access to feed and the agitation plate, and prevent feed from easily being pulled out of the pan by the pigs. The feeding space needs to be designed for the largest pig to use that feeder, whether that is nursery, grow-finish or wean-to-finish pigs. Nursery feeders should have feeding spaces that are 7-8 inches wide, a feed pan that is 5-6 inches deep with a 3-4 inch front lip to accommodate pigs up to 55 lbs. Grow-finish and wean-to-finish feeders should have feeder spaces that are 12-13 inches wide, 10-12 inches deep feed pan, with a 4-6 inch front lip to accommodate pigs up to 270 lb [3,4]. This dry feeder type does not have a water source attached or included in or on the feeder.

**Wet-dry feeder**
The concept of a wet-dry feeder is to provide both feed and water in the same pan (Figure 2). This type of feeder is characterized by having larger, deeper feed pans to capture water that is accessed most generally via a nipple waterer located on the side or at the bottom of the feed pan. Feed flow ability into the pan is adjusted similar to a conventional dry feeder with an adjustment plate that can be moved to a more open or more closed position. One advantage of wet-dry feeders is decreased water wastage. Research has shown that water usage dropped by 17% to 26% for pigs using a wet-dry feeder compared to a traditional dry feeder with fence attached nipple waterers [5, 6]. This significantly reduces the manure volume accumulated in waste storage systems and thus creates less manure to be pumped or transferred. A reduction in water entering the pit can lead to a thicker, more solid manure which maybe more difficult to completely remove from liquid manure systems. However, when comparing water usage in a wet-dry feeder to a conventional dry feeder with a cup waterer, no differences were seen [7].

Pigs fed with wet-dry feeders have shown improved growth performance compared to pigs fed with conventional dry feeders [7, 8]. Pigs fed using a wet-dry feeder had greater gain, feed intake and final body weight compared with pigs using the conventional dry feeder. However, feed efficiency was not different in one experiment but significantly better in a second experiment for pigs fed with wet-dry feeders [7]. Because the pigs grew faster, they were also fatter at slaughter [7]. However, other studies have not shown significant differences in growth performance, but in no case has performance been shown to be lower with wet-dry feeders compared to conventional dry feeders [3].
A disadvantage of wet-dry feeders is starting newly weaned pigs on feed. High levels of management are required with newly weaned pigs, especially in wean-to-finish barns which use a wet-dry feeder. Since the feed in most wet-dry feeders is on an elevated shelf, newly weaned pigs typically have difficulty reaching and agitating the shelf for feed to drop into the feeder. This, coupled with young pigs crawling into the larger feeder pans in this design, allows these young pigs to easily defecate and trigger the nipple drinker in the pan, causing pigs to become wet. Newly weaned pig diets contain highly fermentable ingredients such as whey. If dispensed into pans with water and not immediately consumed, rapid fermentation may occur, changing the nutrient composition of these nursery diets and may lead to mold/mycotoxin contaminated feeder troughs. Wet-dry feeder designs are starting to change to better meet the needs of wean-to-finish barn systems to accommodate a larger range in pig ages with adjustable shelf heights or agitation systems. An added expense with wet/dry feeders is a second water source will be needed during hot weather, as adequate water intake cannot be met with the only water source being in the feeder.

**Tube Feeder**

The use of tube feeders for nursery and grow-finish pigs grew in popularity due to having a lower initial cost compared to conventional dry and wet-dry feeders and relative ease of feeder cleaning. These feeders are connected to the feed line and feed drops by gravity until it reaches the bottom of the tube where it is agitated out into a feed pan and consumed by the pigs (Figure 3). With this design, the water source is included in the feed pan area, similar to a wet-dry feeder design. This design allows for both newly weaned nursery pigs as well as heavier finishing pigs to access the feeder readily.

While it is the least expensive feeder, this type of feeder has the smallest capacity of feed storage with each tube holding only about 20 lbs of feed. This lack of storage can cause tube feeders to more often become empty before the feed line refills the tube. Thus, the potential exists for out of feed events to occur more frequently with this feeder design which can decrease growth performance, increase ulcer formation, and increase the overall stress of pigs. Therefore, closer monitoring and attention to timely feed delivery is needed compared to using conventional feeders. Feed hoppers have been added to some tube feeders to improve feed capacity and reduce this potential problem of out of feed events with the tube feeders. Additional management is also required during the first two – three weeks post-weaning with tube feeders to sustain the proper feed flow with young pigs and their highly hydroscopic nursery diets.

**Round Designed Feeder**

Round designed feeders are similar in function to conventional dry feeders, other than their obvious design difference of being made in a round feeder design (Figure 4). These feeders can serve multiple functions and range in a variety of sizes from use in traditional nursery and finishing barns, to offering advantages in larger pen setting in either hoop barns or outdoor production where feeder space access can be increased due to the round feeding design. The round feeders are often used where increased
feeder storage capacity is needed and there is little or no bulk tank feed capacity to fill feeders frequently. Issues with round feeders can include difficulty maintaining the adjustment and agitation mechanisms around the whole feeder. Additionally, for some round feeder designs, learning to turn the agitation wheel can be an issue in wean-to-finish or nursery barns, where young pigs may have difficulty turning the agitation wheel.

**Breeding Herd**

**Lactation**

Feeders utilized for sows in lactation crates vary greatly in design. Regardless of design, sows need a large, deep bowl that can be easily accessed by sows and one that minimizes feed wastage. Most modern lactation feeding troughs have addressed these concerns. However, producers can choose from a variety of feeders from traditional dry hand- or full-fed, wet-dry hand or full fed, and more recently modified versions that utilize a tube type self feeder directly in the existing feed trough. Also, there are specific designs that allow sows to activate a ball or lever to drop feed, allowing for continuous access to feed.

Producers that have adopted full-fed feeding systems can utilize feed drops that are activated several times a day or a system that directly feeds from a feed line into the feeder. Also, some producers who do not have a feed line in the lactation room can utilize a feed hopper above each sow lactation feeder where it is hand filled, but the sows are still full fed due to the storage capacity of the hopper. The advantages of all full fed systems, when implemented correctly, are to allow sows to have access to feed continually, thus increasing the potential of sows eating more total feed over a lactation period. This is especially important in production systems where employees attempt to limit feed sows or employees simply feel they are full feeding, although they are not as indicated by the occurrence of empty lactation feeders between feedings. Also, this allows fresh feed to be consumed in the evening and night hours when employees are not present. It has been reported that an ad libitum wet/dry lactation feeder compared to feeding by hand twice per day can increase sow feed intake by over 1 lb per day and increase piglet weaning weights by about 1 lb per pig [9].

![Figure 4. Round Feeder design](image1)

![Figure 5. Full fed lactation feeding system in existing dry feeders with feed line.](image2)
Full fed systems are not without management problems, as attention to sow behavior can be more difficult as sows are less likely to be aroused in a uniform manner compared to hand feeding when they might be hungry for feed being hand fed. Thus, it can be more difficult to identify sows having low feed intakes due to sickness or other symptoms. Also, sows that are feed by full feeding may continually activate feed to fill the feeder which may cause excess feed to be wasted due to spoilage.

**Gestation**

Feeding systems in gestation vary widely, just as in lactation feeding systems. However, the majority of sows in gestation stalls are currently fed via individually set drop boxes that are activated once or twice a day (Figure 6). Feed drop boxes vary in size, design and adjustment, but all have feed amounts that can be set for each sow. However, due to changes in bulk density of diets, as well as bending and warping of feed lines over time, box feed amounts may not be accurate to the amount automatically dropped [10]. To adjust drop boxes to accurately drop the desired amount of feed, procedures are available for producers to achieve the desired goal [11]. In addition, some systems utilize hand feeding of each sow individually from a feed cart or spaced feed storage boxes for gestation sows.

The type of trough used for gestation stalls can either be raised (sits directly on the flooring) or recessed (sits down to be level with the flooring) and are designed to run continuous for an entire row of sows in stalls. These troughs can also be used as the water source where water is flooded into the trough after feeding events to supply water continually to sows. The water is then consumed prior to the next feeding event so that feed is not dropped into large amounts of water. Also, some systems use individual nipple waterers for each sow rather than the trough to supply water.

Gestation sows housed in groups settings can be fed directly by hand once or multiple times a day on a solid area where feed wastage can be minimized. Also, some feeding systems have been designed to “trickle” feed amounts over time on a solid portion of the pen, thus allowing sows to eat more frequently and allowing for less aggression and competition compared to once or twice a day feeding. The most sophisticated system involves a computerized feeding stall where an electronic tag on each sow signals the amount of feed to be dropped for her to consume on a daily basis. These systems allow for individual feeding in a group housing system, but are also the most expensive to use.

**Summary**

Feeding systems for swine in the United States are less diverse than many other countries. Complete dry feeds are predominately fed and different feeder designs are available for use in nursery, growing and finishing pigs. Producers must evaluate feeder designs for their operation and determine the correct feeder based on management input and economics, which involved both initial cost and growth performance effects. Also, producers must evaluate new technologies with computerized feeding systems as they determine their optimal feeding program.
References


Frequently asked questions

How much feeder space per pig is needed by feeder design?
The general rule of thumb is that 2 inches per pig space are needed for conventional dry and tube feeders, with 1 inch per pig space needed for wet-dry feeders. This recommendation is for nursery, growing and finishing pigs. However, these can vary depending on feeder design and quality of feeder space [12].

When double stocking wean-to-finish barns at weaning, should I change available feeder space?
The double stocking of newly weaned pigs into wean-to-finish barns is very common in the industry today. These facilities have grow-finish feeder spacing designed for the final number of pigs to be carried to market in a pen, so the feeder space is likely adequate for double the number of nursery age pigs. However, if greater than double stocking density is used or pigs are kept at this high stocking rate past 45-50 lbs, then additional temporary feeders may be needed to ensure adequate feeder space. Additional starter mats will also be needed at higher stocking rates in this situation with wean-to-finish facilities.

What should a properly adjusted feeder look like?
Feeders for nursery, growing and finishing pigs should be adjusted to allow approximately 25-50% of the feed pan covered with feed [13,14]. However, feed should not be allowed to accumulate in the corners and block the flow of feed.

How much impact can feeder design have on feed efficiency and wastage?
Feeder designs with deeper pans are more difficult for pigs to pull or spill feed out of, thus there is the potential for improved feed efficiency for this type of feeder compared to a narrow shallow pan feeder. Regardless of feeder design, properly adjusting feeders to prevent excess feed in the pan is the most important aspect compared to the different types of feeder designs. Research comparing feeder designs under controlled conditions is lacking which makes it difficult to provide specific recommendations and data for all feeder types.