Prairie Swine Centre
Science of Ethology
Volume 1 Issue 4

Electronic Sow Feeders

Harold W. Gonyou, Ph.D. and Fiona Rioja-Lang, Ph.D.

The electronic sow feeding system represents the ultimate in the use of technical control to manage sows. The use of electronics to control all aspects of the system is a major shift in the management of sows, somewhat akin to the use of robotic milkers for dairy cows. It requires a significant shift in our approach to managing animals and the daily routine of the barn.

How the System Works

An ESF system generally provides a single (or very few) feeding station(s) for a large group of sows (typically 40-60 sows/station). The sows must eat sequentially, one after the other, from the same station. Once a sow enters the station the entrance gate locks behind her and she is identified by means of a transponder in her ear tag. The computer controlled feeder allots her a specific amount of feed, dropped into the feed bowl over a limited period of time. During the feed drop, and for several minutes afterward, the entrance gate remains locked so that other sows may not enter. The sow may leave at any time, ending the dispensing of feed and unlocking the entrance for the next sow. The computer records the amount of feed that has been dispensed to each sow (not the amount actually eaten), and allocates any undispensed allotment to a subsequent entrance by the same sow that same day, or to her next day's feed. The system typically cycles on a daily basis, with a new allotment of feed being made available to each sow every 24 hours. As the stockperson will not be present while each sow eats, the system must provide feedback on any sows that fail to eat their allotment each day. This feedback is in the form of an 'attention' list available to the stockperson at the end of each 24-hr cycle, and is used to identify animals that may need additional care.

Controlling Feed Intake

ESF is the only group housing system that currently allows for true control over individual feed intake. When a sow initially enters the system (pen) the manager enters a personalized feed program for her into the system. This will set the amount of feed the sow will receive each day, and allows for increases as gestation progresses. The manager can base these levels on the sows' age, weight,

body condition score or back fat measurement. Other group housing systems try to achieve equal feed intake for every sow in the group, but in ESF systems sows can be programmed to receive more or less than the pen average. It is also possible, with many ESF systems, to program different diet compositions for sows within a pen, allowing the delivery of two different diets to each station, sows being programmed to receive one or the other of the two diets. The two diets can also be blended to achieve the appropriate protein and energy combination for individual sows.

Problems with feed intake may occur if sows do not eat on a regular basis. Most sows will have days when they do not eat their entire ration. ESF systems records how much feed has been dispensed to a sow before she leaves the feeder, and adds the undispensed portion to the following day's allowance. However, the sow may leave a portion of her ration in the feed bowl and this is not carried over to the next day. Some sows may not eat every day. Although such sows may eventually consume their allocation on subsequent days, some may not if they habitually miss feedings. This will be addressed under overstocking and training in later sections.

How Sows Behave

A common observation of people when first observing a group of sows in an ESF system is that the animals are quiet and restful. Because the sows eat sequentially, rarely is the entire group active at the same time. Typically only a few sows are standing, even when stockpeople enter the pen and move about the animals. The greatest activity occurs immediately after the station initiates a new day of feeding (Hodgkiss et al., 1998). Several sows will approach the entrance and compete to be among the first to feed. Towards the end of the feeding cycle only timid, subordinate animals will be left to eat (Strawford et al., 2008).

If the feeding station permits, sows will pass through the feeder approximately 3 times per day (Cornou et al., 2008), and if there is more than one station in the pen they will have a strong preference for one of the stations (Eddison, 1992). Under moderate stocking rates most sows will eat all of their food allowance on their first trip through the feeder (Eddison, 1992; Cornou et al., 2008). When in the feeding station, sows eat quickly, and will show impatience with the dispenser by banging it with their head if feed is not falling as quickly as they are eating. Once finished eating, sows will usually leave quickly rather than waiting for the entrance gate to open and to be pushed out by another sow. Upon exiting the station, a sow typically has an additional drink and may urinate or defecate before moving to the loafing area. Recycling through the station many times during the day is characteristic of a few sows, particularly if the feed bowl is designed such that a small amount of feed falls on the floor or remains in the bowl.

Competition is evident among sows. More dominant sows (typically older, larger and more senior in the group) will enter the station earlier in the feeding cycle. This may involve some aggression in station entrance area, and in late gestation this may result in injuries to swollen vulvas (Rizvi et al., 1998). Dominant sows will also claim the best lying areas of the pen; on solid floor, near a wall (Strawford et al., 2008). Subordinate animals are typically found near the exit of the station or in the dunging area (Moore et al., 1993).

Problems with ESF Systems

Other sow housing systems will continue to function well if staff are negligent in inputting data into the system. This is not the case with ESF systems. Management of sows, in terms of feed distribution, monitoring intake etc., is heavily reliant on the electronic identification system and computer programming. It is critical that animal information be updated in the computer whenever animals are added to or removed from a pen. Information on the animal, in terms of the appropriate feeding curve and due date, allows the system to provide the correct amount of feed and schedule the animal for sorting when necessary. Failure to keep up to date and accurately input information can be a major problem with ESF management. The output from the system, in the form of the daily attention list, is also a key component of electronic management. In addition, lost or failed electronic ear tags must be replaced promptly if the sow is to continue to be fed. Although not common, failure of the equipment must be addressed quickly and a backup feeding system must be in place (typically floor feeding).

Failure to train animals to the system will result in many missed meals and eventually require the removal of these sows (Bressers et al., 1993). Training is not particularly difficult with a well designed training pen and protocol. Gilts should be trained within a week by housing them in small groups and ensuring that each animal passes through the station each day. Once trained in a small group, the animals should be incorporated into a moderately sized group before eventually entering a large group. The longer the training period the fewer days of missed feed will occur. Because feed intake can be variable during training, it should be avoided as much as possible during the first month of gestation.

One of the greatest problems with ESF management is the tendency to overstock feeding stations. The more sows being fed from a station, the less time is left at the end of the feeding cycle for young, timid sows to enter and feed. Overstocking results in competition to access the feeder, evidenced by increased aggression at the station entrance and frequent missed feedings by subordinate sows. The key to achieving a high stocking rate on a station is to decrease the amount of time spent in the station by each sow. Early studies often used stocking rates of 40 sows per station, but many farms are now successfully feeding 60. However, this level could be problematic if managed incorrectly. Overstocking will result in uneven body condition and poor performance by the thin animals.

Keys to Managing Electronic Sow Feeders

- Ensure that all sow IDs, breeding dates and feeding levels are entered into the system whenever a sow joins a group.
- Train animals well so that they are confident in using the feeding system before entering a large group.
- Base your daily management on the attention list generated by the system at each daily reset.
- Create a good flow of animals with your pen design, that promotes movement from entrance, to exit, to loafing areas.
- Avoid overstocking the station. Every animal should be able to eat easily each day.

Reducing Time Spent in the Feeding Station

Overstocking of an ESF occurs when there is not enough time during a feeding cycle for all sows to pass through the station and consume their ration. This problem can be resolved by either reducing the number of sows/station or by reducing the amount of time spent in the station by each sow. One study reported that sows spent an average of 25-30 min/day in the station (Edwards et al., 1988). However, there are a number of ways to reduce this time to make the system more efficient.

Sows eat faster if water is provided in the feeding stations. Including approximately 50% water with the feed (e.g. 50 ml per 100 g) will increase rate of eating by as much as 35%. If water is added, there is little difference in the eating speed for mash vs. pelleted diets. Water should be added with each drop of feed. Most manufacturers make provision for this in their equipment, but managers must ensure that it is working well and maintained.

The feed drop rate can be set to keep up with the fastest eating sows. Sows differ considerably in the time required to consume their daily ration, even if all are fed a wet diet. Older sows may finish their feed in as little as 10 minutes, while gilts will often take longer than 20 minutes. By setting the station to dispense the diet over a 10 minute period, faster eating sows can finish and be out of the station within 12-15 minutes. Once they have exited, the entrance gate will unlock to allow another sow to enter. Slower eating sows and gilts will need to have the entrance gate locked for up to an additional 10 minutes for them to consume their feed and leave. One problem with this approach is that a slow eating animal that leaves after 15 minutes will leave a significant portion of her ration in the feed bowl, and this will be recorded as feed consumed. She will not have access to it the following day.

Total time spent in the station is reduced if sows are discouraged from multiple entries (recycling). It has been reported that sows will enter the station an average of 3 times per day, and some sows will recycle much more often. An important change in feeder design occurred in the mid-90's when the feed bowl was closed after a sow left and only reopened if the next sow had not already consumed her daily ration. The only feed available to a sow that recycled was whatever had fallen on the floor around the bowl. A second means of reducing recycling is to have an identification panel at the entrance to the station that only unlocks the entrance gate if the sow has not previously consumed her entire ration. Sows quickly learn that there is no point in attempting to re-enter the station. A final means of eliminating recycling is to use a 'one-pass' pen design (Stewart et al., 2008). As seen in Figure 1, a set of gates can be used to divide the pen into pre- and post-feeding zones. All sows are herded into the pre-feeding zone prior to the daily reset of the system. Once a number of the sows have passed through, the zones are re-configured to shift space from the pre- to the post-feeding zone. Prior to the subsequent reset of the system, unfed sows can be herded through the station. A single pass system may not be appropriate for all pens on a farm, but could be used for training and problem animals.

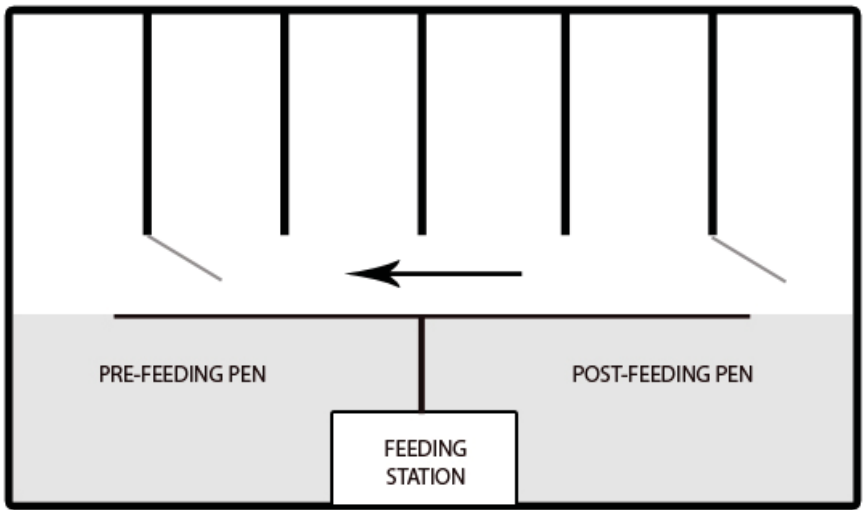

Figure 1. Diagram of a single pass system

Pen Layout

Because it does not involve a row of feeding stalls, or even a long feeding trough, an ESF system can be very flexible in terms of pen design. However, many report that the system is more efficient if the pen is seen as three distinct areas: entrance, exit and loafing. We will take that approach in describing pen design.

The entrance is the area in which sows await their opportunity to enter the station. The animals are hungry and this is the area of greatest aggression. There should be room for animals to flee from more aggressive sows, and corners should not be so tight that animals can be trapped in them. Some form of roughage (e.g. Straw rack) can be provided in this area to help alleviate hunger among the animals (Stewart et al., 2008).

Animals should pass through the exit area fairly quickly, but they may want to drink additional water as they have just finished eating. Although many pen layouts allow sows to move directly from the exit back to the entrance area, this only contributes to recycling. A better animal flow is created if sows must pass through the loafing area before returning to the entrance.

The loafing area is often a large open area for the sows to rest. If any area in the pen is to be solid floor or bedded, it should be the loafing area. Although an undivided area is common, it may be helpful to provide barriers that divide the loafing area into several bays. This is particularly important if a dynamic grouping system is in place, as sows that enter the pen at the same time will generally move into the bay or bays vacated by the group that recently left.

Although there are many variations of this three-zone system, Figure 1 illustrates the principle well. Sows enter the station from one zone, exit into another, and then move to the loafing areas before returning to the entrance. The figure also illustrates the use of gates that can be used to separate the group into pre- and post-feeding. This can be helpful in training or for caring for problem animals that have failed to cope with the

competition around the entrance. By closing gates between the pre and post feeding animals, competition is greatly reduced. However, this would only be used in a few pens within an operation.

If pen layouts are well designed, ESF systems can operate well at space allowances of 18-20 sqft per sow. However, aggression and skin injury scores can be reduced by providing more space (Remience et al., 2008)

Potential for Electronic Based Management

An ESF system identifies animals as they pass through critical points in the pen each day. This information can be used to help manage the animals. For example, in dynamic systems it is common to have to vaccinate or sort for farrowing a number of animals on a given day. Most systems have a sorting system incorporated in the station exit that uses the electronic ID to move these sows into a holding area. If a few sows should be marked for attention within the group, their ID can be flagged within the system and they will be sprayed with paint as they feed.

An early innovation using the electronic ID of sows was to detect animals in estrous. In estrous sows are attracted to boars, and so will spend a great deal of time near a boar pen located in the exit area. Sensors mounted to the boar pen can identify sows and record the time spent in close proximity, which can be used to identify those in estrous. The system could also be set to monitor the time at which sows enter the station, the amount of time spent eating, and the occurrence of low-feed intake days. Each sow will have a repeatable pattern for these measures, and a deviation may be indicative of a change in physiological state such as estrous, illness, or injury (Cornou et al., 2008).

Figure 2. Electronic sow feeder (*photograph Fiona Rioja-Lang*)

An interesting approach to reducing recycling of sows through the ESF and the associated aggression is to program the system to call individual sows to the station (Mantenffet et al., 2011). The computer is programmed to allow each sow to eat during a specific time, and initiates a voice call just prior to the station accepting them. Sows will learn that there is no point in trying to enter the station until they are called. Although not in commercial application, this approach illustrates the type of potential that exists with electronic based management.

References

Bressers, H.P.M., Te Brake, J.H.A., Engel, B., and Noordhuizen J.P.T.M., 1993. Feeding order of sows at an individual electronic feed station in a dynamic group-housing system. Appl. Anim. Behav. Sci. 36, 123-134.

Cornou, C., Vinther, J., and Kristensen, A.R., 2008. Automatic detection of oestrus and health disorders using data from electronic sow feeders. Livestock Sci. 118, 262-271.

Eddison J.C., 1992. Sows display individual preferences for electronic feeding stations. Brit. Vet. J. 148, 157.

Edwards, S.A., Armsby, A.W., and Large, J.W., 1988. Effects of feed station design on the behaviour of group-housed sows using an electronic individual feeding system. Livest. Prod. Sci. 19, 511-522.

Hodgkiss, N.J., Eddison J.C., Brooks, P.H., and Bugg, P., 1998. Assessment of the injuries sustained by pregnant sows housing in groups using electronic feeders. Vet. Rec. 143, 604-607.

Mantenffet, C., Schön, and Manteuffel, G., 2011. Beyond electronic feeding: The implementation of call feeding for pregnant sows. Comput. Electron. Agr. 79, 36-41.

Moore, A.S., Gonyou, H.W., and Ghent, A.W., 1993. Integration of newly introduced and resident sows following regrouping. Appl. Anim. Behav. Sci. 38, 257-267.

Remience, V., Wavreille, J., Canart, B., Meunier-Salaün, M.C., Prunier, A., Bartiaux-Thill, N., Nicks, B., and Vandenheede, M., 2008. Effects of space allowance on the welfare of dry sows kept in dynamic groups and fed and electronic sow feeder. Appl. Anim. Behav. Sci. 112, 284-296.

Rizvi, S., Nicol, C.J., and Green L.E., 1998. Risk factors for vulva biting in breeding sows in south-west England. Vet. Rec. 143, 654-658.

Stewart, C.L., O'Connell, N.E., and Boyle, L., 2008. Influence of access to straw provided in racks on the welfare of sows in large dynamic groups. Appl. Anim. Behav. Sci. 112, 235-247.

Strawford, M.L., Y.Z. Li, and H.W. Gonyou. 2008. The effect of management strategies and parity on the behavior and physiology of gestating sows housed in an electronic sow feeding system. Can. J. Anim. Sci. 88, 559-567.