

Dealing with Variation in Market Weight

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Variation in market weight is a major concern for swine production systems. Because of variation in growth rate and market weights, producers are forced to sort heavily to reduce the cost of weight discounts. The lighter weight end of the distribution curve is the most expensive portion of the variation because it dictates when barns can be emptied and refilled and is the weight range most discounted by the packer.

The concern with variation in growth rate has increased in recent years. The concern has been much greater in Canada than in the U.S., mostly because of the relatively narrow weight window used by Canadian Processors and lack of packers with different desired end weights in Canada. Methods of dealing with variation in market weight can be divided into three areas:

- Artificial reduction in variation
- Methods to reduce variation
- Managing variation without reducing it

All three of these areas deserve attention and must be considered to outline an effective strategy to deal with variation within a production unit.

■ Artificial Reduction in Variation

Over time, producers have instituted various strategies to attempt to reduce variation in pigs within a group. The attempts have focused on reducing visual variation within the point of reference (i.e., litter or pen of pigs) without full knowledge of how these efforts impact variation of the overall group (i.e., weaning group or barn). The two most common strategies that fit this description are sorting by size in the nursery or finisher and aggressive cross-fostering in the farrowing house.

Sorting into the Nursery or Finisher

Sorting pigs to create a pen of pigs with similar weights will reduce the variation within the pen at placement; however, several experiments have demonstrated that sorting reduces ADG without a reduction in variation (Gonyou and Patience 1998; O'Quinn et al., 2001).

Continual Cross-Fostering in the Farrowing House

Continual movement of pigs in the farrowing house is another practice used within the farm to reduce variation within the subgroup (litter). At least two experiments have demonstrated that the aggressive cross-fostering will reduce the variation within the litter. However, growth rate of the entire farrowing group is reduced (Milligan et al., 2001). Therefore, the reduction in variation appears to be because of reducing growth rate of the fastest growing pigs, rather than increasing growth rate of the smallest pigs in the litter. Thus, there is not a net benefit of improving facility utilization because the growth rate of the smallest pigs has not been improved.

■ Methods to Reduce Variation

If market weight CV is already below 10 to 12% in your system, you will be frustrated in your attempts to further reduce CV. Real reductions in variation can be achieved, especially if current CV is above 12%; however, in most situations they require major changes to the production system. Systems must be designed from the outset to be low variation systems in order to achieve the greatest and longest lasting improvement in this area. In this section, I will briefly discuss system design factors that influence variation in weight gain within a group before discussing other methods to lower variation. Many of these methods could be included in the third section of the paper (managing variation rather than reducing it) because the method of reducing variation within a group is by separating pigs with different growth rates. Thus, the overall variation is split into sub-groups rather than truly being reduced. However, I include them in this section because the net effect is reduced variation within the barn and, thus, improved facility utilization, which is the ultimate goal of reducing variation.

Split-Sex Housing

Simply put, raising the gilts separate from the barrows will greatly reduce the variation in weight gain in the group, simply because the barrows grow faster than the gilts. Although simple in concept, the production system must be large enough to fill a barn or site with one sex within a reasonable amount of time. Filling a site or barn over multiple weeks or from multiple sources enters other

large sources of variation (variation in weaning age and health status) that may overwhelm any advantage of single sex housing.

Segregated Parity Flow

Having the offspring of gilts reared separately from the offspring of sows will reduce variation. The offspring from the gilts will grow faster when reared separately than when reared with offspring from multiple parity sows. The advantages are thought to be due to improvement in health status of pigs within both groups (Moore, 2003).

High-Health Systems

Although “high-health systems” is a nebulous term, it is meant to encompass the many factors that improve the health status of pigs within a group. Schinckel et al. (2002) has demonstrated that pigs reared in an all-in, all-out manner have less variation in growth rate and market weight than pigs reared in a continuous flow manner. The CV for the all-in, all-out pigs was 7.5% compared to 8.8% for the continuous flow pigs. Other system design factors that can lead to sustained improvements in health status, such as reduction in sources of pigs, location of the source herd, and location of the growing barns themselves, would be expected to also reduce variation in weight gain.

Use of Opportunity Barns

Opportunity barns are used within some production systems to separate the smallest pigs (5 to 25% of pigs depending on the system) from the remaining pigs and rear them separately. In some systems, the pigs are reared on entirely different nursery sites and flow through different finishing sites. In other systems, pigs are simply separated into a different barn or room within the barn in the nursery stage and then moved to a separate finishing site. Management of the smallest pigs in these opportunity barns also varies across systems. Some systems provide supplemental milk replacer or special diets in an attempt to “normalize” growth rate. Other systems simply separate the pigs and treat them similarly to the other pigs, accepting that they will be slower growing and simply need additional days to reach market weight. The net result is variation in the original weaning group is not reduced, but variation within the production unit (barn or site) is reduced by removing the smallest pigs from the group.

Recent data from Schinckel et al. (2004) demonstrates that the smallest 20% of the pigs at birth grow significantly slower after weaning and are responsible for a majority of the variation in pig weight at various ages after weaning (**Figure 1**). Thus, use of opportunity barns can effectively remove these slower growing pigs from the system. Again, the system must be large enough and

designed with opportunity barns in mind to be able to take advantage of this method of reducing variation.

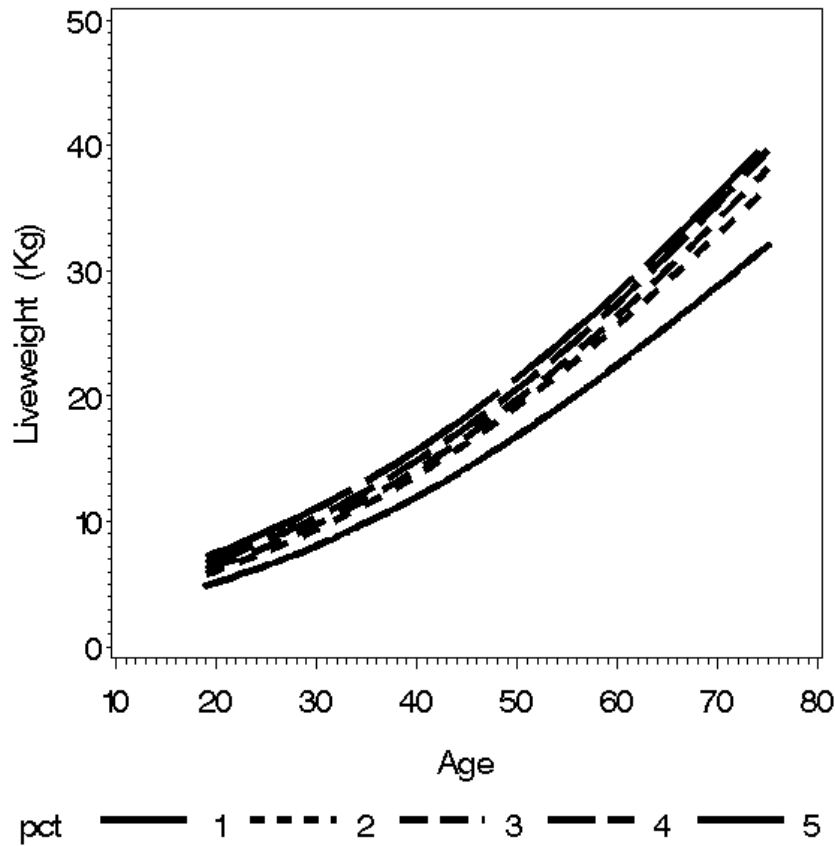


Figure 1. Relationship between body weight and age for five percentile groups of pigs based on birth weight (Schinckel et al., 2004). Note that the lowest birth weight pigs continue to deviate from the weight of the other pigs with increasing time after weaning.

Increase Weaning Age and Reducing Variation in Weaning Age

Main et al. (2004) demonstrated the impact of weaning age on pig weight and the variation in pig weight at the end of the nursery and finishing stages (**Table 1**). This data indicates that variation in weaning age is one of the biggest drivers of variation in final market weight in swine farms. From this dataset, the percentage of pigs in each weight category at the end of the experiment (d 156 after weaning) can be calculated (**Figure 2**).

Table 1. Influence of Weaning Age on Weight and Variation in Pig Weight^a

Item	Weaning age, days			
	12	15	18	21
Weight, 42 d postweaning, kg	16.9	20.3	22.6	25.8
CV of wt at 42 d postweaning, %	20.0	15.6	14.4	12.9
Weight, 156 d postweaning, kg	103.9	109.1	112.0	117.3
CV of wt at 156 d postweaning, %	12.4	10.4	10.4	9.0

^aMain et al., 2004

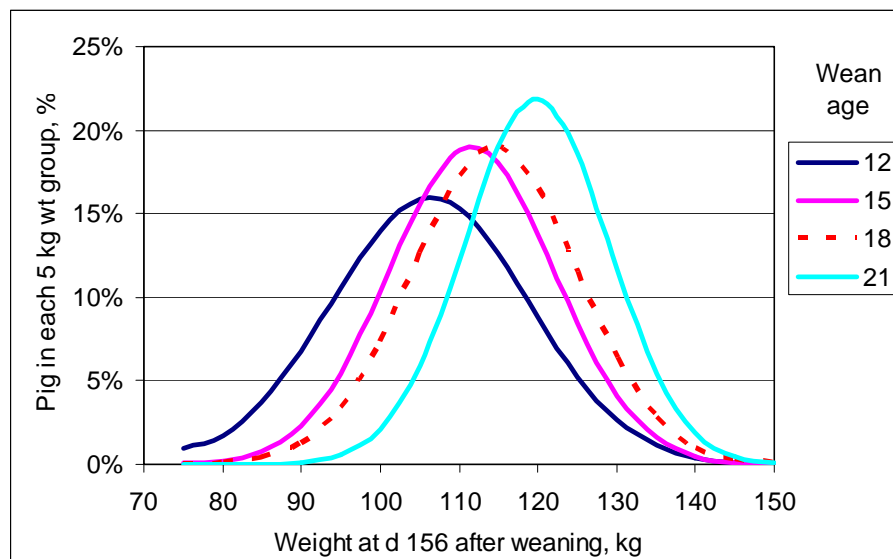


Figure 2. Distribution in pig weight at 156 d after weaning (adapted from Main et al., 2004).

Variation in weaning age impacts variation in market weight in two ways. First, variation increases as average weaning age is reduced. Second, younger pigs grow slower than older pigs. Thus, if pigs are weaned over a 7 day period, final market weight will encompass the variation caused by having younger pigs in the group and the variation in weight gain around each age group.

The question becomes what is the most effective way to reduce variation in weaning age and to increase weaning age. Reducing the variation in weaning

age requires weaning multiple times per week. The number of weaning events per week is often limited by the system design, transport, or health protocols; however, it is often possible to increase weaning age by 1 to 3 days without any facility changes. Many of our production systems have increased farrowing capacity in the last year in order to increase average weaning age. The payback for adding marginal farrowing crates can be quite large. For example, adding the equivalent of one half of one week's worth of farrowing capacity will allow you to increase the weaning age of all pigs on the farm by 3 days. Thus, the payback from the investment comes from all pigs weaned rather than just the pigs weaned from the added crates. Certainly, another way to increase weaning age is to increase the number of days farrowing crates contain lactating sows by reducing the days that gestating sows spend in the farrowing room before farrowing and reducing the time it takes to clean the room after weaning. Bump weaning (weaning the largest pigs in the litter at a younger age) can reduce weight variation at weaning, but has not been proven to effectively reduce variation at market. The weaning age of Main et al., (2003) indicates that early weaning of the biggest pigs may actually contribute to increased weight variation at market.

Increase Weight Gain of the Smallest Pigs in the Group

There are several procedures that can be used to increase the weight gain of the smaller pigs in the group in an attempt to reduce variation. These include: split suckling, use of complex nursery diets, use of supplemental milk, or shifting the smallest pigs to higher producing sows. These technologies all have been proven to slightly increase the weight gain of the small pigs and thus, they can reduce variation at market weight. However, the impacts are all relatively small and thus, the economic payback must be monitored closely.

Donovan and Dritz (2000) demonstrated that split-nursing (allowing the smallest 50% of pigs access to the sow for 2 h within 24 h after farrowing) reduced variation in ADG and, thus, numerically reduced the variation in weaning weight. However, the impact is relatively small (about 2% lower CV). Wolter et al. (2002) found that offering milk replacer in the farrowing house can effectively increase weaning weight by approximately 0.9 kg/pig during hot weather. However, the difference did not increase during the nursery or finishing stage. Thus, the 0.9 kg advantage at weaning remains at market, but it must pay for the entire cost of the milk replacer. Similarly, trials with complex nursery diets have demonstrated increased weight gain in the nursery. However, the advantage often does not become larger during the finishing stage. In any event, these changes in pig weight are relatively small compared to the differences caused by weaning age, sex, or health status.

Selecting Sires With Similar Indexes

Reducing variation by selecting sires with similar indexes or by using fewer sires also has been cited as a method to reduce variation in weight at market. Although this is outside my area of expertise, Dr. Allan Schinckel indicated that sires only account for about 1/4 of genetic variance. Selecting sires with similar ADG EBV's with accuracy of 0.5 will cause the CV to be reduced to 96.875% of original. Thus, if market weight CV was 12% originally, it could be reduced to 11.625%. Thus, 95% of pigs with a mean weight of 260 lb would be in a market weight range of 199.6 to 320.5 instead of the original range of 197.6 to 322.4. Again, selecting boars with similar indexes is a means of reducing variation; however, the change will be relatively small. Creating all half sibs by using only using one sire would only reduce market weight CV to 96.25% of the original CV. Using full sibs (via embryo transfer or using cloned females and only one male) would reduce the CV to 92.5% of the original CV. Because of the high impact of environment on variation, even using clones will only reduce the CV to 83.5% of the original CV.

Feeding Multiple Diets within a Group

How much can the variation in final weight be reduced by feeding multiple diets within a group of pigs? The only nutrient that can effectively and economically be used to alter the weight gain of pigs within a group is energy. If a high energy diet is fed to the smaller or slower growing pigs in a group, they will grow faster (as long as they have the genetic capability) and thus, their weight at market can be increased and the variation in group market weight can be reduced. Adding high levels (5 to 6%) of dietary fat to a corn-soybean meal based diet can increase total weight gain by 3 to 5 kg over the grow finish period. Thus, if the high energy diets were fed to the smallest 50% of the pigs in the group, you could effectively increase their weight at the end of the feeding period by 2.5 to 5 kg relative to the level of their gains without high dietary energy density.

Feeding two diets to offer higher amino acid levels to the lighter pigs in the group is often cited as a possible means of increasing weight gain of the smaller pigs. In reality, the lightest pigs in the group may not actually have a higher amino acid requirement than the heavy pigs in the group. Weight doesn't accurately depict the pig's amino acid requirements within a population. Rate of protein accretion and feed intake are the major determinants of amino acid requirements. Therefore, the heavier, faster growing pigs may actually have a higher amino acid requirement because they have higher protein deposition even though they consume more feed.

Providing diets with varying energy density to pigs within a group needs more research to understand whether the benefit would pay for the potential cost of

having multiple feeding kitchens (sorting pigs by weight to pens with different feed sources).

Although providing multiple diets may not impact variation greatly, providing adequate water access has been shown to reduce variation as compared to insufficient water access (Dewey et al., 2001).

Feed Grade-Antibiotics

The use of feed-grade antibiotics has been cited as a means of reducing variation in final market weight (Tillman and Green, 1996). Published evidence is lacking that this phenomena actually occurs because the impact is relatively small, and a large number of pigs or groups of pigs are required to experimentally prove or disprove the concept. However, there is evidence that in multi-site production systems that feeding antibiotics do not consistently result in an improvement in growth rate of finishing pigs (Dritz et al., 2002).

Prompt Treatment of Clinical Bacterial Disease

As discussed above, health status has a profound impact on weight variation at market. Promptly treating clinical disease to enhance recovery and reduce spread of the bacteria within the group will reduce the number of light weight pigs at market and, thus, reduce variation.

■ Manage the Variation Without Reducing

Because variation is difficult to greatly impact in an existing system, much of the focus must be placed on effective methods to manage the variation rather than reducing it.

Increase Growth Rate of the Entire Group

Increasing the growth rate of the entire group will not reduce variation or the need to sort pigs at market, but it will increase the weight of the slow growing pigs, which is the main marketing issue. Producers should focus on areas where they can increase the growth rate of the entire group, such as:

- Use of genetics capable of high growth rate in commercial conditions
- Maintenance of high health status
- Feeding of Ractopamine if approved
- Use of sows with high milk production
- High feed intake in the farrowing house to increase weaning weight

- Increase energy density of diet to increase growth rate
- Feed correct amino acid levels (slightly higher levels than optimal for cost/lb may decrease downside risk, especially in the late finisher)
- Proper feeding in gestation to enhance litter weight or number of muscle fibers (potential with high feed intake, carnitine, etc. This is a futuristic area, but has great potential).

Increase the Weight Discount Window

Narrow packer weight windows are one of biggest limitations to profitability for producers marketing pigs in the Canadian packing system and with some U.S. packers. Some U.S. packers have very wide weight windows, which encourage heavy market pigs and improved facility utilization. Some producers in the U.S. also have the opportunity to market to multiple packers to sell light pigs to a packer that desires light weights, and heavy pigs to a packer that rewards for heavy weights. With the consolidation of packing plant ownership in the U.S. industry, these opportunities are declining.

What are the options for increasing your sort window? Similar to some of our producers, you are left with only a few options, such as owning your own processing plant, negotiating a wider sort window in a packer contract, or selling to multiple packers (i.e. sending heavy weight pigs to a U.S. packer with those specifications. The cost of a narrow sort window is too great for the industry to ignore.

Auto-Sort Barns

The use of automatic sorting systems allows you to effectively sell the fastest growing pigs in the group and reduce weight discounts for overweight pigs. Manual sorting, along with being labour intensive has proven to not always be an effective means of removing the heaviest pigs from the barn. In short, we often find that people remove a normally distributed group of pigs from the barn instead of only removing the heaviest pigs. Auto-sort barns can eliminate this problem. However, the success of auto-sort barns must be proven over time.

In conclusion, the most effective methods to deal with variation in weight gain are to have a wide sort window and to increase weight gain of all the pigs in the barn (health, energy, lysine, increased weaning age).

■ References

- Dewey, C., A de Grau, and B. Friendship. (2001) Grow/finish variation: cost and control strategies. In: Proceedings of the 1st London Swine Conference. London, Ontario. Pp 115-122.
- Donovan, T.S. and S.S. Dritz. (2000) Effect of split nursing on variation in pig growth from birth to weaning. *J. Amer. Vet. Med. Assoc.* 217:79-81.
- Dritz, S.S., M.D. Tokach, R.D. Goodband, and J.L. Nelssen. (2002) An Evaluation of In-Feed Antimicrobial Regimens in Multi-Site Pig Production Systems. *J. Am. Vet. Med. Assoc.* 220:1690-1695.
- Gonyou, H.W.; and C.F. Peterson. 1998. Pre-sorting pigs by weight for all in/all out or continuous flow facilities. In: 1998 Annual Research Report - Prairie Swine Centre. Pp 37-39.
- Milligan, B.N., D. Fraser, D.L. Kramer. (2001) The effect of littermate weight on survival, weight gain, and suckling behavior of low birth weight piglets in cross fostered litters. *J. Swine Health Prod.* 9:161-166.
- Main, R.G, S.S. Dritz, M.D. Tokach, R.D. Goodband and J.L. Nelssen. (2004) Increasing weaning age improves pig performance in a multi-site production system. *J. Anim. Sci.* In press.
- Moore, C. (2003) Parity segregation: the big picture. In: Live Gilt Free: How parity-specific management can work for you. Pre-conference proceedings from 2003 Amer. Assoc. Swine Vet. Annual Meeting. Pp 1-6.
- O'Quinn, P.R., S.S. Dritz, R.D. Goodband, M.D. Tokach, J.C. Swanson, J.L. Nelssen, and R.E. Musser. (2001) Sorting growing-finishing pigs by weight fails to improve growth performance of weight variation. *J. Swine Health Prod.* 9:11-16.
- Schinckel, A.P., and B.A. Craig. (2002) Evaluation of alternative nonlinear mixed effects models of swine growth. *Prof. Anim. Sci.* 18:219-226.
- Schinckel, A.P., J. Ferrel, M.E. Einstein, S.A. Pearce, and R.D. Boyd. (2004) Analysis of pig growth from birth to sixty days of age. *Prof. Anim. Sci.* In press.
- Tillman, P.B, and J. Green. (1996) The effect of BMD on end-weight variation in grower-finisher swine. In: Proceedings of 1996 Pork Summit, Tempe, AZ. Pp 19-25.
- Wolter, B.F., M. Ellis, B.P. Corrigan, and J.M. DeDecker. (2002) The effect of birth weight and feeding of supplemental milk replacer to piglets during lactation on preweaning and postweaning growth performance and carcass characteristics. *J. Anim. Sci.* 80:301-308.