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LONDON SWINE CONFERENCE

Edited by
J.H. Smith and L. Eastwood

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Where Research Meets Production

Tuesday March 26 & Wednesday March 27

Chair's Message



John D. Rockefeller once said, “I do not think there is any other quality so essential to success of any kind as the quality of perseverance.” From market uncertainty to changing farm practices, people in the swine industry know all about perseverance, and the hard work and learning that goes into long-term success.

One of the main things I have learned over the years is that we can't do this on our own. We're fortunate in this industry to be supported by a wide range of experts dedicated to helping us reach the next level. We have pulled a number of them together for this year's London Swine Conference, and I hope you're as excited as I am about this year's lineup.

Over two days at the 2019 conference, we'll focus on daily farm operations as well as planning for the future of your business. We'll open with Jeff Ansell, who will discuss public relations, and what to do *When the Headline is You*.

In our other main sessions, we will hear about sow and piglet health (*Sow longevity and Neonatal Management*); human resources issues on farm (*What Do Your Staff Think of You?*); and our end product (*Breaking the Carcass Down*). Take in our main sessions as well as a wide range of workshops — both are a chance to learn from informative speakers as well as from each other. Through our workshops, we're asking about the challenges producers and industry professionals face every day. Topics include Building the Best Team and Biosecurity Beyond the Barn.

Take advantage of the peer-to-peer learning in these sessions and during conference networking — I find that our peers can be some of the most valuable learning resources. For more peer-to-peer learning, be sure to visit the new hospitality suite at the end of an information-packed day.

On a personal note, I'd like to thank the London Swine Conference team. It is a pleasure working with all of you. The quality of this conference speaks volumes to your expertise and dedication. Thanks, too, to all of those attending the conference, and for the work you do to help grow high-quality, great-tasting and safe food for our world.

Teresa Van Raay

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London Swine Conference

Thank you to all our sponsors and participants for investing in the future of our industry by supporting the London Swine Conference. We look forward to seeing you again in 2020.

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Day 1: Main Sessions

WHEN THE HEADLINE IS YOU

Jeff Ansell

Jeff Ansell and Associates

Farm & Food Care Ontario

25 MEDIA TIPS

1. Know what you want to say prior to media interviews
2. Support your messages with facts
3. Quote third party experts to support your case
4. Use short, clear sentences
5. Sound conversational
6. Focus on one thought at one time
7. Use inflection and emphasize words to strengthen your message
8. Have meaningful eye contact with the interviewer
9. Use your eyes to match your tone
10. Pause to be thoughtful
11. Don't speculate or answer a hypothetical question
12. Never say "no comment"
13. There's no such thing as 'off the record'
14. Presume you're always being recorded
15. Don't answer a question you don't fully understand – ask for clarification or rephrasing the question
16. Don't repeat negative words
17. Acknowledge the concerns of the other side
18. Be a good listener
19. Have good eye contact with the interviewer
20. Breathe to stay calm, focused, and in the present moment
21. Breathe, especially when listening to or answering a difficult question
22. Focus on what you're talking about as you talk
23. Use your hands to help you talk
24. Look like you mean it!
25. Say it like you mean it!

SOW LONGEVITY AND NEONATAL MANAGEMENT

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ABSTRACT

Management conditions to which future replacement gilts are exposed pre- and postnatally have profound and permanent effects on their longevity and lifetime productivity. Consequently, identification of neonatal traits that are correlated with adult reproductive performance would be beneficial for the swine industry for use as early selection criteria. Birthweight is one possibility. Thirty-five percent of gilts with birthweights ≥ 1.5 kg successfully rebred after parity 7 compared with only 5% on their contemporaries that weighed ≤ 1.0 kg ($p \leq 0.001$). Positive relationships between weaning weights and sow longevity have also been observed. Strategic cross-fostering was used to reduce competition during lactation such that future replacement gilts were weaned from litters of 6 or 12 piglets. Both weaning weights (9.4 vs. 7.3 kg) and the proportion of sows rebred after parity 6 (38 vs. 16%) were higher ($p < 0.05$) for gilts weaned from litters of 6 compared with those from litters of 12, respectively. Litter of origin variables are physiologically related to birthweight and pre-weaning growth. Total number of pigs born, weaning age, and number of pigs nursing after cross-fostering explained 31.4% and 22.3% of the total variation in the proportion of sows that were rebred after parity 6 and total pigs produced over 6 parities, respectively, in 100,00-sow commercial production system. Both litter of origin and individual characteristics of neonatal gilts appear to have good potential for use as early indicators of sow longevity and lifetime productivity.

INTRODUCTION

High sow replacement rates have shifted parity distributions on most North American farms towards younger females. As a result, herd productivity is being limited because females are culled before they reach their peak reproductive performance. There is no question that the manner in which sows are managed during lactation, rebreeding and gestation has a significant impact on their fertility and retention in the breeding herd (Flowers, 1999). This is often referred to as the functional phase of reproductive management because its primary goal is to create an environment in which the reproductive organs of sows function at their maximum efficiency. In most situations, management mistakes during the functional phase are correctable. For example, excessive losses of body condition occurring during lactation due to poor feed intake can be replenished with adjustments in feeding regimens during gestation.

Management conditions to which gilts are subjected pre- and postnatally also have a profound effect on their reproductive performance as adults. This should not be surprising

since both ovarian and uterine development begin during the latter stages of pregnancy and aren't completed until several months after birth (Pressing et al., 1992; Morbeck et al., 1993). These events lay the physiological foundation for how well the brain and other reproductive organs communicate with each other during the functional phase. Hence, it seems appropriate to classify this as the development phase of reproductive management. Mismanagement during the developmental phase often compromises reproduction permanently and usually cannot be compensated for with improved management subsequently during the functional phase.

The impact of management decisions made during the developmental phase are not known until gilts are bred; enter production; and produce several litters. Because this takes several years, establishment of physiological benchmarks correlated with adult reproductive performance would be beneficial for the swine industry. These could be used to assess reproductive and longevity potential of perspective replacement females at young ages and provide guidance in terms of implementation of management programs designed to help them reach their full potential. Therefore, the main objective of this paper is to review recent work examining relationships between neonatal management and sow lifetime productivity with a special emphasis of the use of litter birth characteristics, birth weight, weaning weight and pre-weaning growth as early selection criteria for replacement gilts.

BIRTH WEIGHT

Formation of the ovaries is complete by 70 days of gestation, but the most active period of their growth and development occurs during the last 30 to 40 days of pregnancy (Ashworth et al., 2001). Swine are litter-bearing species and, as a result, their offspring are subject to intrauterine growth restriction: a phenomenon which has been shown to have significant negative effects on most physiological systems (Gondret et al., 2005; Foxcroft et al., 2009). Therefore, it is not surprising that birthweight in swine is positively correlated with the development of many organs including the ovaries and poses the question as to whether it can be used as an early indicator of adult reproductive function. Data from a recent study (Figure 1) indicates that the answer to this question is “yes” (Flowers, 2019). Reproductive performance, as measured by the proportion of sows rebred after their seventh parity, was the highest and lowest in sows with the heaviest and lightest birthweights, respectively. The most plausible explanation for this is that heavier piglets were subjected to less growth restriction and had increased organogenesis. This advanced neonatal development, in turn, resulted in reproductive organs with increased efficiency as adults which resulted in increased reproductive performance.

These data also make it tempting to speculate that there is a minimum birth weight below which it is unlikely that gilts can function reproductively as adults. In this particular herd it appears that the minimum is around 1.0 kg since over 60% of bred gilts from this birthweight group failed to farrow their first litter and only 5% were still in production after parity 7. Consequently, use of a minimum birthweight as an early selection criteria for future replacement gilts appears to warrant strong consideration. It is important to recognize that there probably are quantitative differences among herds in terms of what constitutes high

or low birth weights. However, qualitatively it would be surprising if there wasn't a positive correlation between birthweight and adult reproductive performance in most herds.

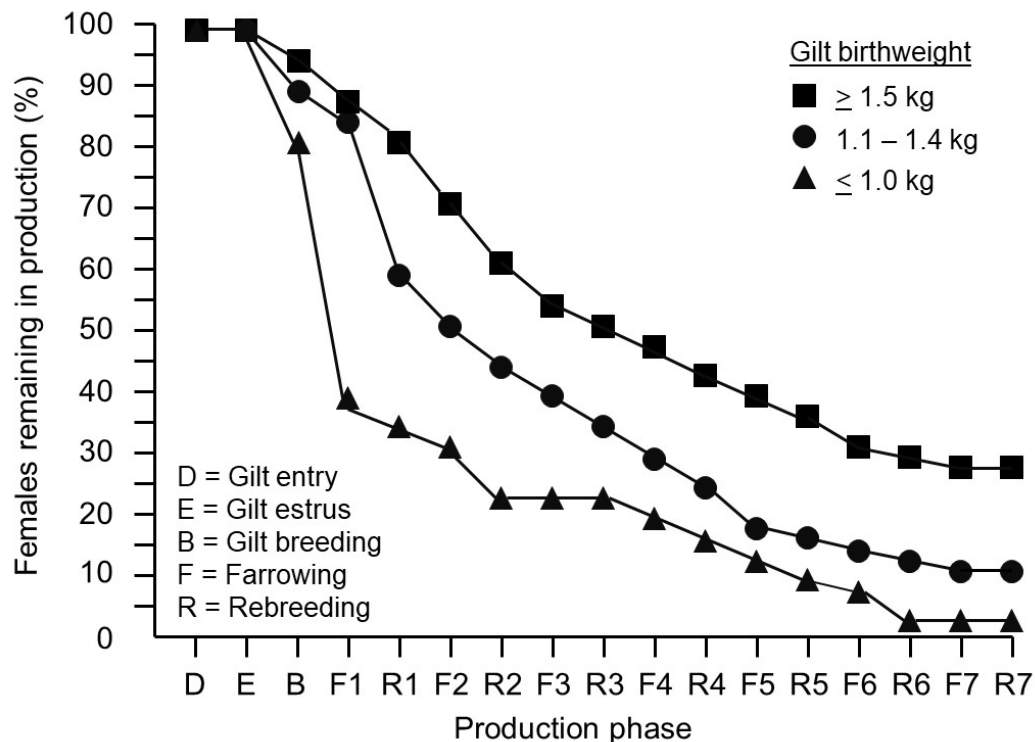


Figure 1. Effect of birthweight on proportion of sows that successfully rebred after parity 7 (adapted from Flowers, 2019).

PREWEANING GROWTH AND WEANING WEIGHTS

Neonatal nutrition is critical for the growth of piglets. Since this period also coincides with active periods of ovarian and uterine development it is also physiologically reasonable to speculate that pre-weaning growth is also positively correlated with reproductive tract development and, thus, adult reproductive performance. In practice, pre-weaning growth and weaning weights can be improved to a greater extent than birthweights by management practices such as supplemental feeding and strategic cross-fostering. The latter of these has been shown to be effective in experimental situations by taking littermate pairs with similar birthweights and assigning them to nurse in litters of either 6 or 12 piglets (Flowers, 2015). As expected, both pre-weaning growth and weaning weights were significantly higher for the gilts nursing in the small litters compared with their counterparts nursing in normal-sized litters. In addition, 38% of sows raised in litters of 6 successfully rebred after their sixth parity compared with only 14% of those that nursed in litters of 12 piglets (Figure 2). Obviously, fostering off 50% of a litter is not feasible in the commercial situations. However, these studies demonstrate the potential that enhancing pre-weaning growth can have on life-time productivity of sows. The minimum number of pigs that needs to be removed from a litter in order to realize this benefit due to enhanced pre-weaning growth is not known,

but recent studies indicate that it may be as low as 25 to 30% of the litter (Flowers, unpublished observations).

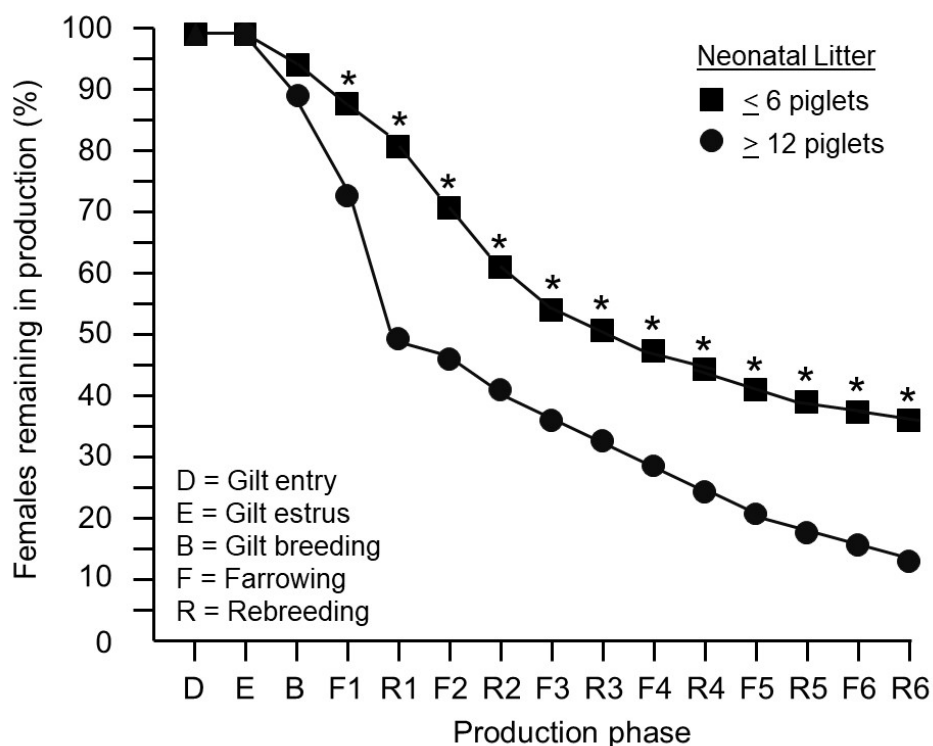


Figure 2. Effect of enhanced pre-weaning growth and increased weaning weight accomplished by strategic cross-fostering on sows that successfully rebred after parity 6. Means with asterisks indicate differences between treatments ($p \leq 0.05$; adapted from Flowers, 2015).

Critical care programs for newborn piglets are increasing in popularity. One of their goals is to ensure that piglets receive adequate colostrum. Both colostrum and mature milk have been shown to contain bioactive compounds which stimulate development of most physiological systems (Hurley, 2015). These observations have led to the Lactocrine hypothesis, which proposes that milk consumed by piglets early in their life has an important role in programming the development of their reproductive organs (Bagnell et al., 2017). Both male and female piglets that were raised only on milk replacer had significant impairments in testicular or ovarian and uterine development, respectively, compared with their littermates that received colostrum (Bagnell et al., 2017). The milk replacer group also had reduced weaning weights which poses the question as to how much of the enhanced development associated with increased pre-weaning growth, discussed previously, is due to colostrum intake. If the components of colostrum responsible for stimulating reproductive tract development can be identified then it is likely that these could be provided orally to young pigs and provide a way to stimulate the development of their reproductive organs. Clearly, work in this area holds promise for improving lifetime productivity.

RELATIONSHIPS AMONG BIRTH LITTER CHARACTERISTICS, INDIVIDUAL GILT CHARACTERISTICS AND LIFETIME PRODUCTIVITY IN A COMMERCIAL PRODUCTION SYSTEM

Obtaining birth and weaning weights for future replacement gilts on multiplication farms may not be possible in many production systems for a variety of reasons. However, it may be possible to use characteristics of the birth litter of gilts as an alternative. These data include total number of pigs born, number of pigs born alive, number of pigs nursing after cross-fostering and lactation length or weaning age. From a physiological perspective all of these influence birthweight, weaning weight, or both. Total number born and number born alive have been shown to have a negative relationship to birthweight as discussed previously due to intrauterine growth restriction. Of these total number born probably is a more accurate estimation of the negative effects of this phenomenon because both mummified fetuses and stillborn piglets occupy uterine space which is unavailable to support live fetuses. Similarly, number of pigs nursing after fostering and lactation length have well established negative and positive correlations with pre-weaning growth and weaning weights, respectively.

Results from a recent study conducted within a 100,000 sow commercial production system indicate that this approach may have merit (Meli, 2019). For this particular study, multiple regression analyses were used to examine the relative importance of litter of origin and individual gilt characteristics on two estimates of lifetime productivity: the proportion of sows rebred after parity 6 (Table 1), and the total number of pigs produced over six parities (Table 2). In both Tables 1 and 2, the partial and total R^2 columns are presented in their decimal form but they can easily be converted to a percentage basis by simply multiplying each one by 100. For example, in Table 1 the total number of pigs born in a litter has a partial R^2 of 0.1503. This is equivalent to stating that 15.03% of the total variation observed in the proportion of sows that were rebred after parity 6 was attributed to variation in the total number of pigs born from which the replacement gilts were selected. What is interesting to note about these results is that total number of pigs born, weaning age, and number of piglets after cross-fostering were the top three variables in terms of explaining variation in the proportion of sows rebred after parity 6 and total pigs produced over six parities. Collectively, these three variables accounted for 31.4% and 22.0% of the total variation (total R^2) within this herd in terms of sow longevity and lifetime productivity, respectively.

Table 1. Contribution of selected litter of origin and individual gilt variables on proportion of sows rebred after parity 6.

Variable	Partial R^2	Total R^2	P-value
Total number of pigs born	0.1503	0.1503	0.0312
Weaning age	0.0990	0.2493	0.0648
Number of piglets nursing after fostering	0.0647	0.3140	0.1138
Average birth weight of gilts	0.0574	0.3714	0.1441
Number of piglets weaned	0.0524	0.4238	0.1446

Table 2. Contribution of selected litter of origin and individual gilt variables on total number of pigs produced over six parities.

Variable	Partial R ²	Total R ²	P-value
Total number of pigs born	0.0997	0.0997	0.0835
Weaning age	0.0624	0.1621	0.1598
Number of piglets nursing after fostering	0.0582	0.2203	0.1613
Number of piglets weaned	0.0517	0.2720	0.1847
Average birthweight of gilts	0.0504	0.3224	0.1920
Average weaning weight of gilts	0.0175	0.3399	0.3995

It is important to recognize that results from multiple regression are retrospective so they do not necessarily establish cause and effect and they are production system specific with regards to the inherent variation in the trait of interest. Nevertheless, their usefulness from a practical perspective is that they can provide guidance in the establishment of litter of origin selection criteria for replacement gilts. For example, in this particular production system, 56% of replacement gilts born in litters of 15 total pigs or less were rebred after their sixth parity. In contrast, a comparable figure for their contemporaries born in litters with 16 or more total pigs was only 20%.

Many production systems rely on computerized systems to record all of the litter of origin traits analyzed in this study: total number of pigs born; number of pigs born alive; number of pigs nursing after cross-fostering; lactation length; and number of pigs weaned. In addition, they also record when all replacement females enter production as bred gilts and when they are eventually culled. Consequently, all the pertinent information needed for these types of analyses are already being collected by most farms. The challenge is developing a way to combine these two datasets, litter of origin information from multiplication farms and sow longevity and lifetime productivity from commercial operations.

CONCLUSION

Litter of origin and individual gilt characteristics have potential for use as physiological benchmarks for estimating sow longevity and lifetime productivity. Birthweight has a positive correlation with development of reproductive organs in gilts and also probably reflects the degree to which they may have been affected by intrauterine growth restriction during fetal development. It also is positively correlated with sow longevity, but its best use may be the establishment of a minimum acceptable limit for replacement gilts. Pre-weaning growth and weaning weights also have positive relationships with sow longevity.

Supplemental feeding and strategic cross-fostering are management techniques that have been shown to improve both of these but their practicality and cost effectiveness currently in commercial production system requires further investigation. Routine production data collected from sows on multiplication farms are litter of origin variables for replacement gilts. Even though they are production system specific they still appear to have good

potential for use as early selection criteria for sow longevity and lifetime productivity provided that they can be combined with commercial production data and analyzed accordingly.

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MAXIMIZING PERFORMANCE OF THE SOW

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ABSTRACT

Milk and colostrum yields are crucial factors for the survival and growth of suckling piglets and sows limit the amounts available to piglets. Stimulating mammary development is one avenue that could be used to improve sow milk production. It was demonstrated that nutrition of gilts or sows during the growing period and late gestation can stimulate mammary development. Factors such as amount of feed provided, dietary supplementation with plant extracts and feeding agents that stimulate hormonal production should be considered. Management of primiparous sows also impacts their future lactation performance in that a teat must be used at least 2 days after farrowing to ensure its optimal productivity in the subsequent lactation. The amount of colostrum produced by sows is very variable and is affected by circulating concentrations of hormones. Results from a recent study suggest that with only one injection of a high dose of oxytocin in the 12 to 20 hours following the end of farrowing one can prolong the colostrum phase, thereby improving the quality of milk ingested by piglets in early lactation.

SOW PERFORMANCE AND PIGLET GROWTH

It is known that sows do not produce enough milk to ensure optimal growth of their piglets (Harrell et al., 1993), furthermore, that is also the case for colostrum. Indeed, a minimum amount of 250 g of colostrum must be ingested by an average size neonatal piglet (1.4 kg) in order to acquire immune protection and sustain body growth. However, approximately one third of sows cannot produce enough colostrum to fully support their litters (Quesnel et al., 2012). It is therefore imperative to attempt to increase sow lactation performance in order to maximize growth and survival of their litters. One important determinant of potential sow milk yield is mammary gland development that takes place before puberty (as of 90 days of age) and during the last third of gestation. Mammary development is affected by numerous factors, such as nutrition and hormonal status. Once lactation is initiated, prolongation of the colostrum phase could be an avenue to provide more of the essential immunoglobulins and bioactive nutrients to the piglets. Those two approaches will be discussed.

MAMMARY DEVELOPMENT IN SWINE: EFFECTS OF NUTRITION

Numerous studies were carried out to look at the potential impact of nutrition on mammary development of gilts and sows. It is during phases of rapid mammary accretion that one can attempt to further stimulate mammary development using nutritional strategies. A

summary of the dietary treatments that can enhance mammary development in growing prepubertal gilts and gestating pigs is shown in Table 1.

Table 1. Nutritional treatments that stimulate mammary development (in terms of mammary parenchymal tissue that synthesizes milk) in growing or gestating gilts.

Treatment	Treatment period	Effect on parenchyma	References
10% flaxseed	<i>In utero</i> (day 63 gestation to end lactation)	31% ↑ parenchymal weight	Farmer et al. (2007)
2.3 g/day of genistein (to ↑ estrogens)	90 to 183 days	44% ↑ parenchymal cell number	Farmer et al. (2010)
Ad libitum feeding vs. 25% feed restriction	90 days to puberty	46% ↑ parenchymal weight	Sorensen et al. (2002)
Ad libitum feeding vs. 20% feed restriction	90 days to puberty	36% ↑ parenchymal weight	Farmer et al. (2004)
Ad libitum feeding vs. 33% feed restriction	90 days to 5½ months	52% ↑ parenchymal weight	Sorensen et al. (2006)
24 vs. 36 mm BF ¹ at end of gestation via changes in energy and protein intakes	Gestation	240% ↑ parenchymal cell concentration	Head and Williams (1991)
21 to 26 or 17 to 19 mm BF vs. 12 to 15 mm BF at end of gestation via changes in feed intake	Gestation	33% ↑ parenchymal weight	Farmer et al. (2016a)
5.76 vs. 10.5 Mcal ME/day	Day 75 to end of gestation	27% ↑ parenchymal weight	Weldon et al. (1991)
Domperidone (to ↑ prolactin, 0.4 mg /kg BW)	Days 90 to 110 of gestation	80% ↑ in lumen diameter milk secreting cells	VanKlompenberg et al. (2013)

¹BF = backfat thickness

Feed restriction from 90 days of age (but not before 90 days) until puberty impairs mammary development. It is therefore essential to feed animals ad libitum during that period. Feeding certain plant extracts with estrogenic or hyperprolactinemic properties may also prove beneficial in stimulating mammary development at specific physiological periods. Phytoestrogens are naturally-occurring plant compounds that are present in large amounts in soya and that can have estrogenic properties. When the phytoestrogen genistein was fed to gilts from 3 months of age until puberty, it led to a 44% increase in the number of mammary parenchymal cells at 183 days. Dietary supplementation with 10% flaxseed from

day 63 of gestation until weaning had beneficial effects on mammary development of the female offspring of the treated sows at puberty. This is most interesting because it shows an in utero effect and therefore opens new avenues in terms of potential management schemes to stimulate mammary development of gilts.

Feeding in gestation is important largely because of its effect on body condition. When manipulating body composition of gilts by changing their protein and energy intakes during pregnancy, obese gilts (36 mm backfat) on a high energy-low protein diet had reduced mammary development and produced less milk than leaner gilts (24 mm backfat) of the same body weight. On the other hand, gilts that are too lean (12 to 15 mm backfat) at the end of gestation have less developed mammary tissue. Increasing the amount of dietary lysine in gestation did not affect mammary development before farrowing but may increase subsequent milk production.

Feeding in lactation also affects mammary development; an increase in weight of functional mammary glands is seen when sows are fed either more protein (65 vs. 32 g of lysine/day) or more energy (17.5 vs. 12 Mcal ME/day). It is therefore imperative to maximise sow feed intake during lactation.

MANAGEMENT OF FIRST-PARITY SOWS

It is now known that if a teat is not suckled in first lactation it will produce less milk in second lactation. But the question remains: for how long must a teat be suckled in first lactation to avoid such a negative effect? A project was carried out at the Sherbrooke Research and Development Centre of Agriculture and Agri-Food Canada with 61 primiparous sows to compare lactation lengths of 2, 7, or 21 days in first lactation (Farmer et al., 2017a). The effects of treatment on piglet growth and milk composition in second parity were determined. In both lactations, litters were uniformized to 12 piglets of average body weight within 12 h of farrowing and only 12 teats were kept functional. Surplus teats were taped so that there was one teat available per piglet. During the second lactation, the same 12 teats were made available and piglets were weighed at birth, and on days 2, 7, 14, 21, 31 and 56 postpartum. Weaning took place on day 21 of lactation and suckling piglet had no access to dry feed so that their growth rate reflected sow milk yield. Representative milk samples were obtained on day 21 of lactation to measure dry matter, fat, protein and lactose contents.

Sows with a 21 day lactation in first parity consumed more feed in the first week of the second lactation (average daily consumption of 4.80, 4.58 and 5.65 kg for sows with lactation lengths of 2, 7 and 21 days, respectively, in parity 1). However, this was not maintained in later lactation and was not associated with a greater piglet growth rate or with changes in milk composition. Those results show that if a teat is suckled for only 2 days in parity 1, its milk yield will not be reduced in parity 2. When comparing lactation lengths of 2, 7 or 21 days in first parity, milk yield of sows in second parity was not affected. There is therefore no advantage to leaving piglets for more than 2 days on a teat in terms of milk yield from that teat in the next parity. This finding is crucial for swine producers because it will impact the management of first-parity sows that have a poor body condition.

PROLONGING THE COLOSTRAL PHASE

Colostrum is the elixir for life in newborn piglets. It is their sole source of energy and it also provides passive immunity from the mother via the transfer of immunoglobulins. Furthermore, colostrum contains hormones, growth factors, enzymes, vitamins and minerals that are all required for proper development of the piglets. Lactal secretions are considered as colostrum for approximately 24 hours following parturition; they then become transition milk until 72 hours postpartum, to finally become milk. This difference is due to the drastic changes in composition of lactal secretions that take place in early lactation. There are marked decreases in concentrations of protein, immunoglobulins and growth factors and increases in fat, lactose and energy contents.

The amount of colostrum produced is very variable from one sow to the next and is affected by circulating concentrations of various hormones. Oxytocin is a hormone that is frequently used in farrowing houses to help speed up the farrowing process, but it also plays an important role on milk quality in early lactation. Indeed, oxytocin affects the amount of space (tight junctions) between mammary cells. During the colostrum phase these junctions are open allowing large molecules such as immunoglobulins to pass directly from the sow blood to the colostrum. After parturition, these junctions gradually become tighter to eventually be impermeable, thereby altering the composition of lactal secretions and ending the colostrum phase.

A trial was recently carried out at the Sherbrooke Research and Development Centre of Agriculture and Agri-Food Canada to study the potential role of oxytocin to prolong the colostrum phase in sows (Farmer et al., 2017b). Twenty Yorkshire X Landrace sows of second parity were divided into two treatment groups. They either received saline injections (controls) or a very high dose (75 IU) of oxytocin 4 times in early lactation. The first injection was given 12 to 20 hours (average of 16 hours) after birth of the last piglet, and injections were then given twice a day at 08h00 and 16h30 totalling 4 injections. Litters were standardized to 11 ± 1 piglets on day 2 (day 1 was the day of farrowing) and piglets were weighed twice on day 2 (at a fixed 8-hour interval) and once on days 7, 14, 21 (weaning on day 22) and 35 postpartum. Suckling piglets had no access to solid feed. Four milk samples were collected, two on day 2 of lactation (morning and afternoon), and one on days 4 and 5 of lactation. Composition in terms of dry matter, energy, fat, protein, immunoglobulins G and A, lactose, sodium, potassium as well as concentrations of the growth factor IGF-1 was determined.

As soon as 8 hours after the first injection of oxytocin, there were great differences in milk composition due to treatment. Milk from treated sows contained more proteins, immunoglobulins G and A, IGF-1 and energy compared to that of control sows. The sodium/potassium ratio was also much higher, indicating a greater opening (i.e. permeability) between mammary tight junctions. These differences were transitory because they were no longer present on day 4 of lactation. The weight gain of piglets did not differ between treatment groups but there was a tendency for a lower incidence of pre-weaning mortality in litters from sows receiving oxytocin. It is important to mention that the number of litters used was not large enough to be able to draw any conclusions as to the effect of treatment on animal performance. Oxytocin therefore acts on mammary cells by delaying

tightening of the junctions between mammary epithelial cells, therefore making it possible for large molecules to pass directly from the circulation into milk.

CONCLUSIONS

Nutrition of prepubertal and late-pregnant gilts can undoubtedly affect their mammary development. However, even though advances were made in understanding the nutritional control of mammary development in pigs, much remains to be learned before the best nutritional strategy to enhance mammary development can be developed. During lactation, maximizing energy and protein intakes of sows will optimize their mammary development. New information also shows that it could be possible to remove some piglets from the udder of first-parity sows without affecting milk yield from these teats in the next lactation, as long as they have been suckled for a minimum of 2 days. This would permit to reduce litter size in sows that show poor body condition in order to ensure optimal reproductive performance and longevity in the herd. In terms of colostrum yield, recent findings show that a single injection of a high dose of oxytocin given in the 16 h following the end of farrowing prolongs the colostrum phase. This leads to an improvement in the quality of milk in early lactation via increases in concentrations of immunoglobulins and the growth factor IGF-1. This is a novel finding in swine and the minimal dose of oxytocin required to elicit such positive effects remains to be established, as well as the impact of this treatment on performance and health of sows and their piglets.

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Day 1: Workshop Sessions

ROLE OF NUTRITION IN PROMOTING SWINE HEALTH

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ABSTRACT

In response to consumer demand and recent changes to antimicrobial regulations, producers are taking great steps to reduce use of antibiotics in swine production. A more judicious use of antimicrobials puts pressure on swine nutritionists to explore alternative feeding strategies to optimize health of the herd. This workshop will focus on several concepts to consider how to formulate diets that promote swine health.

Keywords: Additives, Feeding strategies, Intestinal health, Pigs

MYCOTOXINS

Mycotoxins are metabolites produced by field crop moulds. The 2018 southwestern Ontario corn crop was likely the worst on record for quality. Fusarium mould produced deoxynivalenol (DON) levels in Ontario grain corn so high that made it unmarketable. Pigs are particularly susceptible to DON in feed. Also called vomitoxin, DON is a mycotoxin known to impair the health of pigs by causing feed refusal, diarrhea and as the name suggests, vomiting and stomach ulcers. Perhaps more concerning, is the immuno-suppressive impact of DON. The pigs' ability to combat viral and bacterial infections through immune cell production of antibodies can be impaired by DON levels of less than 5ppm in the feed. Since much of Ontario's corn has been contaminated with DON, feedmills and farms have taken on various strategies to make use of local grain all while managing risk associated with DON feeding. These strategies include dilution of contaminated grain with cleaner grain, cleaning out fine particles where the highest degree of contamination resides and using toxin mitigation additives in the feed.

VITAMINS

Today's high lean genotype has an incredible ability of converting feed into pork carcass. Research for fine tuning amino acid and energy requirements of these improved pigs has been relentless. However, new information into vitamin needs is harder to find. With pigs doing more with less, the concept of increased requirements needs further exploration. The health benefits of 13 different vitamins are numerous. Some may play a bigger role in maintaining healthy herds today than 10 or 20 years ago. Vitamin D is one such vitamin that is crucial to the mineral metabolism pathway. With fast growing genetics demonstrating increased susceptibility to lameness, stiffness, and bone density issues, we should consider the effects of lower vitamin D when formulating diets. Recently, world markets were shorted on vitamin supply, particularly vitamins A and E. As such, many nutritionists had no choice but to lower vitamin levels for swine due to cost and availability. Some hypothesized performance challenges in 2018 may have been experienced due to subclinical deficiencies.

PLANT EXTRACTS

One exciting category of alternatives to conventional antibiotic use in livestock production is plant extracts. Also referred to as essential oils, concentrated extracts can exploit natural antimicrobial characteristics of various compounds found in plants such as cinnamon, oregano, and thyme, to name a few. In vitro studies are quick to demonstrate effectivity of these extracts on bacterial populations, however, in vivo animal studies show more work needs to be done to understand true mode of action. Another exciting addition to the “nutraceutical” lineup is commercially available medium chain fatty acids (MCFA) from plant sources like palm kernel and coconut oil. MCFAs are believed to combat pathogenic bacteria at the gut level of the pig through penetration of the bacterial cell membrane and inhibiting important DNA replication needed for growth.

PARTICLE SIZE AND ULCERS

Reducing the particle size of corn increases the digestibility of energy and in general, the smaller the particle size is the greater is the ME concentration of corn. In general, if particle size is reduced from around 800 to around 300 microns, the ME increases by around 25 kcal per kg for each 100 microns particle size is reduced. In other words, by reducing the particle size of corn from 800 to 300 microns, approximately 1.75% fat can be replaced by corn in the diet without changing the energy value of the diet. Reduction of particle size, therefore, represents a significant saving in formulation of diets for growing finishing pigs. For other cereal grains, a similar relationship between particle size and ME exists although the magnitude of the increased ME that is a result of particle size reduction may be different.

However, the down side to reducing particle size is that pigs are more prone to developing gastric ulcers. If these ulcers result in increased death losses then some of the economic benefits of reducing particle size will be eliminated. It is, therefore, from both an economical and an animal welfare point of view, necessary that a balance between particle size and prevention of ulcers is identified. This balance may be different among genetic lines of pigs, among diets with different ingredient compositions, and between pelleted and meal diets.

COPPER AND ZINC

The requirement for copper by pigs is likely less than 10 mg per kg of feed and the requirement for zinc is around 75 mg per kg. However, it is well established that greater concentrations of both copper and zinc in diets for weanling pigs may reduce scouring and increase growth performance. The benefits of adding extra zinc (up to 3,000 mg per kg) is primarily limited to the post-weaning nursery period, whereas benefits of additional copper (100 to 250 mg per kg) are realized all the way to market. The reason for the beneficial effects of both copper and zinc is most likely that the intestinal microbiome is changed with a reduction in concentrations of pathogens, which reduces the risk of pigs developing diarrhea. In addition, results of recent research have indicated that elevated levels of copper in diets for growing pigs also results in improved post absorptive energy metabolism, which may be a result of a more efficient utilization of absorbed dietary lipids.

Using 100 to 250 mg per kg of copper in diets for pigs also appears to result in a general increase in the immune system. Pigs fed high-copper diets are, therefore, better able to resist a particular environmental or dietary challenge and copper appears to provide insurance against pigs reducing growth performance due to diseases.

FIBER IN DIETS FOR PIGS

Fiber is usually not included in diets for pigs to improve health but there is evidence that in particular in weanling pigs, it may be beneficial to add small amounts of certain dietary fiber. Indeed, diets for weanling pigs based on barley or oats result in improved pig growth performance and reduced scouring compared with pigs fed diets based on only corn or wheat. Beneficial effects of adding small amounts of pure oat fiber to diets for weanling pigs have also been reported. The reason for these positive effects is believed to be that the beta-glucans and possibly other fiber components in barley and wheat results in increased fermentation and increased synthesis of lactic acid in the hindgut of pigs, which in turn will reduce colonic pH and therefore create an environment that is unfavourable for intestinal pathogens. This may result in reduced incidence of diarrhea, improved intestinal morphology, and improved microbiota with an increase in concentrations of beneficial bacteria such as lactobacilli and bifido bacterium. Thus, it is possible that the fibers in barley and oats may act like prebiotics in the intestinal tract of weanling pigs and thereby improve intestinal health.

LOW-PROTEIN DIETS FOR NEWLY WEANED PIGS

Excess dietary crude protein has a negative impact on post-weaning diarrhea and reductions in dietary crude protein may, therefore, reduce diarrhea. The reason for this most likely is that by reducing dietary crude protein, the amount of undigested crude protein that reaches the hindgut is reduced and this will in turn reduce pathogenic growth, fermentation of protein in the hind gut, and synthesis of ammonia and amines. It is also possible that reduced dietary crude protein has a positive impact on intestinal permeability because diarrhea increases intestinal permeability and gut leaking and by eliminating diarrhea, a healthier intestinal tract can be maintained. It is therefore advisable that dietary crude protein in diets for newly weaned pigs is maintained at 16 to 19%. By reducing dietary crude protein to this level, pig growth performance may be reduced, but this reduction will be compensated by improved growth rate during the following period. The main focus should therefore be on preventing diarrhea during the post weaning period.

THINKING LIKE A PIG?
PUTTING THEORY INTO PRACTICE TO MAKE SWINE WELFARE IMPROVEMENTS ON FARM

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ABSTRACT

Ensuring good swine welfare is essential for the sustainability of the pork industry. Efforts to resolve several ongoing welfare concerns will require increased system inputs. This is exemplified by the requirements of the 2014 Code of Practice for the Care and Handling of pigs, which outlines major infrastructure and management changes to provide group living for gestating sows, pain control for specific husbandry procedures and provision of enrichment.

A number of inputs require considerable financial investment alongside an evolution of management to achieve the end goal: an improvement in animal welfare. To help float the cost of increased inputs, it is necessary to also ensure an improvement in animal performance. There is a sizable body of scientific knowledge on approaches to improve swine welfare. However, adoption and application on a commercial scale can often produce some unexpected, or unintended challenges. It is important these are discussed so workable solutions can be found.

This talk will examine the various changes that are being made within the swine industry to achieve welfare requirements, the long term goals, and the challenges that often accompany trying to implement such changes. Topics include social management of animals in group-housing, implementation of environmental enrichment and problem behaviours such as tail biting. Troubleshooting to reduce and resolve issues will be discussed.

SOW ENRICHMENT – A PRODUCER PERSPECTIVE

**Geert Geene
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Geert Geene farms with his brother Peter, and father in Amberley Ontario. Geert's focus is on the sow operation and his brother Peter does the nursery, finishing, and feed mill.

In 2012, they constructed a new sow barn with loose housing for the gestating sows. They produce their own breeding stock raised in the sow barn. In 2017 they added some more sow spaces in the form of freedom stalls, and also more gilt rearing space.

The focus of Geert's presentation is sow and gilt behaviour in his loose housing system, and what he has done to try to enrich their environment.

WALKING THROUGH NURSERY AND FINISHER BARNs – FACILITIES AND EQUIPMENT

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INTRODUCTION

An important part of managing a pig barn is the daily walk-through in the entire barn in order to observe the animals and their environment, thereby ensuring that attention is paid to specific details as required. However, as with any routine tasks, this can be susceptible to short-cuts or some things being taken for granted, due to fatigue from doing the same tasks a multitude of times. The purpose of this presentation is to re-visit the important practice of doing a daily walk-through, mainly to highlight the important things to look for, and possibly to update current routines in view of new developments in technologies and practices, as well as to get re-familiarized with some of the principles and reasons why such details are important to note when doing the walk-through in nursery and finishing barns. The presentation on this topic is divided into two parts: one focusing on the animal aspects (to be covered by my co-presenter), while this part will cover the facilities and equipment aspects.

Basic daily walk-through considerations

What are the main things to look for? In addition to observing the animals, the basic items to look for during the barn walk-through pertaining to equipment and facilities should include the following (PIC, 2014):

1. Feed – ensuring that the pigs are not out of feed
2. Water – pigs have access to sufficient amount of clean water
3. Air – effective thermal environment of the pigs is conducive to optimal growth
4. Space – stocking density is correct for the size of pigs in the pens
5. Manure – no excessive accumulation on pen surfaces, underfloor pits not full.

Depending on the type of production system, additional items may be added to the list; for example, bedding material for barns that use them, but the above list basically covers the minimum essential points related to barn equipment and facilities that need to be monitored closely during a daily walk-through regardless of the type of barn.

Scope of assessment. To facilitate the assessment of various parameters during the walk-through, it is recommended that the herds person doing the walk-through conduct a systematic assessment of the impact of the various listed parameters at the following levels (Linden, 2015):

1. Animal level – health status, behaviour and welfare of individual pigs, mortalities
2. Pen level – items within the pen such as feeder and drinkers, as well as pen floors
3. Room level – parameters that are controlled at the room level such as temperature, humidity, airflow, inlets, fans, static pressure, gases and dust levels, manure pits, lights

4. Barn level – mainly items that impact multiple rooms or the entire barn such as controllers and sensors, feed bins and feed delivery system, manure transfer pump, stand-by generator, power washer, biosecurity (shower, pest control).

Timeframe of assessment. Majority of the abovementioned parameters should be checked on a daily basis, which is the focus of this presentation. However, some items pertaining to equipment and facilities are more appropriately assessed at different timeframes as shown below:

1. Daily - feed, water, air, manure
2. Weekly – feed inventory, barn repairs, load-out, mortalities disposal
3. Monthly - space allocation, controller/sensor calibration, water heater, washer/dryer, office/kitchen equipment (computers, fridge, microwave), utilities meter reading (water, electricity, gas), pest control, emergency devices and alarms, stand-by generator
4. Room cycle – room disinfection, cleanliness inspection (prior to room fill), room equipment repairs
5. Seasonal – ventilation settings change-over, fan covers, supplemental heaters operation check, sensors/controllers/actuators calibration, equipment winterization, insulation inspection

Different production operations may vary in scheduling their checks on some of these items, nevertheless it is important that all of these items are included in a checklist and given due attention on a regular basis from year to year.

Personnel considerations. Based on the above considerations, a checklist that includes all the basic parameters to be monitored in the daily walk-through should be created. While it can be expected that with sufficient training, an average herds person should be able to conduct the walk-through and be able to make reasonable assessment of the various parameters (and conduct remedial actions if necessary) in the checklist, especially those that must be monitored closely on a daily basis (e.g., feed, water, air, manure), however, it might be more appropriate for a more experienced personnel or perhaps the barn manager to conduct the walk-through when checking on the parameters that are assessed on longer time-scales (i.e., from weekly to seasonal), as these require more experience and technical knowledge.

Nursery barn walk-through

In the nursery barn, it is critical that the newly-weaned pigs are given the proper early care needed to overcome the stress of weaning and to set them up for optimal performance in the subsequent growth stages. This involves close daily monitoring of the following barn parameters (in addition to health and welfare checks), especially during the first 1-2 weeks after moving the pigs to the nursery:

1. Temperature – before entering the nursery room, check and note down the temperature set-point on the controller for the room. It should be within the range of desirable levels specified in Table 1 below, depending on the age/weight of the pigs.

Table 1. Optimum temperatures specified in the Canadian Code of Practice for housed weaners and grow-finish pigs as measured at pig level (NFACC, 2014).

Animal	Optimum Temperature* °C (°F)	Desirable Limits* °C (°F)
Young pigs (4-5 days post-weaning)	35 (95)	33-37 (91-99)
Young pigs (5-20kg [11-44lbs]) in weaned pens	27 (80)	24-30 (75-86)
Growing pigs (20-55kg [44-121lbs])	21 (70)	16-27 (61-81)
Finishing pigs (55-110kg [121-243lbs])	18 (65)	10-24 (50-75)

** Stated temperatures reflect the desired temperature in the environment directly around the pig, and not necessarily the overall temperature of the barn. Supplementary heat sources (e.g. heated mats) can be used to achieve desired temperatures.*

The goal is to provide a thermal environment which is within the thermoneutral zone of the pigs (see Figure 1); within this zone, the pigs utilize the bulk of the energy they derive from their feed for growth, rather than on metabolic processes to try to cope with their environment. Upon entering the room, compare the controller set-point with the actual temperature reading from the temperature sensor (e.g., bulb thermometer) at the level of the pigs, and make adjustments on the controller if necessary. If there is no installed temperature indicator in the room, then this set-point verification step should be carried out separately at least once every season.

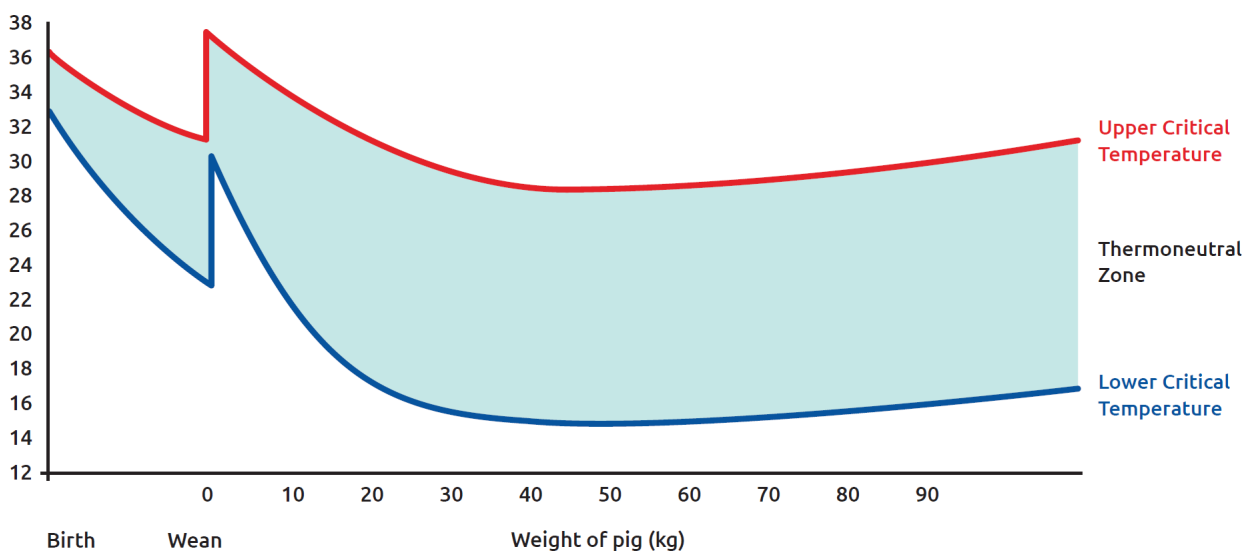


Figure 1. Thermoneutral zone for pigs at different weights (AHDB, 2014).

2. Feed – check every feeder in each pen, making sure that there is fresh feed and that the right diet phase is supplied. The feeder should be adjusted properly, aiming for 50% pan coverage as shown in Figure 2. Check for feed spills and blockage in the feed delivery lines, paying close attention to bends and corners where parts wear-and-tear is highest, as well as for areas where condensation can occur or water can drip unto feed lines and hoppers.



Figure 2. Recommended pan coverage (about 50%) for optimum feeder adjustment.

3. Drinkers - check each drinker to ensure there is clean water available to the pigs; flush drinking cups or bowls if necessary. Measure flow rate from each drinker periodically and adjust nipple drinkers to correct height depending on the height of the pigs (see Table 2). Ensure that there is no leakage in water lines and drinkers to avoid water wastage and unnecessarily adding to the volume of manure slurry. Check for water pressure in nursery water lines which is recommended to be about 20 psi (PIC, 2014).
4. Ventilation – depending on the temperature settings, check that the fans that should be in operation are actually working, starting with the minimum ventilation fan. The recommended minimum ventilation for nursery pigs is 2 CFM/pig; the actual minimum ventilation in the room should be verified by doing a controller calibration using the applicable fan curves at least once every season. Also check the air inlets, particularly for any that are grossly mis-aligned with the others. When walking through the pens, check for drafts when passing near the air inlets. Humidity levels should be between 60 to 80%; excessive humidity levels can lead to condensation on surfaces, resulting in potential rapid deterioration of barn structures and equipment as well as health issues for the pigs.
5. Air quality – when walking through the room, assess the room airspace visually for dustiness and smell for noxious odour and gases. Rotten egg smell is an indicator of elevated levels for hydrogen sulphide, while strong pungent smell and eye irritation are indicators of high ammonia levels. High levels of noxious gases and dustiness (both airborne and settled dust) as well as strong odours in the room are not only detrimental to pig growth and to the health of barn workers, but they also indicate problems that need to be investigated further and attended to; this could involve the ventilation system, manure handling system, feed and water system, or the overall management of the room.

Table 2. Recommended flow rates and height of nipple drinkers (PSCI, 2018).

Phase	Weight (kgs)	Intake (L/day)	Nipple Drinkers		
			Flow (L/min)	Height (cm, 45°)	Height (cm, 90°)
Nursery	5	1.0 - 2.0	0.5 to 1.0	30 cm / 12"	25cm / 10"
	7	1.5 - 2.5	0.5 to 1.0	35cm / 14"	30cm / 12"
	15	2.5 - 3.5	0.5 to 1.0	45cm / 18"	35cm / 14"
	20	3.0 - 4.0	0.5 to 1.0	50cm / 20"	40cm / 16"
Finishing	25	3.0 - 4.0	0.5 to 1.0	55cm / 22"	45cm / 18"
	50	5.0 - 7.0	0.5 to 1.0	65cm / 26"	55cm / 22"
	75	5.0 - 7.0	0.5 to 1.0	75cm / 30"	65cm / 26"
	>100	5.0 - 7.0	0.5 to 1.0	80 cm / 32"	70 cm / 28"

Source: <http://www.prairieswine.com/wp-content/uploads/2018/11/PSC-Water-Intake-Checklist.pdf>

6. Space – evaluate whether the pigs in the pen have adequate space allocation in accordance with the Code of Practice (NFACC, 2014), especially at start and at the end of room cycle.
7. Manure – inspect the pen floor for excessive manure accumulation, wetness, and scouring. Scrape manure accumulated on pen surfaces if needed. Check slurry levels in underfloor manure pits to determine whether the pits need to be emptied. For barns with pit ventilation, ensure that the pits are not too full for proper pit fan operation and air movement.
8. Lighting – check that the light levels are sufficient and uniform in all pens in the room. Recommended light intensity is 50 lux, which is equivalent to brightness needed for a person with normal sight to be able to read a newspaper, mainly to be able to inspect thoroughly all areas of the room and to be able to conduct normal husbandry practices. Weanling pigs may benefit from additional hours of light in order to locate food sources, hence leaving lights on during the first 24 hours post weaning can help facilitate the initiation of feeding (NFACC, 2014). Afterwards, the Code of Practice (NFACC, 2014) recommends a minimum of 8 hours continuous lighting daily, with some studies reporting beneficial impact on piglet feed intake with lighting cycles of between 16 to 23 hours with light and the remaining hours in darkness (Bruininx et al., 2002).

As mentioned previously, this presentation focuses mainly on the basic items that must be looked at when walking through nursery rooms on a daily basis, hence the above checklist

covers only those specific items. There are also other important items that must be monitored at the barn level, although most of these can be looked at on a different schedule, not necessarily on a daily basis. For completeness, some of these other items have been mentioned in the previous sections; they can be incorporated into a separate checklist, and may be monitored by barn personnel with suitable experience and capability to properly examine those items.

Finishing barn walk-through

While the focus of the nursery walk-through is to ensure that the piglets receive proper early care and to firmly establish them for subsequent optimal growth, in the finishing barns the focus is on ensuring that the pigs go to market at the fastest rate possible (i.e., optimal growth environment, no disease setback), with minimal losses (i.e., mortalities), and with the least input cost (i.e., feed). In the finishing barn walk-through, the same parameters as in the nursery barn walk-through need to be looked at, with variations in the target settings for some of the parameters.

1. **Feed** – with feed being the largest input cost in finishing stage, check feeders to ensure access to feed with no feed spillage and avoiding wastage. Depending on the size of the pig and type of feeder, the Canadian Code of Practice (NFACC, 2014) has recommendations for minimum feeder space that should be provided in order to maximize feed intake while minimizing feed wastage. Feed levels in the bins should be checked regularly, particularly during diet phase changes, to ensure diets do not run out before the next phase is delivered.
2. **Air** – temperature should be set according to the recommendations specified in Table 1. Check that humidity and airflow are at acceptable levels, gas levels are below threshold limits, and no unwanted drafts are detected. The recommended minimum ventilation for grow-finish pigs ranges from 4 to 10 CFM/pig; this should be verified by periodically checking the controller settings and conducting a calibration using the applicable fan curves at least once every season.
3. **Water** – check that drinkers are adjusted to the recommended flow rate and set at proper height as shown in Table 2. Check for water pressure in nursery water lines which is recommended to be between 15 to 40 psi (PIC, 2014).
4. **Space** – ensure that the pigs have adequate space allocation in accordance with the Code of Practice (NFACC, 2014), especially at start and at the end of room cycle
5. **Manure** – inspect the pen floor for excessive manure accumulation, wetness, and scouring. Scrape accumulated manure as needed. For barns with shallow underfloor manure pits with pull plugs, they will need to be emptied multiple times over the course of a room cycle; hence, check slurry levels in the manure pits and schedule the emptying of the pits in coordination with the schedule of pit-pulling in other rooms in the barn.
6. **Lighting** – check that the minimum light intensity of 50 lux is met and uniformly distributed in all pens in the room. While the Code of Practice (NFACC, 2014) recommends a minimum of 8 hours continuous lighting daily, studies showed no photoperiod impact on finishing pigs, hence lighting cycles implemented in most barns are mainly for the benefit of the herds person when conducting tasks in the finishing rooms.

The above checklist is focused on the essential items for a basic walk-through in the finishing barns on a daily basis. Similar to the nursery walk-through checklist, there are also other important items that must be monitored in the finishing barns which may be more appropriately conducted on a different schedule.

CONCLUSIONS

Conducting a proper daily walk-through in nursery and finishing barns is an important part of being able to manage pig barns successfully. The details gathered from close observation of the animals in the environment in which they are reared provide important indicators not only on the performance and welfare of the animals but also on the functions of the interrelated barn facilities and equipment systems that are intended to provide the optimal living environment for the animals. Only by knowing these indicators gathered from the walk-through that the pig producer can determine the appropriate courses of action to ensure optimal productivity of the pigs, therefore translating to overall profitability and success of the operation.

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WALKING THROUGH THE BARN – WEAN TO FINISH

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SUMMARY

The purpose of the daily walkthrough is to identify any potential problems, determine why they have occurred and taking action to solve them. Splitting your focus across four levels allow you to separate the various contributions to your observations. Attention is needed within the 4Ps; People, Premise, Pen and Pig levels, these being observed throughout the walkthrough and never in isolation of each other. Each of the four levels can have a cause and effect reaction on the other, utilizing all your senses hearing, smelling, feeling.

PEOPLE LEVEL

Pigs were domesticated 9,000 years ago since then they have relied on people to provide care and shelter. The caretaker is a fundamental element to achieving success. Even the best caretakers can benefit from an outsider's perspective; details can blur especially in challenging situations. The role of the advisor is to help bring clarity to challenges, it's important for the advisor to listen carefully to the concerns of the caretaker. Ask lots of questions prior to and during the walkthrough and follow up with observations to verify what the intended outcome is. Relationships need to be built on comfort and trust for both parties involved.

PREMISE LEVEL

Observations on the Premise level happen outside and inside the barn. Starting outside look at feed storage checking bin levels and look for any spilled feed from bin or augers and examine biosecurity setup and practices. Once inside continue to observe and enter the barn with all your sensory system engaged. "Smell" of ammonia, scour, feed. "Listen" to the sound of pigs prior to entering the room, listen to fans which might not be functioning properly. "Feeling" the climate in the barn for temperature, humidity or drafts.

PEN LEVEL

Pen level observations usually are the first indication of environmental comfort for the pigs. Quietly approaching pens prior to disturbing the pigs is key to understand their comfort. While entering the pen check feeder making sure feed is available without excess waste, check water flow and observe drinker height. Examine the pen floor looking for any unusual manure characteristics. Move slowly through the pen, scanning all areas for any defects or abnormalities.

PIG LEVEL

Individual pig evaluation takes discipline and focus. Getting them up and moving should be a daily routine. Pigs are great at “faking it”, just a few seconds of careful observation can detect problems. Evaluations of ill or injured pigs, deciding if they should be treated and/or removed to special care pen daily. Time spent daily in the pens will result in easier movement and loading at the time of shipping. Large groups are a challenge to see each pig daily, however, you should see the ones needing attention. Inspect each pig from nose to tail, pay attention to eyes, legs, body and, variation from the normal.

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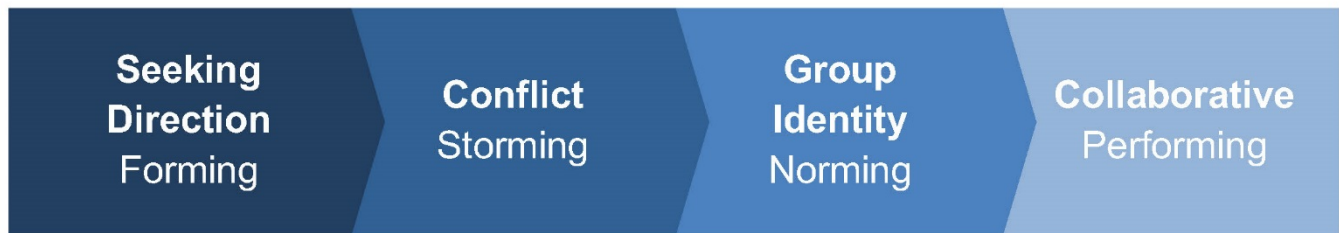
BUILDING THE BEST TEAM

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The following pages are resources for the workshop.

STEP 1	STEP 2	STEP 3	STEP 4
FORMING	STORMING	NORMING	PERFORMING
During the first stage forming , team members establish interpersonal relationships, become familiar with the assigned task (their group assignment) and create ground rules.	The second stage storming marks a time of intragroup conflict due to lack of group unity. Because team members still see themselves as individuals rather than as part of a team, they may resist the formation of group structure in favour of expressing their individuality.	The third stage, norming , is characterized by the emergence of group harmony as group members begin to openly express ideas and opinions. Members begin to accept teammates for who they are and task-related conflicts are avoided in an effort to preserve harmony.	The final stage, performing , reflects a period of productive collaboration in which members demonstrate support for each other and assume roles that will enhance task activities. Constructive attempts are made to resolve an issue related to the completion of the task.



“A team is not a group of people that work together. A team is a group of people that trust each other.” – Simon Sinek

Understanding and Appreciating Communication Style

Most communication experts will tell you that it is important for your communication style to correspond to the person you are speaking with. A few minor adjustments to your communication style to suit the situation, can greatly improve your odds of getting your message across.

	MINGLERS	DIRECTOR	RELATOR	INTELLECT
How to identify:	They get excited.	They like it their way, decisive and strong.	They like positive attention, to be part of a team and to be treated amiably.	They seek a lot of detail, ask many questions, and behave methodically and systematically.
Tends to ask:	Who? (Personal dominant question)	What? (Results-oriented question)	Why? (Personal non-goal question)	How? (Technical analytical question)
Dislikes:	Boring explanations and wasting time with too many facts.	Someone deciding for them	Not being part of a team, treated impersonally, uncaring & unfeeling attitudes.	Making an error, being unprepared, and spontaneity.
Reacts to pressure and stress by:	Selling their ideas or becoming argumentative.	Taking control.	Becoming silent, withdrawn, and introspective.	Seeking more data and information.
Best way to deal with:	Get excited with them, everything is a party!	Let them be in charge.	Be supportive; show you care.	Provide details and more details; love data and information.
Is motivated by:	Applause, feedback, and recognition.	Results, and goal-oriented.	Friends, and close relationships.	Activity and business that leads to results.
Must be allowed to:	Get ahead quickly and likes challenges.	Get into a competitive situation and likes to win.	Relax, and feel like part of the family.	Make decisions at own pace, and not cornered or pressured.
Will improve with:	Recognition and some structure to reach the goal.	A position that requires cooperation with others.	A structure of goals and methods to achieve each goal.	Interpersonal and communication skills.
Likes to:	Rely heavily on gut feelings and hunches	Get things done.	Relationships and friendships are very important to them.	Get everything right.
For best results:	Inspire them to bigger and better accomplishments.	Allow them freedom to do things their own way.	Care and provide detail, specific plans and activities to be accomplished.	Structure a framework or "track" to follow. Success metrics work great with them.

Communication (listens to others)	Seldom	Sometimes	Usually	Almost Always
Solicits ideas, suggestions and opinions from others.				
Listens to other's point of view with an open mind and doesn't judge.				
Listens carefully without interrupting.				
Summarizes input and discussions, and ensures understanding.				
Communication (verbal and written)	Seldom	Sometimes	Usually	Almost Always
Expresses thoughts clearly in written communication.				
Is an effective and articulate speaker and can get to the point quickly.				
Communicates in a straightforward manner, even when discussing delicate issues.				
Communicates the organization's vision, values and goals in a motivating and energizing way that engages employees.				
Leadership	Seldom	Sometimes	Usually	Almost Always
Instills trust and keeps promises.				
Provides direction and makes expectations clear.				
Keeps focused on the big picture while executing action plans.				
Ability to empower and delegate responsibility to the right people.				
Keeps self and others focused on the organization's vision and goals.				
Inspires and motivates employees to be high performers.				
Personal Leadership Development	Seldom	Sometimes	Usually	Almost Always
Accepts criticism constructively and encourages others to suggest ideas for development.				
Identifies and pursues resources for leadership performance improvement.				
Has an executive coach, advisory board or peer group to continue learning and growing.				
Is committed to self, the organization and staff for ongoing personal growth and development.				
Adaptability	Seldom	Sometimes	Usually	Almost Always
Adjusts to circumstances and is flexible dealing with different personalities.				
Reacts constructively to setbacks, views obstacles as opportunities for change and growth, and maintains composure in high-pressure situations.				
Changes leadership and communication style based on the situation and person.				
Relationships (cultivates talent)	Seldom	Sometimes	Usually	Almost Always
Builds a culture in which people feel appreciated and valued.				
Delivers negative feedback tactfully and constructively.				
Creates an atmosphere of team cooperation and synergy.				
Provides effective and valuable feedback to ensure the ongoing growth and success of employees.				
Shares a contagious enthusiasm that promotes a positive attitude.				

Your Leadership Development Action Plan: What three things do you want to develop in the next three months?

Development Area #1		
Why is this important to the company and me?		
Action plan	How will I measure improvement?	Due date
Development Area #2		
Why is this important to the company and me?		
Action plan	How will I measure improvement?	Due date
Development Area #3		
Why is this important to the company and me?		
Action plan	How will I measure improvement?	Due date

Giving Effective Feedback

One of the most effective ways to increase employee performance is to give timely, relevant, honest and objective feedback.

Feedback is usually defined as **reinforcing feedback** or **re-directive feedback**.

Reinforcing feedback is used to recognize positive performance and is a four-step process:

1. **Describe** the specifics of the behaviour you saw or heard.
2. **Explain** the impact of the behaviour on the department.
3. **Credit** the employee for the positive action.
4. **Thank** the employee and encourage them for the future.

Remember to reinforce feedback:

When you see it, say it.

Great work that gets noticed gets repeated.

Don't let great work go unnoticed.

Re-directive feedback is used to improve performance and is a five-step process:

1. **State** what you noticed in a neutral way with no editorial opinion. Deal only with the specific behaviour and don't generalize.
2. **Wait** for the person's response. Make sure you get all the information and really focus on listening effectively.
3. **Remind** the person of the goal or desired state (i.e. we need).
4. **Ask** the person to come up with a solution to meet the goal. Focus on the future and what will be done differently (i.e. so I can count on you to , how will you ?).
5. **Agree** on a positive solution. Review or summarize what the person has committed to and describe the positives of what will happen if the change occurs. Document the discussion and goals and set a goal date and a follow up meeting.

Remember for re-directive feedback:





Expectation Plan

TITLE: OPERATIONS ASSISTANT	DATE:
EMPLOYEE NAME:	REPORTS TO: OPERATIONS MANAGER

To be completed within the first month (by Jan. 28, 2018)
Review the Operations Assistant job description and ensure clear understanding of job expectations and performance measurements.
Review organizational chart: understand roles and responsibilities of owners and staff, including seasonal staff.
To be completed month two (by Feb. 18, 2018)
Completes daily records and reports for inputs and supplies.
Conducts weekly audits and inventory scans for seed, products, equipment, etc.
To be completed month three (by March 30, 2018)
Identifies ways to improve efficiencies and overall profitability.

SOW FEEDING STRATEGIES: BODY CONDITON OF GILTS

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ABSTRACT

Greater mammary development, hence increased number of cells that secrete milk, means more milk produced in lactation (Head et al., 1991). But what can be done to optimize mammary development in late-pregnant gilts? It was recently shown that body condition of gilts affects their mammary development. A gilt that is too thin (12-15 mm backfat thickness at the P2 site of the last rib) on day 110 of gestation has less milk-secreting tissue (parenchymal tissue) in her udder than a gilt with 17 to 26 mm backfat (Farmer et al., 2016a). This difference was achieved by feeding varying amounts of feed throughout gestation (1.30, 1.58 or 1.83 times the maintenance requirements). It was also demonstrated that changes in mammary development brought about by varying body conditions at the end of gestation differ depending on whether these differences in body condition are due to varying feeding levels in gestation or to differences in body condition that were already present at mating (Farmer et al. 2016b). Findings showed that it is important to consider both body weight and body condition of gilts at mating to achieve optimal mammary development and suggest that nutrition in gestation is more important than body condition at mating for mammary development in late gestation. Such findings are important to assist producers in maximizing potential milk yield of first parity sows and demonstrate that body condition must be considered. Feeding regime in gestation therefore has an impact on subsequent lactation performance of primiparous animals.

CONDITIONING OF GILTS AND MAMMARY DEVELOPMENT

Sow milk yield is a major determinant for the growth rate of suckling piglets. It can be affected by various management strategies and one that requires more attention is optimal body condition of gilts. Conditioning of gilts is based on assessment of body mass or composition and is an important aspect of swine husbandry practices because it can impact lifetime reproductive performances (see review by Rozeboom, 2015). Even though some studies showed no clear evidence of a link between body condition at first service and subsequent reproduction (Rozeboom et al., 1996; Thingnes et al., 2015), a recent study done over five parities showed an advantage for sows to be genetically fatter (Lewis and Bunter, 2013). Yet, the potential relationship between body condition at mating and subsequent mammary development was never studied. Furthermore, recommendations for the ideal backfat to achieve at first parturition vary and the potential relationship between body condition of gilts in late gestation and litter growth rate is not clear. Obesity, described as a backfat of 36 mm, was shown to have a negative impact on mammary development of late-pregnant gilts (Head and Williams 1991), but until the following trials were performed, it was

not known if differences in backfat that are seen commercially have an impact on mammary development.

TRIAL 1: FEEDING LEVEL IN GESTATION

A research project was undertaken at the Research and Development Centre of Agriculture and Agri-Food Canada in Sherbrooke to determine the impact of body condition on mammary development in late gestation (Farmer et al., 2016a). It was carried out with 64 (Yorkshire x Landrace) x Yorkshire gilts that were bred with semen from Duroc boars. Gilts selected for the project had a backfat thickness at the P2 site of the last rib of 16.4 ± 1.0 mm at mating. They were then fed differently throughout gestation (see Table 1) to achieve backfat thicknesses of 12-15 mm (low, LBF), 17-19 mm (medium, MBF), or 21-26 mm (high, HBF) on day 110 of gestation.

Table 1. Amount of feed provided daily (based on body weight at mating) to gilts during gestation for them to achieve a low backfat (LBF; 12-15 mm, 13 gilts), medium backfat (MBF; 17-19 mm, 13 gilts) or high backfat (HBF; 21-26 mm, 13 gilts) on day 110 of gestation.

	LBF	MBF	HBF
From mating to day 100 of gestation, kg			
Body weight at mating, kg			
- 120	1.60	2.35	3.10
- 130	1.70	2.40	3.15
- 140	1.75	2.45	3.25
- 150	1.80	2.55	3.30
- 160	1.85	2.60	3.30
From day 101 of gestation onward, kg			
Body weight at mating			
- 120	2.60	3.35	4.10
- 130	2.70	3.40	4.15
- 140	2.75	3.45	4.25
- 150	2.80	3.55	4.30
- 160	2.85	3.60	4.30

Backfat thickness had an effect on mammary development (Table 2). The LBF gilts had less extraparenchymal fatty tissue and less parenchymal milk-secreting tissue than HBF gilts. There was also less total fat in the parenchyma of LBF gilts, which makes sense because they

were thinner. Only one other measure of composition was altered in the parenchymal tissue of gilts. Thin LBF gilts had a parenchyma with a greater percent protein, however, when looking at it on a total basis, there was no difference in protein content of the parenchymal tissue between LBF gilts and the other two groups of gilts. Of all hormones and metabolites measured in the blood of gilts the day before slaughter, only leptin was affected. There was a tendency for leptin concentrations to be lower in LBF than MBF gilts and values were also 20% lower in LBF than in HBF gilts. This was expected because the hormone leptin is secreted by fat cells.

Table 2. Mammary gland composition on day 110 of gestation for gilts with low backfat (LBF; 12-15 mm, 13 gilts), medium backfat (MBF; 17-19 mm, 13 gilts) or high backfat (HBF; 21-26 mm, 13 gilts).

	LBF	MBF	HBF
Extraparenchymal tissue, g	1075 ^a	1360 ^b	1578 ^b
Parenchymal tissue, g	1059 ^a	1370 ^{ab}	1444 ^b
- dry matter, %	38.4	40.8	42.5
- fat, %	62.8	65.9	68.2
- fat, g total	255 ^a	367 ^b	394 ^b
- protein, %	45.1 ^a	31.3 ^{ab}	29.4 ^b
- protein, g total	14.9	176	179
- DNA, mg/g	10.9	10.0	9.0
- DNA, g total	4.4	5.6	5.4

^{a,b}Means within a row with different superscripts differ significantly from each other.

In conclusion, this first study demonstrated that being too thin at the end of gestation (12-15 mm backfat) has a negative impact on mammary development of crossbred gilts, whereas having backfat varying from 17 to 26 mm has no apparent detrimental effects on mammary development. Backfat thickness in late pregnancy must therefore be considered to achieve optimal sow lactation performance, but one must remember that the exact backfat values obtained in the current project will likely vary depending on the gilt genetic background. Yet, the principle remains that one should avoid overly thin gilts at first farrowing to increase subsequent milk yield.

TRIAL 2: BACKFAT AT MATING MAINTAINED THROUGHOUT GESTATION

The goal of this second project was to determine if different body conditions in late gestation, which are due to varying body conditions at mating, affect mammary development of gilts (Farmer et al., 2016b). Gilts that were fed ad libitum in the growing period were selected based on their backfat depths to form three groups at mating, being, low (LBF; 12-15 mm, n = 14), medium (MBF; 17-19 mm, n = 15), and high (HBF; 22-26 mm, n = 16) backfat. During gestation, LBF, MBF, and HBF gilts were fed approximately 1.25, 1.43

and 1.63 of maintenance requirements to maintain their differences in body condition (see Table 3). Feed intake was increased by 1 kg in the last 10 days of gestation.

Table 3. Amount of feed provided daily during gestation for low backfat (LBF; 12-15 mm, n = 14), medium backfat (MBF; 17-19 mm, n = 15), and high backfat (HBF; 22-26 mm, n = 16) gilts, based on their body weight at mating.

	LBF	MBF	HBF
From mating to day 100 of gestation, kg			
Body weight at mating, kg			
120	1.60	1.90	2.20
130	1.70	1.95	2.25
140	1.75	2.05	2.35
150	1.80	2.10	2.40
160	1.85	2.20	2.50
170	1.95	2.25	2.55
From day 101 of gestation onward, kg			
Body weight at mating, kg			
120	2.60	2.90	3.20
130	2.70	2.95	3.25
140	2.75	3.05	3.35
150	2.80	3.10	3.40
160	2.85	3.20	3.50
170	2.95	3.25	3.55

Animals were weighed and had their backfat thickness measured regularly during gestation. Blood samples were obtained from gilts at mating and on day 109 of gestation to determine hormonal and metabolic status. Animals were then slaughtered on day 110 of gestation to collect mammary glands for dissection and compositional analysis of the parenchymal tissue.

Mammary extraparenchymal tissue weight was less in LBF and MBF than in HBF gilts (1259.3, 1402.7 and 1951.5 ± 70.4 g, respectively). Weight of parenchymal tissue was not affected by treatment, but its composition was altered. Concentrations of DNA and RNA decreased as backfat depth increased, whereas percent fat and dry matter increased. Circulating concentrations of leptin tended to be lower at mating and were lower on day 109 of gestation in LBF than HBF gilts. On day 109 of gestation, concentrations of insulin and the

growth factor IGF-1 were lower in LBF and MBF than in HBF gilts, whereas those of urea were greater. When differences in body conditions of gilts that were present at mating were maintained throughout gestation, it had an impact on mammary development. Extraparenchymal tissue mass was affected and, more importantly, composition of parenchymal tissue was altered indicating a beneficial effect of gilts being in the thinner treatment groups at mating.

CONCLUSIONS

It is now known that body condition of gilts affects their mammary development. A gilt that is too thin (12-15 mm backfat thickness) on day 110 of gestation has less milk-secreting tissue in her udder than a gilt with 17 to 26 mm backfat. Body condition in late pregnancy must therefore be considered to achieve optimal sow lactation performance. Differences in backfat at farrowing can be brought about by nutrition during gestation or by differences in body condition that are already present at mating and not corrected throughout gestation. Findings suggest that nutrition in gestation is more important than body condition at mating to achieve optimal mammary development in late gestation.

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SOW FEEDING STRATEGIES: GESTATING SOWS

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ABSTRACT

Sows experience significant changes in their energy and nutrient requirements during gestation, which are mainly driven by stage of gestation and sow maturity. As such, it is up to nutritionists to determine the optimal way to meet these changing nutrient requirements and the consequences or benefits of altering gestation feeding programs (or not). Ultimately, we want to minimize variation in sow body condition at all stages of the reproductive cycle and aim to achieve an optimal body condition at each stage (i.e. from breeding to weaning). Parity-segregated, phase-feeding or precision feeding approaches appear to be the most successful at meeting the changing energy and nutrient requirements of gestating sows. Optimizing the nutrition of the gestating sow is crucial to ensure the sow's health, well-being, and long-term productivity.

THE DYNAMIC NUTRIENT REQUIREMENTS OF GESTATING SOWS

Energy requirements for gestating sows are dictated by maternal body maintenance functions, growth of conceptus, and the changes in maternal energy stores (i.e. protein and fat retention). We typically estimate the energy requirement of gestating sows using parity, sow body weight, (anticipated) litter size, (anticipated) piglet birth weight, and environmental conditions (thermal environment, floor type, and sow activity level; NRC, 2012) as model inputs. The order of priority for the gestating sow is to first meet her energy requirements for maintenance (e.g., body temperature regulation), then growth of conceptus, and finally, maternal protein gain. Any additional energy intake is directed toward maternal fat deposition and, in instances of insufficient energy intake, the sow will mobilize her own fat reserves to meet the requirements for maintenance and conceptus growth (NRC, 2012).

Amino acid requirements for gestating sows are also dictated by maternal maintenance functions, growth of pregnancy-associated tissues, and deposition of protein in the maternal body. Amino acid requirements for maintenance are largely driven by basal intestinal endogenous amino acid losses, which are influenced by feed intake, and losses associated with shedding of hair and sloughing of skin cells. Expansion of the pregnancy-associated (i.e. fetus, uterus, placenta and associated fluids, and udder) and maternal protein pools, however, constitute the majority of amino acid needs during gestation. Each of these tissues have a unique amino acid profile and the growth of each occurs at vastly different rates and at different times during gestation. For example, the placenta and fluids grow rapidly early in the second trimester, but they remain relatively constant in size throughout the remainder of gestation. Conversely, the fetal and udder tissues experience rapid and sustained growth during the final trimester (NRC, 2012; Trottier et al., 2015). As with energy, the sow will sacrifice her own body amino acid (protein) stores to maintain pregnancy-associated growth when the diet is deficient in amino acid(s).

Understanding the rates of tissue growth and the energy and amino acids required for each tissue allows nutritionists and researchers to estimate the precise amount of energy and amino acids required on each day of gestation; these estimated requirements can be vastly different between early and late gestation and among sows of different parities. For example, the estimated energy requirement of first parity sows increases by approximately 45% between day 1 and day 114 of gestation, but estimated lysine requirements increase by nearly 200% in the same timeframe (Figure 1; NRC, 2012; Buis 2016). Danish researchers also predict that energy and lysine requirements increase by 60 and 149%, respectively, between day 104 and 115 of gestation (Feyera and Theil, 2017). Differences also exist among sows of different parities. For example, the estimated lysine requirements between day 1 and 89 of gestation (first + second trimesters) versus between day 90 and 114 (third trimester) increase by approximately 35% for first parity sows but, the estimated lysine requirements for parity 4+ sows are approximately 36% lower than first parity sows for both gestation periods (Figure 2; NRC, 2012). Therefore, when feeding a single diet to all gestating sows, regardless of stage of gestation or parity, it is likely we over supply nutrients to most sows in early gestation (parity 2+) and potentially undersupply nutrients to sows in late gestation (particularly first parity sows). If we consider growing and finishing pigs, between 20 kg and 120 kg of body weight, estimated energy and lysine requirements increase by approximately 50 and 130%, respectively (NRC, 2012), and yet, these animals are routinely fed a minimum of 3 different diet phases in order to closely match nutrient requirements with dietary supply. In doing so, we can optimize growth, improve feed efficiency, and reduce both feed costs as well as nutrient losses to the environment. Granted, the logistics of switching diet phases among growing and finishing pigs are relatively less complicated as specialized feed delivery equipment and housing are not required (i.e. versus gestating sows). Moreover, unlike the growing pig where the drive is to grow the body, the gestating sow's goal is to support pregnancy, therefore, she is able to buffer the diet with her own reserves of protein and energy. It appears that the sow can do this very well, at least for a short time, and therefore, the effects of under- or over-supplying nutrients are not always easy to discern in the short-term. Therefore, it is important to meet energy and nutrient requirements "right now" but also to consider that how we feed the sow at this moment can also influence future phases of the reproductive cycle.

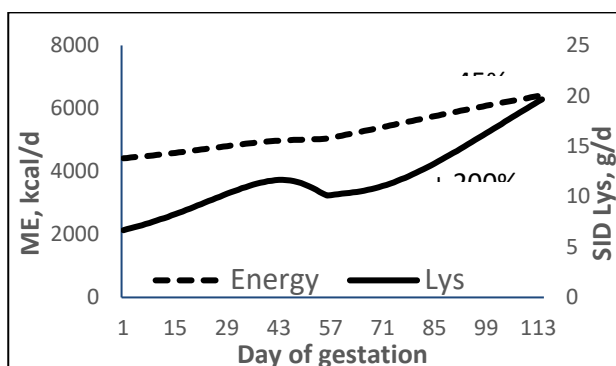


Figure 1. Estimated energy and lysine requirements for first parity sows (NRC, 2012; Buis, 2016).

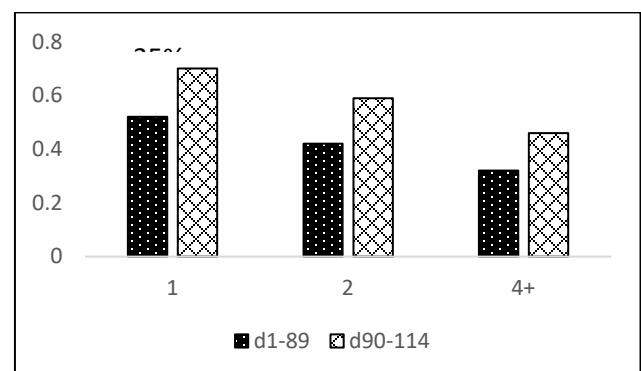


Figure 2. Estimated lysine requirements (SID, %) for sows based on parity and stage of gestation (NRC, 2012).

MEETING NUTRIENT REQUIREMENTS

Ultimately, we want to minimize variation in sow body condition at all stages of the reproductive cycle and aim to achieve an optimal body condition at each stage (i.e. from breeding to weaning). During gestation, for example, sow feed intake is often restricted to minimize excessive body weight and fat gain. The degree of competitiveness at feeding time can, however, influence the amount of feed a sow receives and greatly impact the variation in body condition at the time of farrowing, no matter how accurately the diet is formulated.

Feeding Programs and Feed Delivery Technologies

Gestating sows are typically fed a constant level of feed throughout gestation, regardless of age, with adjustments in feed allowance based on a visual assessment of body condition by a stockperson. The large changes in energy and nutrient requirements during gestation and across parities suggests that the dietary supply of energy and nutrients should also be adjusted accordingly. Considering that lysine requirements increase to a much greater extent than energy requirements (between early and late gestation), a simple increase in feed allowance to meet energy needs may still limit lysine intake and promote the breakdown of maternal protein stores, even before farrowing (Ball and Moehn, 2013). Indeed, a parity-segregated, phase-feeding approach seems to be the simplest way to meet the dynamic energy and nutrient requirements of gestating sows. In this program, one diet with lower nutrient density is fed during early gestation (day 0 to 84) and a second diet with greater nutrient density is fed during late gestation (day 85 to 114). To account for parity differences in nutrient requirements, different feeding levels are suggested for parity 1, parity 2, and parity 3+ sows. It was estimated that adaptation of such a feeding program would equate to \$10 cost savings per sow per year as the extent of nutrient wastage would be reduced (e.g., minimize instances of oversupplying nutrients in early gestation; Ball and Moehn, 2013). The implementation of such a feeding program requires a minimum of two feed lines and bins, and the ability to group sows based on parity and stage of gestation within the facility.

Precision feeding, with the application of computer-controlled electronic sow feeders (ESF), is a more technologically advanced approach to meeting estimated (daily) nutrient requirements of gestating sows, which can also be used to implement a parity-specific, phase feeding program. Some systems enable blending of two (e.g., high and low protein diets) and up to four diets directly within the feeder. Therefore, based on the nutrient requirement software integrated with the system, the feeder can blend a personalized diet on each day of gestation to meet the estimated nutrient requirements of each individual sow (Buis, 2016). Research in this area showed that first parity sows receiving a precision feeding program had greater body weight gain during late gestation, when nutrient demands for fetal growth are the highest (Buis, 2016), indicating that nutrient requirements were met for pregnancy-associated weight gain but also maternal weight gain (i.e. the sows did not have to compensate diet insufficiencies by sacrificing their own growth or maternal tissues). In addition, the sows that received the precision feeding program during gestation also had approximately 7% greater feed intake during the subsequent lactation (Buis, 2016).

Clearly precision feeding technology has the greatest start-up costs but also has the potential to nearly eliminate any variation in feed consumption to maintain ideal body condition. Thus far, implementation of phase- or precision-feeding systems under commercial conditions has been limited because of the logistical and financial burdens of reconfiguring feed handling systems and increased management requirements. However, as we continue to move toward group housing of gestating sows, ESF will become more widely used and parity-segregated, phase feeding, or precision feeding will become more practical.

(LONGTERM) CONSEQUENCES OF GESTATION FEEDING PROGRAMS

Improper nutrition has a cumulative effect on reproductive sows across reproductive cycles (Trottier et al., 2015) and effects may extend to the offspring as well (e.g., Chen et al., 2017). The consequences for sow longevity and offspring productivity among different gestation feeding programs and feeding systems are largely unexplored in the scientific literature, but some inferences can be made.

In a large commercial study, it was found that first parity sows typically entered a negative energy balance prior to farrowing (i.e. between day 75 and 109 of gestation), which resulted in reduced maternal protein deposition (growth) and net lipid (fat) loss (Thomas et al., 2018). This is noteworthy as lipid loss prior to farrowing may compound with the extensive lipid loss during lactation, particularly for first parity sows whose lactation feed intake is restricted by gut capacity, and negatively impact future performance and herd retention (Trottier et al., 2015). So, a logical solution is to increase feed allowance during late gestation. In most instances, however, it appears that increasing energy intake in the last trimester does not have beneficial effects for birthweights of offspring, but increases total weight gain during gestation, decreases sow feed intake during lactation, and increases maternal weight loss during the subsequent lactation (Mallmann et al., 2018). Such fluctuations in sow body weight and body composition can also negatively impact post-weaning performance of these sows (e.g., lengthened post-weaning interval to estrus, anestrus, reduced subsequent litter size; Yoder et al., 2013), and thus their likelihood of being retained in the herd as productive members.

Finally, offspring outcomes may be influenced by inappropriate maternal nutrition during gestation. For example, the early development of the piglet gastrointestinal tract and immune system occurs during gestation and therefore, supplying insufficient or unbalanced energy and nutrients can have long-term implications (O'Doherty et al., 2017). Previous research has shown that failing to meet energy requirements during (late) gestation can reduce the digestive capacity and immune system robustness of the offspring (Chen et al., 2017), which could have long-term implications for subsequent piglet growth. Moreover, oversupplying feed to the pregnant sow between day 25 and 50 and between day 50 and 80 of gestation each reduced offspring growth, carcass weight, and meat quality at slaughter (McNamara et al., 2011).

CONCLUSION

Regardless of housing or feed delivery system, we want to minimize variation in sow body condition at all stages of the reproductive cycle and aim to achieve an optimal body

condition at each stage (i.e. from breeding to weaning). Parity-segregated, phase-feeding or precision feeding approaches appear to be the most successful at meeting the changing energy and nutrient requirements of gestating sows. Optimizing the nutrition of the gestating sow is crucial to ensure the sow's health, well-being, and long-term productivity, as well as the quality of her offspring. As we continue to move toward group housing of gestating sows, computer-controlled feed delivery systems will become more widely used and parity-segregated, phase feeding, or precision feeding will become more practical.

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BIOSECURITY BEYOND THE BARN
Marlon Bauman, Vernla Transport Inc.
Tyler Jutzi, Brussels Transport Ltd.
Ontario Livestock Transporters' Alliance

The Ontario Livestock Transporters' Alliance was formed in 2017 to provide a unified voice on issues affecting the livestock transport sector in Ontario. The association is a voluntary, not-for-profit membership association representing 12 livestock transport companies and five associate members.

The mandate of the association is to:

- create a communications network which will provide education and sharing of information among the livestock transport sector;
- and,
- work with producers, processors, and government departments on issues that benefit the livestock transportation sector in general and the swine and cattle industries specifically.

What is biosecurity?

Biosecurity is a form of risk management. The risks in this case are disease-causing organisms such as viruses, bacteria, and parasites.

The basic concept is to “keep disease out” as a first line of defense but if an issue arises on your farm you want to “keep it in” to prevent its spread and “shut it down” as quickly as possible to reduce its impact on your production and on the pork sector as a whole.

Producers, farm workers, transporters and everyone else involved in the transportation of pigs is responsible for ensuring their health and welfare including mitigating the risk of disease.

Why is biosecurity important to producers?

On average, pigs are transported three or four times in their lifetime. These transportation events provide an opportunity to spread infectious diseases, such as Porcine epidemic diarrhea (PED) and Porcine reproductive and respiratory syndrome (PRRS), which may cause significant financial losses to the impacted producers and throughout the pork supply chain.

Some herd owners spend thousands of dollars each year fighting disease outbreaks. In addition to the costs of health care, valuable livestock and production are also lost. While diseases that lead to mortalities are the most obvious and urgently treated, there are a large number of production limiting diseases which have a significant effect on the economic viability of the farming operation. A good biosecurity program will reduce the spread of endemic disease such as PRRS and as well as foreign animal diseases (e.g. African Swine Fever, or ASF). On-farm biosecurity practices will also help reduce the spread of potential human pathogens such as *Salmonella spp.*, *Listeria spp.*, *E.coli O157:H7* and *Campylobacter spp.*

Transport biosecurity

Generally accepted best practices for transport biosecurity include the following:

- Clean and disinfect trailers between transportation events using cleaners (detergents, degreasers) and disinfectants according to the manufacturer's directions.
- Follow biosecurity protocols for departure and destination sites. Respect and follow posted biosecurity signs.
- When accessing sites, avoid muddy or manure-contaminated roads and laneways. Drive slowly to minimize contamination of the undercarriage of the trailer.
- Do not cross-contaminate between the truck and trailer and the site. Establish a line of separation for clean and dirty sides at the sites. Do not cross that line unless you wear clean coveralls, gloves and footwear.
- Be aware of disease outbreak updates provided by the CFIA, USDA, and provincial governments. Whenever possible, select routes which avoid locations where a disease has been identified.
- Transporters need to be aware of signs of disease and fitness for transport. Transporters have the right to refuse to load any animal they deem is unfit for transport.
- Clean out (scrape) all organic waste, including bedding, feed and manure at a designated scrape-out location or at the destination site (depending on the situation).

What producers can do to assist transporters

In order to follow good transport biosecurity practices, there are some on-farm measures that producers and farm managers are asked to provide or implement.

- Inform your transporter of your farm biosecurity protocols and the health status of animals at the premises including confirmed or suspect disease. This will help the transporter schedule pick-up and deliveries and also plan for possible additional cleaning and disinfecting.
- Ensure feed is withdrawn several hours before loading, exact timing will depend on type of movement, e.g. to slaughter, to another facility. Feed withdrawal before transport is done as an animal welfare measure and a food safety practice. Heavy feed intake before transport can lead to motion sickness, vomiting and death loss in pigs. It also increases body heat and thus temperature of load. Feed withdrawal will reduce the amount of manure in trailers and prevent fecal contamination of carcasses at the processing plant.
- Ensure laneways and roadways used by transport vehicles are kept free of manure and mud. Organic matter, potentially infected with pathogens, can accumulate on wheels, wheel wells and the undercarriage, if farm access

routes are contaminated and are poorly maintained. These pathogens can be transmitted to other farms or delivery sites.

- Identify the entrance you wish drivers to use as the access point to your facilities (house, office). Post a durable and clearly visible sign stating “Visitors’ Entrance” and directional signs if needed.
- Ideally, drivers should not enter the production area where animals are housed.
- A buzzer or other device, such as a hand-held radio, should be available at the barn/office/house entrance so that visitors can contact the producer or employees in the barn if no one is available in the house/office area. Ensure your telephone or cell phone number is posted and clearly visible.
- Provide a covered and sheltered area where drivers can change footwear, etc., before entering the trailer.
- Have sufficient help on hand to load animals and prevent backward movement of pigs or bedding/manure from transport unit when loading.
- Locate deadstock pick up sites away from barns and load out areas so the transport vehicles are not travelling through this area.
- Provide a container or plastic bag immediately outside the barn or in the anteroom for collecting any disposable items used by drivers. This will ensure drivers do not transport any potential pathogens off farm on the disposable clothing.

RESOURCES

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Day 2: Main Sessions

THE RISKIEST THING YOU CAN DO IS PLAY IT SAFE

Kevin Stewart
The Forward Factors

Growing up on the farm dad always told us, *"The status quo is never sustainable. You always regress."* If he was right, why do we always regress when we defend the status quo? It certainly makes sense when you think of it in terms of the crops you plant. Your crops are only ever growing or dying. There is no status quo for plants. Are we any different?

If you are content with the way you've been running your business for the past few years, you may have a reluctance to change anything since it seems to be working well. In this situation there is a good chance you're not seeking out new and innovative ways to do things. In the meantime, everything around you is changing... customer preferences change, equipment ages, you age, assumptions get out dated, even your competition changes. If all the factors influencing your business are constantly changing, then what are the odds you can be successful staying the same?

"Be not afraid of going slowly; be afraid only of standing still." Chinese proverb

Tom Peters author of Thriving on Chaos says the old saw, *'If it ain't broke, don't fix it,'* doesn't apply anymore. *"In a constantly shifting world, anything can happen. If it ain't broke, you just haven't looked hard enough.... fix it anyway...nothing is forever. Learn to live with change, better yet, be prepared to take advantage of change."*

Why is standing still and defending the status quo such a problem? Seth Godin, author of, *Survival Is Not Enough: Why Smart Companies Abandon Worry and Embrace Change*, says, *"The riskiest thing you can do now is play it safe."* Godin has created a list of warning signs that you might be defending the status quo and not know it. Ask your team if any of these apply to you. When confronted with a new idea, do you:

- exaggerate how good things are now in order to reduce your fear of change?
- undercut the credibility or experience of people behind the change?
- do you compare the best of what you have with the possible worst of what a change might bring?
- grab onto the rare thing that could go wrong instead of the likely thing that will go right?
- focus on short-term cost instead of long-term benefits?
- slow the implementation and decision making down instead of speeding it up?

The key to making this work is to be open to possibilities:

...the possibility that you might be wrong

...the possibility that there is a better way and you don't see it

This approach will help you to embrace disruption and abandon the status quo.

*Kevin Stewart is a keynote speaker and developer of **Forward Factors: Disruptive Ideas that Drive Innovation** www.theforwardfactors.com*

DIGESTIBLE CALCIUM AND DIGESTIBLE PHOSPHORUS IN SWINE DIETS

The CFM DE LANGE Lecture in Pig Nutrition

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ABSTRACT

Values for digestible Ca are believed to be additive in a complete diet. Therefore, use of digestible Ca may result in the most accurate diet formulations for pigs. The standardized total tract digestibility (**STTD**) of Ca in Ca-containing feed ingredients have been reported in recent years. Supplementation of exogenous phytase to swine diets increases not only P digestibility but also Ca digestibility. Therefore, the STTD values without or with phytase are also available. Values for the STTD of Ca and P by sows in mid-gestation are less than by growing pigs, which indicates that formulating diets for gestating sows using STTD values that were obtained in growing pigs may result in inaccuracies. Several experiments were conducted to determine the requirement for STTD Ca by growing pigs and the STTD Ca values in feed ingredients that have been evaluated were used to formulate diets. Results demonstrated that feed intake and average daily gain are reduced if excess Ca is included in diets. The negative effects of excess dietary Ca on growth performance are ameliorated by increasing dietary P above the requirement. As a consequence, the ratio between STTD Ca and STTD P appears to be more important than the actual inclusion rates. The estimated STTD Ca:STTD P ratios to maximize growth performance of pigs decrease from 1.40:1 to 1.10:1, as BW of pigs increases from 11 to 130 kg, whereas the STTD Ca:STTD P ratios to maximize bone ash increase from 1.70:1 to 2.30:1, as the pig grows. It appears that less dietary Ca is needed to optimize growth of pigs compared with optimizing bone ash. Therefore, greater STTD Ca:STTD P should be used if pigs are destined for the breeding herd than for terminal pigs.

Keywords: Calcium, Digestibility, Pig, Requirement

INTRODUCTION

With monosodium phosphate or monocalcium phosphate as standards, relative bioavailability of P in feed ingredients for pigs had been used (NRC, 1998). Only limited data for the relative bioavailability of Ca in feed ingredients were published, but the availability of Ca in most Ca supplements was believed to be close to 100% (Ross et al., 1984; Kuznetsov et al., 1987). However, values for the relative bioavailability vary among standard phosphates (Petersen et al., 2011), which makes values for the bioavailability of P difficult to compare from study to study. Therefore, the standardized total tract digestibility of P has been measured and is now used to estimate requirements of P for pigs (NRC, 2012).

Unlike P, Ca requirements for pigs have been expressed as total Ca because there has been scarce information about the digestible Ca in feed ingredients. If information on digestible Ca is available, therefore, the requirement for Ca by pigs also can be expressed on a digestible Ca basis.

DIGESTIBILITY OF CALCIUM

Apparent total tract digestibility (**ATTD**) values (%) can be calculated as previously outlined (Almeida and Stein, 2010) using Eq. [1]:

$$\text{ATTD} = \frac{\text{intake} - \text{output}}{\text{intake}} \times 100, \quad [1]$$

where intake and output of Ca in feces are expressed as g per d.

The values for ATTD are often underestimated because endogenous loss of Ca contributes to the fecal Ca excretion. The endogenous loss of Ca from pigs is composed of basal endogenous loss of Ca and diet specific endogenous loss of Ca. The basal endogenous loss of Ca is an inevitable loss from the body that is related to dry matter intake (**DMI**) and the diet specific endogenous loss is related to diet-specific components (Stein et al., 2007). Therefore, the standardized total tract digestibility (**STTD**) can be calculated by correcting the ATTD values for the basal endogenous loss, and true total tract digestibility (**TTTD**) can be calculated by correcting the ATTD values for total endogenous loss, which includes both basal and specific endogenous losses. Because STTD and TTTD values are not affected by the level of nutrients in the ingredient, the values are additive in mixed diets (Zhang and Adeola, 2017; She et al., 2018).

Basal endogenous loss of Ca has been measured by feeding a Ca-free diet to pigs (González-Vega et al., 2015a) and are calculated as previously outlined (adapted from Almeida and Stein, 2010) using Eq. [2]:

$$\text{Basal endogenous loss} = \frac{\text{output of Ca}}{\text{DMI}} \times 1,000, \quad [2]$$

where basal endogenous loss is expressed in mg/kg of DMI, DMI in kg of DMI/d and the fecal output of Ca in g/d.

The STTD values (%) can be calculated from the following Eq. [3] (adapted from Almeida and Stein, 2010):

$$\text{STTD} = \frac{\text{intake} - (\text{output} - \text{daily basal endogenous loss})}{\text{intake}} \times 100, \quad [3]$$

where intake, output, and daily basal endogenous loss are in g/d.

Unlike the basal endogenous loss of P, which has a relatively constant value of around 190 mg/kg DMI among studies (NRC, 2012), the basal endogenous loss of Ca varied from 123 (González-Vega et al., 2015b) to 550 mg/kg DMI (Merriman, 2016). Values for the basal endogenous loss of Ca and the ATTD of Ca were lower if pigs were fed cornstarch-based diets compared with corn-based diets (González-Vega et al., 2015a). The increase in values

for basal endogenous loss of Ca and ATTD of Ca by pigs fed corn-based diets may be because of the presence of fiber in corn, which prevents precipitation of Ca in the intestine.

The total endogenous loss of Ca can be estimated by using a regression method (González-Vega et al., 2013). The TTTD values (%) can also be calculated as previously outlined (Petersen and Stein, 2006) using Eq. [4]:

$$\text{TTTD} = \frac{\text{intake} - (\text{output} - \text{daily total endogenous loss})}{\text{intake}} \times 100, \quad [4]$$

where intake, output, and daily total endogenous loss are in g/d. The negative y-intercept represents the total endogenous loss and the slope represents the TTTD of Ca in the regression, which regressed absorbed Ca against intake of Ca. The total endogenous loss of Ca that have been published varies from 160 mg/kg DMI (González-Vega et al., 2013) to 314 mg/kg DMI (Zhang and Adeola, 2017), depending on the feed ingredients in diets.

DIGESTIBILITY VALUES FOR CALCIUM IN FEED INGREDIENTS

Most digestible Ca in diets for pigs originate from mineral supplements including Ca phosphates and Ca carbonate, but animal and plant origin ingredients may also provide Ca. Calcium from feed ingredients is not always fully digested and absorbed by pigs and previous data indicated that digestibility of Ca decreased by increasing dietary phytate (Almaguer et al., 2014). Phytate is a primary form for P in plant feed ingredients and pigs usually cannot utilize phytate-bound P due to the absence of phytase secreted from the body. In addition, phytate can chelate Ca ions and form Ca-phytate compounds (Selle et al., 2009). Because corn is a primary source for swine diets, phytate from corn can bind to Ca ions from Ca carbonate or other feed ingredients (González-Vega et al., 2015b; Merriman et al., 2016b). Therefore, supplemental phytase increases both P and Ca digestibility (Almeida et al., 2013; Rodríguez et al., 2013; González-Vega et al., 2015b). The digestibility of Ca in Ca phosphates appears not to be affected by use of exogenous phytase because Ca from monocalcium phosphate or dicalcium phosphate already is bound to phosphoric acid (Walk, 2016). The ATTD, STTD, and TTTD of Ca in feed ingredients without or with supplemental phytase have been determined in recent years (Table 1).

DIGESTIBILITY VALUES FOR CALCIUM BY GESTATING SOWS

Values for STTD of Ca and P that were determined in growing pigs have been published in recent years (NRC, 2012; Stein et al., 2016), but values for the ATTD of Ca and P were less in sows in mid-gestation compared with growing pigs (Kemme et al., 1997; Lee et al., 2018a). The difference in feed intake was not the main reason for the difference in digestibility of Ca and P because level of feed intake appears not to affect digestibility of Ca and P (Lee et al., 2018a). Greater quantities of endogenous losses from gestating sows compared with growing pigs may affect the ATTD values, because the basal endogenous losses of Ca and P from mid-gestating sows were more than 3 times greater than from growing pigs (Lee et al., 2018b). However, even if correcting the ATTD values for the greater basal endogenous losses, sows in mid-gestation had lower values for STTD of Ca and P compared with growing pigs. Therefore, differences in feed intake and basal endogenous losses were not the main

reason for the differences in digestibility values. The digestibility of Ca and P also differed among gestating sows in different trimesters and sows in late-gestation had greater STTD of Ca and P than sows in early- or mid-gestation. (Lee et al., 2019). This difference may be related to the different requirement for Ca and P by sows in different gestation periods. Therefore, it is not always accurate to formulate diets for gestating sows using digestibility values for Ca and P that were obtained in growing pigs or in sows in a certain period of gestation.

Table 1. Apparent total tract digestibility (ATTD), standardized total tract digestibility (STTD), and true total tract digestibility (TTTD) of Ca in feed ingredients without and with phytase added to the diet fed to growing pigs

Item, %	ATTD of Ca		STTD of Ca		TTTD of Ca	
	-	+	-	+	-	+
Supplementation of phytase ¹ :						
Mineral supplements						
Calcium carbonate ^{2, 3, 4, 5, 6, 7, 8, 9}	68	74	71	77	70	-
Calcium carbonate without fat source ⁶	52	-	-	-	-	-
Dicalcium phosphate ^{2, 3}	73	76	77	79	76	-
Lithothamnium calcareum ²	63	66	65	69	-	-
Monocalcium phosphate ²	83	83	86	86	-	-
Plant feed ingredients						
Canola meal ^{7, 8, 10}	41	-	45	70	47	70
Soybean meal ^{7, 8, 11}	53	-	78	-	-	-
Sugar beet co-product ²	66	63	68	65	-	-
Sunflower meal ⁸	22	-	-	-	-	-
Animal feed ingredients						
Meat and bone meal ¹²	75	-	77	82	-	-
Meat meal ¹²	75	-	77	86	-	-
Fish meal ¹³	62	71	65	73	-	-
Poultry meal ¹²	85	74	82	76	-	-
Poultry by product meal ¹²	81	84	88	87	-	-
Skim milk powder ⁷	95	-	97	-	-	-
Whey powder ⁷	97	-	99	-	-	-
Whey permeate ⁷	61	-	63	-	-	-

¹Phytase level varies from 500 to 1,500 phytase units/kg diet.

²González-Vega et al. (2015b); ³Zhang and Adeola (2017); ⁴Blavi et al. (2017); ⁵Merriman and Stein (2016); ⁶Merriman et al. (2016a); ⁷Unpublished data from the University of Illinois; ⁸Zhang et al. (2016); ⁹Kwon and Kim (2017);

¹⁰González-Vega et al. (2013); ¹¹Bohlke et al. (2005); ¹²Merriman et al. (2016b); ¹³González-Vega et al. (2015a).

REQUIREMENTS FOR CALCIUM BY GROWING PIGS

Supplementation of phytase, genetics of animals, energy concentrations in diets, and management strategies may affect Ca requirements by pigs (Suttle, 2010). Other factors including ratio between dietary Ca and P (Veum, 2010), concentration of vitamin D in the diet (Crenshaw, 2001), and the age of the animal (NRC, 2012) also can affect the requirement for Ca by pigs.

REQUIREMENTS FOR TOTAL CALCIUM

Because of a lack of data for the digestibility of Ca in feed ingredients fed to pigs, Ca requirements have been expressed based on total Ca. Although factorial calculations are believed to be more accurate to estimate nutrient requirements compared with empirical measurements, the empirical method has been more frequently used for determination of Ca requirements by pigs (Crenshaw, 2001). The most common response criteria for the empirical method are growth performance and bone development, but other parameters including blood composition and carcass measurements have also been used (Cromwell et al., 1970; Stockland and Blaylock, 1973). Most previous experiments had a fixed ratio between dietary Ca and P or had varied Ca levels with a fixed concentration of P in the diets. It has been demonstrated that greater quantities of Ca and P are required to maximize bone development than to maximize growth.

The reason requirements for Ca by pigs have been expressed on the basis of total Ca rather than as digestible Ca is that there has been a lack of data for the digestibility of Ca in feed ingredients. Therefore, the requirement for total Ca by growing pigs was estimated by NRC (2012) by multiplying the STTD P requirement by 2.15. A modelling approach was used to estimate the requirements for STTD P by growing pigs and the model was based on several assumptions: 1) 85% of the P requirement to maximize bone ash is enough to maximize growth performance, 2) there is a linear relationship between body P mass and body protein mass, 3) the efficiency of STTD P utilization for P retention is 77%, 4) the basal endogenous loss of P is 190 mg/kg DMI, and 5) there is a daily minimum urinary loss of P of 7 mg/kg BW. The following equation [5] was used to estimate the STTD P requirement (%):

$$\text{STTD P requirement} = 0.85 \times [\text{maximum whole-body P retention} / 0.77 + 0.19 \times \text{DMI} + 0.007 \times \text{BW}], \quad [5]$$

REQUIREMENTS FOR DIGESTIBLE CALCIUM

Although requirements for Ca are expressed as total Ca because of a lack of the data for the digestibility of Ca in feed ingredients, it was indicated that Ca and P requirements are more accurate if expressed as a ratio between digestible Ca and digestible P (NRC, 2012). Therefore, the STTD of Ca in different Ca-containing feed ingredients was determined, which allowed the formulation of diets based on STTD Ca and the estimation of STTD Ca requirements for growing pigs. Five experiments have been conducted to estimate the requirement for STTD Ca and the optimum ratio between STTD Ca and STTD P by growing pigs in different phases that were between 11 and 130 kg of BW.

The first study was conducted for 22 days using pigs from 11 to 25 kg and 6 dietary treatments (González-Vega et al., 2016a). Diets consisted of 6 levels of STTD Ca and a fixed

concentration of STTD P. The response variables were growth performance, bone mineralization, and retention of Ca. Results indicated that bone ash (grams per femur) and Ca retention were maximized if the STTD Ca concentrations were at or above 0.48% and 0.60%, respectively. However, due to a reduction in ADG and G:F at STTD Ca concentrations above 0.50%, the STTD Ca that maximized growth performance could not be estimated. Therefore, in the following studies different concentrations of STTD P that were below, at, or above the requirement were used to estimate the requirement for STTD Ca and the optimal STTD Ca:STTD P ratio.

The subsequent studies were designed to have 5 levels of STTD Ca (from 30% to 170% of the estimated requirement for Ca) and 3 (Merriman et al., 2017; Lagos et al., 2019a) or 4 (González-Vega et al., 2016b; Lagos et al., 2019b) concentrations of STTD P (from 50% to 150% of the estimated requirement for P). A total of 15 or 20 different diets and STTD Ca:STTD P ratios were thus tested in each experiment.

In the study conducted by González-Vega et al. (2016b), pigs from 25 to 50 kg were fed 20 experimental diets for 28 days. Results supported the previous observation of detrimental effects of excess dietary Ca on growth performance, and also demonstrated that the severity is greater if STTD P is at or below the requirement than if the concentration of P is above the requirement. This observation highlights the importance of using STTD Ca:STTD P ratios in the formulation of diets for growing pigs. It was then concluded that growth performance, bone ash, and Ca retention is maximized at STTD Ca:STTD P ratios of 1.16:1 to 1.43:1, 1.55:1 to 1.77:1, and 2.45:1 to 3.10:1, respectively.

The following 2 studies were conducted to estimate requirements for STTD Ca in growing-finishing pigs using 15 different STTD Ca:STTD P ratios (5 STTD Ca levels and 3 STTD P levels). Pigs from 100 to 130 kg (Merriman et al., 2017) or from 50 to 85 kg (Lagos et al., 2019a) were fed experimental diets for 30 and 28 days, respectively. Because results of previous studies demonstrated that Ca requirements for Ca retention are greater than for bone ash, in these studies the response variables were only growth performance and bone mineralization. Again, results demonstrated the negative effects of excess dietary Ca on growth performance and this impact could be ameliorated by supplying P above the requirement for P. Results also indicated that if P is at the requirement, STTD Ca:STTD P ratios below 1.10:1 and above 2.30:1 are needed to maximize growth performance and bone ash, respectively. Results of the study with 50- to 85-kg pigs indicated that to maximize growth performance of pigs, a STTD Ca:STTD P ratio of 1.23:1 is needed if P is at the requirement, whereas bone ash is maximized if the STTD Ca:STTD P ratio is greater than 1.59:1.

The last study was conducted using pigs from 11 to 25 kg and 20 dietary treatments (5 STTD Ca levels \times 4 STTD P levels) to estimate STTD Ca requirements to maximize growth performance and bone ash (Lagos et al., 2019b). Results from this study concurred with data from heavier pigs and indicated that excess dietary Ca is detrimental to growth performance if P is supplied at or below the requirement. In this experiment it was observed that an STTD Ca:STTD P ratio that is below 1.40:1 is needed to maximize growth performance of pigs, whereas a ratio of 1.66:1 is needed to maximize bone ash.

CONCLUSIONS

The total tract digestibility method has been used to measure digestibility of Ca and values for STTD of Ca in feed ingredients for pigs have been determined in recent years. Diets for growing and finishing pigs should be formulated based on a ratio between STTD Ca and STTD P because growth performance of pigs decreases by increasing STTD Ca if P is at or below the requirement. Calcium and P requirements for maximizing bone ash are greater than requirements to maximize growth performance, which indicates that after requirements for growth performance are met, pigs utilize Ca and P for bone tissue synthesis. Data from 4 recent studies indicate that the STTD Ca:STTD P ratio to maximize growth performance decreases as pigs grow, whereas the STTD Ca:STTD P ratio to maximize bone mineralization increases as the weight of the pigs increases (Table 2). Results also indicate that less dietary Ca is needed to optimize growth performance of pigs than to maximize bone ash. It is likely, therefore, that pigs that are destined for the breeding herd need diets with a greater STTD Ca:STTD P ratio than terminal pigs.

Table 2. Requirements for Ca to maximize growth performance and bone ash expressed as a ratio between standardized total tract digestible (STTD) Ca and STTD P for growing and finishing pigs fed diets that met the STTD P requirement¹

Item	Body weight range, kg			
	11 to 25	25 to 50	50 to 85	100 to 130
Growth performance	< 1.40:1	< 1.35:1	< 1.25:1	< 1.10:1
Bone ash	1.70:1	1.80:1	2.00:1	2.30:1

¹STTD P requirement estimates are based on NRC (2012).

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WHERE DO ALL THE PIG PARTS GO?

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An overview of export market trends and trade 2018 based on Canada's top ten export market destinations that utilize 92% of our exports. The presentation will focus on each market and their segments, volume, value and product mix trends to illustrate the diversity and challenges of the export marketplace.

(Editor's Note: Due to the interruption in market data in the US, up-to-date information was not available in time to appear in print.)

USMCA, CPTPP AND THE LIKE: DECIPHERING THE ALPHABET SOUP OF TRADE AGREEMENTS

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SUMMARY

While international trade negotiations used to be confined to newspapers' business and economic sections, for the past two years, they have been dominating headlines and steadily delivering headline-grabbing news content.

What has been delighting news editors has also been a major source of concern and anxiety for Canadian business executives, who have had to cope with growing uncertainty and a rapidly changing trading environment.

With the signing of a new agreement between the United States, Mexico and Canada (USMCA) on November 30, 2018, and the coming into force of the Comprehensive and Progressive Transpacific Partnership (CPTPP) one month later, the two largest and darkest clouds on Canada's trade horizon have now dissipated. While some issues of concern have yet to be resolved – notably the ratification of the USMCA, the continued imposition of tariffs on Canadian steel and aluminum by the United States and the future of trade relations with China – the fact remains that preferential access to the Canadian pork industry's two largest export markets is no longer the source of uncertainty it was only four months ago.

TRADE IS VITAL TO CANADA'S PORK INDUSTRY

That Canada's pork industry has been highly engaged in Canada's trade negotiations is not surprising given that access to foreign markets is the sector's lifeblood, with the industry exporting two thirds of its production to customers around the world. Overall, Canada is the seventh largest producing nation in the world, representing 2 percent of global production.

USMCA

Recent trade negotiations have been a high-stakes issue for the Canadian pork industry, including the negotiations that led to the USMCA. The Trump administration potentially pulling out of the North American Free Trade Agreement (NAFTA) had been a major threat facing the industry over the past two years, given that the United States had been Canada's largest export market until 2018.

With the USMCA now signed by the leaders of Canada and its second and fourth largest export markets, a repeal of NAFTA is no longer a threat. The Canadian industry now knows what will replace that agreement if USMCA is ratified and implemented by the three countries.

Besides getting rid of the uncertainty surrounding the future of NAFTA, the USMCA may also lead to better outcomes than its predecessor. For example, the USMCA has new sanitary-phytosanitary (SPS) provisions, including ones on plant inspection equivalence and plant auditing, that expand on rules contained in the old agreement. The agreement may also lead to further integration among the three countries and should open opportunities to discuss disputes and address potential trade distortions. New committees to be created under the USMCA would oversee agri-food trade and might prove useful at promoting further tri-national collaboration.

CPTPP

The CPTPP now being in force is excellent news for the Canadian pork industry, in large part because it expands access into the Japanese market. The fact that the European Union had concluded trade negotiations with Japan in December 2017 put pressure on the Canadian government to finalize the CPTPP negotiations despite the United States pulling out of that agreement. Canada and its 10 Asia-Pacific partner countries thankfully signed this agreement in March 2018. The agreement came into force on December 30, 2018, among the first six countries that ratified the agreement, including Canada and Japan, more than a month before the EU-Japan agreement came into force on February 1, 2019.

In 2018, Japan surpassed the United States as Canada's top export market for pork products. The CPTPP will likely further consolidate Japan's position as Canada's top export market given that the United States exports US\$1.6 billion to Japan and does not have a preferential trade agreement with that country. With tariffs of up to 21 percent on some pork products being eliminated over a 15-year period, the Canadian pork industry is well positioned to further grow its presence in that market. In addition, the CPTPP also includes Australia, New Zealand and Chile, the Canadian pork industry's eighth, ninth and tenth export markets.

With new or renewed trade agreements covering its two largest trading partners (see Table 1 below) and seven of its top 10 export markets, the Canadian pork industry now faces a much more certain trading environment than it did only a few months ago.

OUTSTANDING QUESTIONS

Despite the improving trade outlook described above, three major questions remain outstanding and will be worth watching in coming months.

The first is if and when the USMCA might be ratified by the U.S. Congress. As the Canadian Ambassador to the United States recently stated, the question is not so much whether the agreement will gather a sufficient number of votes to be ratified by Congress, but rather one of when it may actually be put up to a vote.

A related question is whether the U.S. administration will lift its steel and aluminum tariffs imposed under section 232 of the Trade Expansion Act of 1962 on the grounds of national security. Many expected these tariffs to disappear once USMCA negotiations concluded, but they remain in effect and continue to disrupt supply chains in highly integrated industries, including the pork industry. One of these tariffs' side effects has been the fact that Mexico levies retaliatory tariffs against imports of American pork, which distorts trade and impacts hog prices.

Table 1. Canada's pork exports by country.

Export market	Percentage of Exports (as of Nov. 2018)
Japan*	33%
United States*	32.7%
China*	12.9%
Mexico*	6.4%
South Korea*	4.1%
Philippines	2.7%
Taiwan	2.2%
Australia*	1.2%
New Zealand*	0.7%
Chile*	0.3%
Other countries	3.3%

** Denotes countries with whom Canada has preferential trade agreements.*

A second outstanding question is the future of Canada's trade relationship with China, Canada's third-largest export market for pork products. The two countries were reportedly close to launching trade negotiations in late 2017, and there were still rumours a few months ago that the two countries were contemplating entering into a full-scale trade deal or a series of smaller, sector-by-sector agreements. Recent events have led to a significant deterioration of political relations between the two countries, putting any hopes of an enhanced trading relationship on the back burner for the foreseeable future. Even if diplomatic relations were to improve in the coming months, the road to any sort of trade agreement with China will undoubtedly be long, complex and convoluted.

A third issue worth watching in the coming months is whether Canada will enter into trade negotiations with the Association of Southeast Asian Nations (ASEAN), a group of 10 countries that includes the Philippines, Canada's sixth export market. Canada and ASEAN launched exploratory discussions to examine the potential for a free trade agreement in 2017, and the federal government held consultations last year to gauge interest in such an agreement. ASEAN has trade agreements in place with Australia, New Zealand, China, India, Japan and South Korea, and it remains to be seen whether Canada will soon move forward in launching negotiations towards a comprehensive trade agreement with that group of nations.

Day 2: Workshop Sessions

TROUBLE SHOOTING REPRODUCTIVE PROBLEMS USING RECORDS AND OBSERVATIONS

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ABSTRACT

Reproductive failures are often difficult to diagnose. However, use of gestation flow charts and sow card information can be very helpful in determining when problems occurred, and which management phases should be examined. Regular returns to estrus after insemination usually are conception failures. Therefore, insemination dose preparation and handling, detection of estrus, and insemination techniques are the likely culprits. Irregular returns to estrus usually are management conditions that affect sows after week 5 of gestation. These could be due to a number of things. The observation that sows are being detected as not pregnant at the same stage of gestation indicates that one or more routine management tasks probably are involved. Examination of information on farrowing cards for sows in the affected groups that do successfully complete their pregnancy also can be very useful, especially if number born alive is low or mummies and stillborns are high. Low number born alive is consistent with problems associated with a high incidence of regular returns whereas increases in mummies and stillborns can be associated with problems associated with irregular returns. Consequently, these can be used to either substantiate or refute suspect management practices associated with breeding or gestation management.

INTRODUCTION

Causes of reproductive failures can be difficult to diagnose. The main reason for this is that they often aren't observed for some time until after whatever caused them has occurred. For example, when sows give birth to small litters this could have been caused by problems associated with breeding or early pregnancy management, both of which took place at least 3 months prior to the birth of the small litter. Consequently, analyses of production records from a reproductive perspective in conjunction with observations from the farm or farms in question usually are necessary for identification of problems and their subsequent correction. This requires an understanding of what "should have happened" and then application of this information as the basis for trying to determine "when things went wrong". The primary purpose of this presentation is to briefly review reproductive physiology in sows and then illustrate how failures at key stages create rather predictable patterns in production records. Special emphasis will be placed on the importance of collecting information directly from the affected group of sows.

REPRODUCTIVE PHYSIOLOGY

Figure 1 contains a time line of the major events during the management of a sow; the key reproductive events associated with these; and the corresponding reproductive failures

often observed on the farm. In this time line, the day that the sow is rebred after weaning is considered to be Day 0 or the onset of pregnancy.

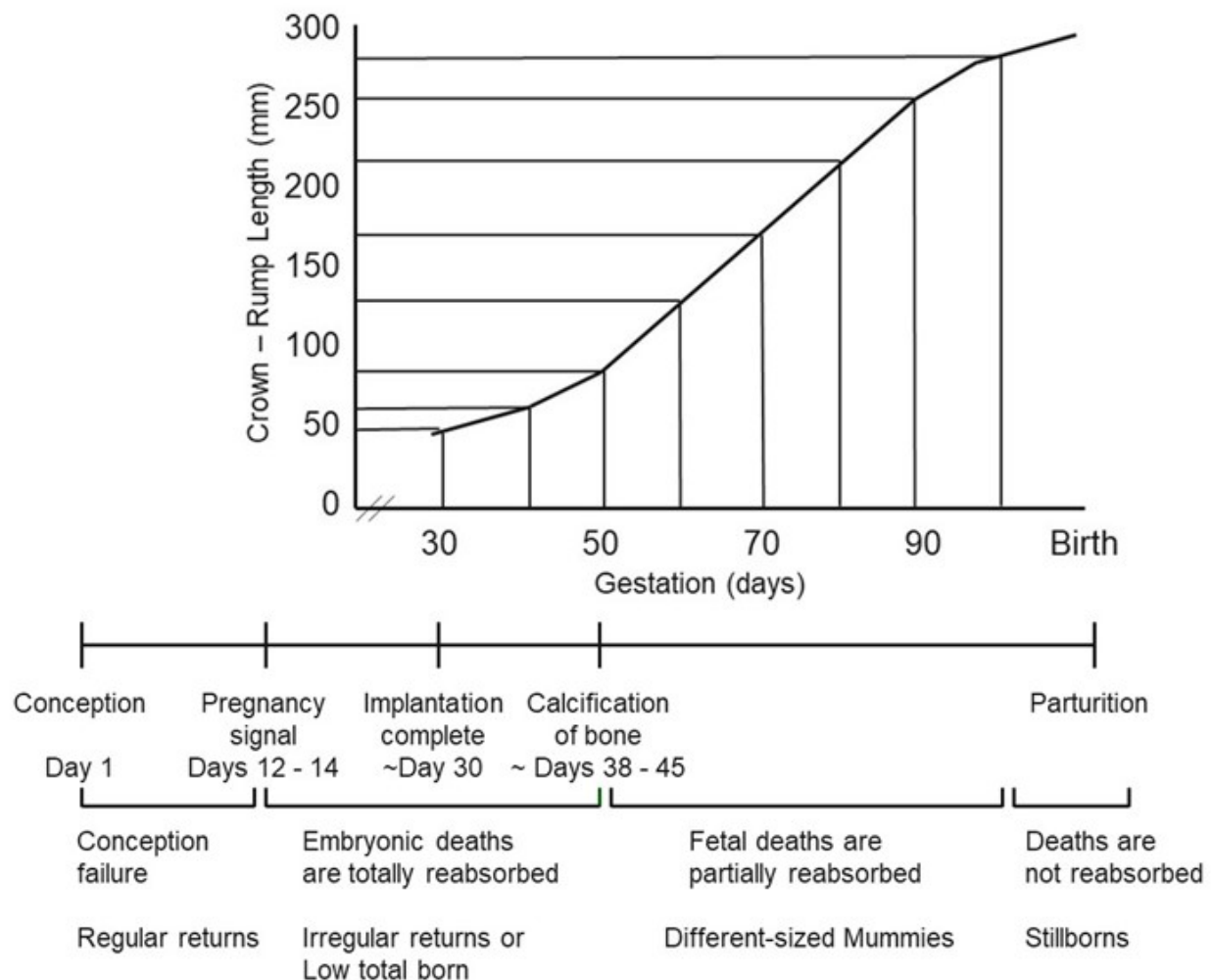


Figure 1. Summary of normal reproductive physiology of sows following insemination and production problems that result when the normal sequence of events is compromised or interrupted (adapted from Flowers, 2019).

Fertilization and First and Second Pregnancy Signals. Fertilization requires that sufficient numbers of fertile spermatozoa be present in the oviduct several hours prior to ovulation. From a management perspective, semen quality, detection of estrus, and the technical competence of breeding technicians all play important roles in fertilization. However, provided that these are done reasonably well, fertilization rates in pigs are usually very high, often exceeding 90%.

After fertilization, embryos remain in the oviduct for several days and then enter the uterus. Around day 12 of pregnancy they begin to elongate and produce estrogens. This local production of estrogens by the embryos is the first signal required for pregnancy. It has been estimated that there needs to be at least 5 viable embryos in the uterus by day 12 in

order to produce enough estrogen for the first pregnancy signal. If there are less than 5, then sows never know that they are pregnant and return to estrus in 18 to 21 days.

If sows receive the first signal by day 12, then pregnancy is maintained. The embryos continue their elongation process and actually begin to form attachments with the uterine endometrium. Sometime after day 17 and before day 28 of pregnancy, the developing embryos initiate a second period of estrogen production. This second pregnancy signal is associated with the development of the fetal portion of the placenta. It is assumed that there also needs to be at least 5 embryos present for this to happen as well. If there are less than 5 during this period, then sows usually return to estrus at irregular intervals which typically are in excess of 30 days post breeding.

Fetal Development. After day 30, implantation is complete and the developing embryos begin to resemble live pigs and are referred to as fetuses. In addition, there is no minimum number of fetuses that need to be present in order for pregnancy to continue. This is one reason why litters of one or two pigs and pseudopregnancy (not-in-pig) occur. During fetal development, the skeleton initially is composed mostly of soft tissue. Between days 50 and 60 of gestation, calcification of this soft tissue begins. When fetuses die prior to this time sows can break down and reabsorb most of the fetal remnants. In contrast, if fetuses die after days 50 to 60, then sows are able to reabsorb only the soft tissue, but not bones that are being calcified. These are referred to as mummies. Stillborn pigs are morphologically normal pigs that are born dead. Most stillborn pigs die during the last week of pregnancy or during farrowing. Based on the normal course of fetal development, the following observations can be made. Pseudopregnancy and small litters with no stillborns or mummies result from problems between days 30 and 50 of gestation. Small litters with a high number of mummies arise when problems occur between day 60 and 100 and the size of the mummies provides a way to estimate when during this period the problem occurred: the smaller the mummy, the earlier the problem occurred after day 60. Finally, small litters with a high number of stillborns are caused by problems that occurred during the last week of gestation or during farrowing, itself.

PRODUCTION RECORDS AND OBSERVATIONS

Gestation flow charts (Figure 2) and sow card information (Figure 3) are two types of records that are available for most production systems. In many situations data from these are summarized to provide monthly, quarterly and yearly performance summaries. The basic idea of the gestation flow chart is that it summarizes when sows are being found as not pregnant. This is often reflected in the “Diff” row which is basically the difference between two consecutive weeks. This is extremely useful for identification of regular (week 3) or irregular returns (> week 4). Regular returns usually are sows that return to estrus 18 to 24 days after breeding and represent conception failures or poor management during the first two weeks post breeding. Irregular returns are sows that are identified as not pregnant after week 4. The first time this is routinely done on most farms is during pregnancy diagnosis with real-time ultrasonography. However, as gestation progresses visual observation of sows is important. Those that do not show displacement of the abdomen during the latter stages of pregnancy are likely not pregnant. This can be confirmed with

real-time ultrasonography, but visualization of the skeletons of developing fetuses is used as the main criterion instead of the presence of amniotic vesicles (Flowers et al., 1999).

Breeding		Gestation															Farrowing	
Group	No. Bred	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Farrowing	%
1	125	125	125	100	100	100	100	100	100	100	99	99	99	99	99	99	99	79
2	121	121	121	102	102	102	102	102	102	102	102	102	102	102	102	102	102	84
3	120	120	120	106	105	105	105	105	105	105	105	105	104	104	104	104	104	87
4	119	119	119	105	105	105	105	105	105	105	105	105	105	105	105	105	105	88
5	130	130	130	109	109	109	108	108	108	108	108	108	104	104	104	104	104	80
6	121	121	121	104	104	104	104	104	104	98	87	87	87	87	87	86	86	71
7	119	119	119	102	102	109	109	109	109	78	78	77	77	77	77	77	77	65
8	120	120	120	106	106	106	106	106	106	97	87	87	86	86	86	86	86	72
9	125	125	125	100	100	100	100	100	100	93	86	86	86	86	86	86	86	69
10	123	123	123	104	104	104	104	104	104	93	86	86	86	86	86	86	86	70
11	124	124	124	105	105	105	105	105	105	105	98	90	90	90	90	90	90	73
12	134	134	134	108	108	107	107	107	107	107	100	95	95	95	95	95	95	71
13	133	133	133	106	106	106	106	106	106	106	100	98	98	98	98	98	98	74
14	120	120	120	99	99	98	98	98	98	98	98	95	95	95	95	95	95	79
15	120	120	120	97	97	97	97	97	97	90	90	90	90	90	90	90	90	75
16	125	125	125	99	99	94	94	94	94	94	94	94	94	94	94	88	88	70
17	125	125	125	110	110	110	110	110	110	98	98	98	98	98	98	90	90	72
18	125	125	125	108	108	107	107	107	107	104	104	104	104	104	104	104	104	83
19	125	125	125	99	97	97	97	97	97	96	96	96	96	96	96	96	96	77
20	125	125	125	95	95	95	95	95	95	95	95	90	90	90	90	90	90	72
Diff.			0	415	3	1	1	0	0	87	56	24	6	0	0	1		
Cum.		0	415	418	419	420	420	420	507	563	587	593	593	593	594			
Average	124	124	124	103	103	103	103	103	103	99	96	95	94	94	94	94	94	76

Figure 2. Gestation flow chart example. The first column denotes the breeding group number and all subsequent columns represent the number of sows that were bred; pregnant at each week of gestation; and farrowed. The last column denotes the farrowing rate for each breeding group. Diff. represents the difference in the number of pregnant sows between consecutive columns (weeks of gestation). Cum. denotes the cumulative loss of pregnant sows.

In the gestation flow chart shown above, there appear to be two periods where there are a high number of sows being detected as not pregnant: week 3 and weeks 9 through 11. At this point this is where observations of how things are done on the farm are extremely useful. The situation with the high number of sows exhibiting normal returns to estrus after insemination usually signifies some type of problem associated with semen quality; detection of estrus; or insemination technique. Evaluation of how semen is handled from the time it is collected from the boar until insemination is necessary to identify practices that may contribute to poor fertilization rates. Preparation of checklists is useful and identification of things that aren't problems is often more helpful than trying to find things that are. The list of things being done correctly usually is shorter than the thing being done incorrectly.

The sows being detected as not pregnant during weeks 9 through 11 would be classified as irregular returns to estrus. Identification of factors causing irregular returns often are challenging since they usually occurred several weeks before sows are identified as not pregnant unless they tend to be acute stresses that are severe. The gestation flow chart shown in Figure 2 was actually taken from a farm whose standard operating procedure was to vaccinate all sows at week 8 of gestation for a variety of diseases. This management practice while beneficial in some areas certainly has to be considered as a possibility for the

pregnancy losses in weeks 9 through 11, especially if there were a subset of sows that reacted to the vaccinations.

408603	Dam Tattoo: 132801		Sire Tattoo: 39906				
	Genetics: 0004		Age (yrs): 3.04				
	Last Event: Served		BA/Yr @ FW: 30.93				
	Date of Last Event:		WN/Yr @ WN: 24.28				
Parity	1	2	3	4	5	6	Av.
Boars & Genetics							
Farrowing Interval		139	138	141	140		139.50
Services/Matings	1/2	1/3	1/3	1/2	1/3	1/2	
Problem							
Gestation Period	115	117	115	116	116		115.80
Born Dead	1	1	1	1	1		1.00
Born Mummified	0	0	1	1	1		0.60
Born Alive	12	12	13	11	9		11.40
Fostered on	2	0	0	3	1		1.20
Fostered off	-2	0	-2	-2	0		-1.20
Piglet deaths	-3	-2	-3	-1	-2		-2.20
Piglets weaned	9	10	8	11	8		9.20
Weaned substandard	0	0	0	0	0		0.00
Piglet birth wt.	1.29	1.57	1.20	1.37	1.34		1.35
piglet weaning wt.	10.42	10.92	10.23	5.94	5.20		8.54
Days lactating	18	19	21	20	19		19.40

Boars (genetics): 077-06	Cull _____	21 Day Heat Check
Date of Service:	Vacc. 1 _____	
Est. date of Farrowing:	Vacc. 2 _____	
Date of Farrowing:	Tattoo _____	Farm No. 1
Date of Weaning:		

SOW ID: **408603** **09/06** BARN ROOM PEN *Start 10 Asst.*

GROUP ID: *Lut. 09/03* **F 1 8** *✓*

FARR DATE	BORN ALIVE	STILLBORN	MUMMIES	BIRTH WT	LITTER ID
09/04	10	1	1	12.3	404

DATE	NUMBER	DATE	NUMBER	REASON
09/05	-1	09/04	1	crushed
09/06	+3	09/06	1	low viability

WEAN DATE	WEANED	WEAN WT	SERV DATE	BOAR
09/23	10	19.3		

NURSE ON	NURSE OFF
+3	-1

crushed 09/08

Figure 3. Representative sow card. The top half of the card contains the previous production history of the sow while the bottom half contains information from her current litter. Recording notes on the sow card related to management practices that were performed to both the sow and litter are useful in helping identify potential problems.

Whenever there is a pattern of pregnancy losses after week 8 of gestation examination of information on sow cards and additional observations can be useful. In addition to causing the complete loss of pregnancy, stresses during the latter stages in gestation can also cause fetal death and depending on when it occurred the incidence of mummified fetuses and stillborns could increase. If the incidence of mummified fetuses is high, then observations with regards to average size of the mummies really is the best way to “pinpoint” when in gestation the insults to the sows are occurring. Figure 3 is an example of information that may be recorded on a sow card.

If the information on this sow card was representative of a sow that did farrow in the same herd from which the gestation flow chart shown in Figure 2 was generated, then some additional assumptions can be made. First, the sow only had 10 pigs born alive and 12 total

born which is probably on the low side for most modern genetics. Low number of pigs born alive in the absence of high levels of mummified fetuses or stillborns would be consistent with deficiencies in semen handling; detection of estrus; or insemination techniques. Insemination doses with low numbers of viable sperm; poor timing of matings due to improper identification of receptive sows; and sloppy insemination technique could all be contributing factors related to reduced fertilization and low numbers of pigs born alive. In addition, the absence of high numbers of mummies would indicate that whatever is causing sows having irregular returns between weeks 9 and 11 is acute and severe because the affected sows lose their entire litter. The size of the mummy was not recorded on this sow card, but it is not a bad practice to make a notation as to whether it was small (S), medium (M) or large (L). This can be very useful in determining when during fetal development it died (Figure 1).

SUMMARY

Reproductive failures are often difficult to diagnose. However, use of gestation flow charts and sow card information can be very helpful in determining when problems occurred, and which management phases should be examined. Regular returns to estrus after insemination usually are conception failures. Therefore, insemination dose preparation and handling, detection of estrus, and insemination techniques are the likely culprits. Irregular returns to estrus usually are management conditions that affect sows after week 5 of gestation. These could be due to a number of things but the fact that sows are being detected as not pregnant at the same stage of gestation for each group indicates that something that is routinely done in terms of managing the sows probably is involved. Examination of information on farrowing cards for sows that do successfully complete their pregnancy also can be very useful, especially if number born alive is low or mummies and stillborns are high. Low number born alive is consistent with problems associated with a high incidence of regular returns whereas increases in mummies and stillborns can be associated with problems associated with irregular returns.

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TIPS FROM THE HIGHEST PERFORMING PRODUCERS ON HOW TO START PIGS (NURSERY AND FINISHER) AND HOW TO IDENTIFY AND MEDICATE PIGS EARLY

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ABSTRACT

The presentation has a focus on tips and good management practices for a good start of a new batch of nursery or finisher pigs. It will also explore how to identify and act early on individual pigs requiring special care (medication or ...).

The presentation has been built from several interviews with elite-type producers (producers with the top 10% performances in their benchmarking groups). The most common or most relevant management practices of those producers will be shared in this presentation.

The topics discussed will include:

- Preparation of the buildings (before the pigs arrive)
 - Cleaning
 - Audit of the equipment
 - Maintenance of the building
 - Water quality and water freshness management
 - Feed system management
- Important steps at animal entrance
 - Keep empty pens
 - Sorting
 - Observation for lameness following transport/movement
 - Light availability
 - Early euthanasia for severe lameness or respiratory disease
 - Stimulating feed intake
- Daily barn check
 - Equipment needed for a good walk through of the barn
 - Frequency of barn checks for different production stages
 - Steps before entering the room
 - First observations when you enter the room
 - Routine observation pen-to-pen
 - Information to be recorded at the end of the tour
- Other routine observations or routine tasks
 - Fix equipment fast
 - Pit/manure management
 - Feeding frequency
 - Frequency of cleaning feed bins

- Water treatment and monitoring
- Individual pig care
 - Hospital pen management (number, location, environment, pig density)
 - Isolate pig or leave it in the original pen?
 - Medication - yes or no?
- Cost of medication relative to pig value
- Considerations for judicious selection of an antibiotic (i.e. choosing the right treatment)
 - Minimum diagnostics to be completed
 - Risk of antibiotic resistance
 - Number of doses required
 - Withdrawal
- Cost of individual versus mass medication
- Survey on antibiotics (quantity and cost) per pig and per mode of administration for nurseries and finishers

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- Yvan Fréchette, pork producer, COOP network
- Alain Lefebvre, pork producer / Jyga Technologies Inc.

Producers:

- Serge Ménard, Méloporc, 1300-sow F-F (multiple sites)
- Jean-Pierre Audesse, F. Porcine Audesse, 250-sow F-F
- Robert Lapointe, Ferme Robert Lapointe, 2 finisher barns (total of 1,600 pigs)
- René Harton, Ferme René Harton, wean-to-finish operation, 2 barns (total of 2500 pigs)
- Anick Leduc, Les Gorets inc., contract production, nursery 4500 pigs
- Guy Lemay, Ferme Dumay, contract producer, finisher barn (1200 pigs)
- Valérie Bousquet, Ferme Culture JB, contract producer, 2 finisher barns (1000 pigs)
- François Robert, Petit Manoir, farm employee, finisher barn (4600 pigs)
- El Houssaine Rachik, Les Élevages Lessard, farm employee, nursery barns (AIAO production), 1 site with 4 x 1200 places and 3 x 2800 and 1 site with 4 x 1400 pigs

CONCLUSION

In conclusion, the top producers we visited all placed priority on a set of critical herd management factors that must be controlled in order to maximize pig performances and limit the number of pigs requiring individual treatment. These producers all share similar

characteristics, such as aiming to be among the best in their benchmarking group, carefully using their 3 senses (sight, smell, hearing), paying particular attention to pig comfort and, finally, not tolerating any issues that may negatively affect the pigs.

It seems clear that it is the sum of all those details that make these producers successful. Any of these management tips taken individually may not have a significant impact on the performances, but all together, they seem to clearly make the difference.

“FORGOTTEN KNOWLEDGE”

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Most problems have multiple factors. Finding out the factors greatly assists in putting together a solution for the problem. In this presentation, a number of observations and tips will be provided for the farrow to nursery area of swine management.

1. Piglet Diarrhea

- Death often a result of dehydration, not the infection per se
- Management of diarrhea depends on:
 - Body defences (antibodies)
 - Replenishment of body salts that are lost during diarrhea
 - Proper environment (warmth) for recovery
- Effects of dehydration result in clinical signs:
 - Vomiting
 - Weakness
 - Seizures (may look like Strep suis)
 - Worse in malnourished pigs – they are already low in potassium
- Use oral replacement electrolytes (NOT stress electrolytes)
 - Calf replacement electrolytes will work
 - Can use World Health Organization recipe if no electrolytes are immediately handy:
 - 1 litre water
 - 8 tsp sugar
 - 1 tsp table salt
 - Can add flavouring if desired (koolaid)

2. Needles

- Change regularly
- Recommended to change needles every 10 pigs
- Otherwise, tips of needles will form a “burr”
 - Will create a larger hole when injecting animal
 - Read the label
 - Concentration
 - Contact time
 - pH
- Test strips available for a specific disinfectant to measure if concentration is accurate coming out of foam gun

- Bacterial resistance is developing to disinfectants
- Regular rotation of disinfectants is a good idea

3. Feed

- Regularly save a sample of feed from each area of production
 - Put in plastic bag; label with date and throw in freezer
 - You then are able to retrieve a feed sample if you need to reach back to see what was happening
 - Feed analysis for toxins
 - Feed analysis for ingredients
 - a. Protein
 - b. Calcium, phosphorus

4. Hovers for the Nursery

- Used to use these
- Create microenvironments for the weaned piglets
- Considerable savings on energy costs

A 1991 study showed energy savings of up to 45% when using hovers and reducing temperatures. This study noted an increase in mortality with reduced temperatures but did not further explain.

In summary, paying attention to details and making small improvements may result in large savings.

HOW ARE BEST MANAGEMENT PRACTICES APPLIED ON CANADIAN FARMS?

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ABSTRACT

In 2017, on-farm best management practices were audited on a total of 24 farms throughout Canada as part of a national project titled “From Innovation to Adoption: On-farm Demonstration of Swine Research”. A series of eight fact sheets describing the results of these audits were made available, as well as two technical datasheets.

INTRODUCTION

In 2017 and 2018, Swine Innovation Porc coordinated a national initiative titled “From Innovation to Adoption: On-farm Demonstration of Swine Research”. The main goal of the project was to increase the speed of adoption of new technologies and management strategies arising from research projects. To reach this goal, le Centre de développement du porc du Québec (CDPQ) and Prairie Swine Centre (PSC) partnered with a number of pork producers and related organizations throughout Canada. The project focused on three pillars which included: nation-wide workshops (group sow housing), on-farm demonstration projects, and auditing best management practices.

A total of 24 farms were audited regarding a number of best management practices in eight key areas. Every participating farm received a detailed report highlighting their farm’s performance, and benchmarking against other participating farms, in addition to suggesting improvements. The data gathered from these audits resulted in a series of fact sheets being produced, providing pork producers throughout Canada an idea about everyday practices that may be improved. Participating farms were located in Prince Edward Island, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia.

ON-FARM BIOSECURITY

Overall results of the audits indicate that producers across Canada place a great deal of importance on biosecurity within their operations. It is important to note that a majority of the audits took place prior to the PEDv outbreak in Manitoba (2017), indicating that biosecurity has always been a key element in successful pork production.

Key indicators include:

- All but one of the participating farms have only one source of animals entering their facilities. Having multiple sources for pigs heightens the risk of a biosecurity breach.

- More than 80 % of audited farms have adopted biosecurity procedures, including taking a shower and providing a change clothes and boots before entering a barn. Typically, if producers did not meet this requirement, it was due to limitations associated with the age of the facility and associated renovations.
- All participating farms ensured that staff were properly trained regarding biosecurity protocols, with a vast majority of the farms (92%) reviewing them annually.

Potential areas of improvement:

- Most farms know the importance of a visitor registry. Results from the audit, however, indicate that just over half of the farm registries were up to date at the time of the audit. While this is a simple step in the audit process, it can be one that is easily overlooked and can be exceedingly important at times of a disease challenge.
- Protocols for entering or exiting the building are posted and respected in approximately two-thirds of participating farms. In digging deeper into this question, farm managers agree that biosecurity procedures are respected by staff and visitors. However, in one-third of the farms audited, proper signage related to biosecurity was lacking on and within the production site.

PERSONAL PROTECTION & TRAINING

Results from the audits indicate pork producers are committed to providing the safest workplace possible for their employees. Dust masks, hearing protection and hydrogen sulphide (H₂S) monitors are being used to varying degrees in production units across Canada.

While all farms that use H₂S monitors use them for pit pulling, it is very important that they be used in other key day-to-day activities where H₂S could arise. One of these situations would be power washing, as workers may be exposed to H₂S concentrations that exceed acceptable limits.

While approximately 60 % of participating farms offer H₂S training, it is very important that recertification does not get lost in day-to-day activities. Training and standard operating procedures should be provided, at least every three years, so workers can learn how to deal with routine operation and emergency situations generating high H₂S concentrations.

Regarding pig handling, research has shown that proper animal handling reduces stress for pigs and people. Producers realize the importance that proper pig handling plays in their operations, as audit results indicate a majority of the farms offer pig handling training to their employees. A number of different training methods were utilized, ranging from in-house training sessions, in addition to pig handling videos developed by various pork councils and organisations throughout Canada.

WASHING PROCEDURES

Animal drinking and cleaning are the top uses of water in swine barns. Implementing water conservation strategies will ultimately lower cost of production and contribute towards a more sustainable environment as less manure is produced.¹

Results from the audits indicate a majority of producers pre-soak rooms prior to washing. However, research indicates that there are situations in which this may not be necessary, as water sprinkling (or soaking) results in significantly higher water consumption. Specifically, research reinforces that high pressure washing in fully slatted flooring can be done without prior water sprinkling (soaking).

On the other hand, significantly more time was needed when washing partially-slatted concrete flooring without sprinkling. Therefore, it is important to remember that soaking is still beneficial if your farm has partially slatted floors in grower-finisher rooms. Results from the audits show that approximately 80 % of the participating farms pre-soak rooms. However, this number does not differentiate between flooring (partially or fully-slatted) types.

With regard to nozzle selection, audit results show that slightly more than 50 % of participating producers currently use conventional nozzles in the washing process. Research reinforces that this is the best choice when it comes to water conservation. Use of conventional nozzles led to the lowest water volume consumed and time spent in washing rooms with partially and fully slatted concrete flooring among all tested nozzles.

GESTATION HOUSING SYSTEMS

Converting to group sow (gestation) housing systems is a major challenge and opportunity currently facing Canadian pork producers. Of the 24 farms audited in 2017, 21 of them included sows either as a farrow-to-finish or farrow to-wean facility. Of these 21 farms, nine incorporated some type of group sow housing system, while the remaining housing systems would be considered traditional stall systems.

Of the nine farms that have made the transition to group sow housing, two thirds have chosen a non-competitive system such as an electronic sow feeder or free-access system, while the balance of producers have chosen a competitive feeding system. In speaking with producers, the decision to proceed with a direct competitive feeding system is typically based on the cheaper cost of conversion, while those choosing electronic sow feeding systems are utilizing the data collection aspects as a herd management tool.

Timing of group formation is essential for ensuring high productivity from the sow herd. Groups should be formed prior to day 7 or after day 28 due to the importance of implantation. Results indicate that 100 % of farms were compliant. Feedback from producers involved in the group sow housing process also indicates that they are becoming more comfortable mixing sows earlier than day 7 which, in turn, reduces the total number of stalls required on the farm.

Within the Code of Practice for the Care and Handling of Pigs (2014)², enrichment is considered to be a recommended practice within group sow housing systems, specifically as a way to minimize aggression. Taking a look at the data we can see that eight of nine farms audited have incorporated some type of enrichment, typically chains or wood, within their operation. According to the Code, enrichment should be simple, safe, soft, sanitary, suspended and well-positioned.

FARROWING SYSTEMS

The most critical period in the life cycle of a pig is from birth to weaning. What we do in farrowing not only has a direct and immediate impact on piglets and their subsequent performance, but also impacts future breeding herd performance. Attention to detail often pays huge dividends in farrowing and the rest of the production process. When analyzing the data from the 21 farms across Canada, we can see that Canadian pork producers are doing an outstanding job when it comes to implementing best management practices in farrowing.

Heat Source

Choosing the appropriate heat source is an important step in ensuring piglet survival. As observed on the farms audited, heat lamps and heat pads are utilized at a rate of 90 % and 70% respectively, with a little under two-thirds of participating producers incorporating both lamps and pads. In this situation, heat lamps are typically utilized for the first number of days just after farrowing for maximum piglet benefit. After this introduction period, heat pads would be the only heat source available in order to keep utility costs in check.

Creep Feeding

According to audit results, approximately 90 % of participating producers utilize some type of creep feeding strategy during farrowing. Most producers generally implement creep feeding 5-7 days prior to the anticipated weaning date. Research has shown the provision of creep feed in the farrowing room did not affect piglet body-weight at weaning, regardless of weaning age (3 or 4-week weaning). However, the provision of creep feed in the farrowing room did improve performance in the nursery for piglets that actually consumed creep feed. The challenge is that only 4 to 40% of pigs consume it.³

The manner in which creep feed is presented to attract piglets could be improved as a whole. Research has shown that piglets are observed at a significantly higher frequency at the tray feeder compared to the standard feeder. In addition, this different presentation of creep feed appeared to numerically increase the percentage of piglets per litter showing evidence of creep feed consumption.³

NURSERY FACILITIES

The results of the audits completed in 18 nursery facilities indicate that pork producers are overall doing a relatively good job ensuring that best management practices are adopted in their facilities. However, one potential area of improvement is in the adoption of enrichment.

Based on audit data, enrichment in the nursery is one area that requires additional attention of pork producers. According to audit results, only 11% of farms audited currently incorporate enrichment into nursery facilities, with chains being the most common form of enrichment. According to the Code of Practice for the Care and Handling of Pigs (2014)², pigs must be provided with multiple forms of enrichment that aim to improve the welfare of the animals through the enhancement of their physical and social environments. Enrichments can typically be installed at a relatively low-cost over a short time frame (end of room

turns), without sacrificing biosecurity. However, like most things the level of cost and complexity will change with individual producers' own preference.

FINISHING FACILITIES

A total of 16 finishing facilities were audited achieving a score of more than 80 % (for the adoption of best management practices) in a number of key areas. As with nursery facilities, one possible area of improvement is increased adoption of enrichment, as only two thirds of farms currently utilize enrichment in finishing pens. Other areas of consideration should focus on re-assessing sorting pigs and ensuring adequate water availability.

Enrichment

Based on audit data, the use of enrichment in finishing facilities is one area that requires some attention. Data suggests that only 65 % of farms audited currently incorporate enrichment in their finishing facilities, with chains being the most common form of enrichment (70 %) followed by wood (30 %).

Feeder Type and Water availability

As observed throughout the audits, a vast majority of the participating producers have adopted wet/dry feeders, which have been shown to increase pig performance. Approximately 50 % of the audited producers utilize the feeder as the only source of water within the pen. In some situations, it has been shown that reduced floor space allowance may negatively affect growth performance, due to decreased access of feed and water, especially at later stages of the grower-finisher period. In some cases, producers should consider increasing the number of water sources, as research has indicated that adding one extra drinker resulted in a significant improvement in average daily gain and feed efficiency as well as reduced average daily feed intake.⁴

MANAGING WATER INTAKE

Previous work has shown finishing pigs can waste 25 % of water from well-managed nipple drinkers therefore opportunities exist to reduce wastage when flow rates are adjusted on a regular basis⁵. On-farm water flow rates and nipple drinker heights were measured on 24 farms across Canada, representing each phase of production from gestation to finishing. Note that not all farms had nipple drinkers installed in each phase of production, for example, some producers solely relied on wet/dry feeders without an additional water source.

Overall water management within audited farms varied across phase of production. Generally producers do a better job in managing flow rates within Gestation (pens) and Nursery, where approximately 60 % of the nipple drinkers measured met the target flow rate. The challenge is in Finishing, where approximately two-thirds of nipple drinkers provide flow rates in excess of pig's requirement, with 11 % of nipple drinkers being rated very high (>2.5 L/min).

CONCLUSION

Information presented within this article is based on the results of auditing 24 farms across Canada varying in location, size and type of operation. Overall, pork producers are doing a good job of staying on top of those management issues that could potentially be “profit-robbars.” It is important to remember to review policies and procedures in order to ensure that some seemingly small things do not get lost in the day-to-day activities within the production facility.

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COST OF PRODUCTION – BUILD IT, USE IT!

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Cost of production (COP) information is an important tool for farm level decision making. Good cost of production information starts with good farm records. Knowing your cost of production by enterprise is good first step in understanding your farm's finances and their impact on your overall farm operation.

COST OF PRODUCTION APPROACHES

There are 2 main approaches to building your cost of production:

Production systems

The production practices of each enterprise are detailed out and input prices applied to arrive at a total cost for each cost. Capital investments are costed out based on replacement costs with typical depreciation, interest, repair and insurance rates. From a planning perspective these are useful because the amounts used and prices paid are detailed out so changes to rations or input prices can be made and the impact on the financials can be quickly determined.

On farm data

Historical on farm financial and production data use actual farm results and provide a measure of past enterprise performance. Operations that have multiple enterprises will need to develop a process to allocate the whole farm costs to the individual enterprises.

Anatomy of a COP budget

While the format of COP budgets can vary they typically include the following:

- **Revenue:** the gross revenue from crop and livestock sales before any costs have been deducted.
- **Direct Variable Costs:** input costs for the production of a specific commodity. These change depending on the level of production (e.g. feed, veterinary, seed, fertilizer and pesticides).
- **Indirect Variable Costs:** costs used in producing all commodities on the farm (e.g. fuel, labour and utilities). These also change depending on the level of production but not in direct relationship with production.

- **Fixed Costs:** costs that remain the same regardless of the level of production (e.g. property taxes, fire insurance, term interest and depreciation).
- **Net Farm Income (Profit Margin):** revenue minus all variable and fixed costs.

USES OF COP IN FARM DECISION MAKING

Enterprise mix decisions

Farms with multiple enterprises can assess which enterprises are making money and which are not.

Purchasing and marketing decisions

Know your breakeven points. Pricing targets for inputs and outputs can be set at different cost breakeven levels.

Breakeven price to cover variable costs:

$$\frac{\text{Total variable costs}}{\text{Expected yield}} = \$ / \text{unit produced}$$

This is the minimum price needed to cover variable costs.

Breakeven price to cover total costs:

$$\frac{\text{Total cost}}{\text{Expected yield}} = \$ / \text{unit produced}$$

This is the minimum price needed to cover all costs.

Breakeven yield:

$$\frac{\text{Total costs}}{\text{Expected price}} = \text{Unit produced}$$

This is the minimum yield/production needed to cover all costs.

Concentrating on individual or groups of costs

Once you have the COP by enterprise you can start to concentrate on individual or groups of costs that affect it. For swine farms, like most livestock enterprises, feed costs represent a large percent of the costs so management time focused on feed costs is time well spent. For swine finishing operations, livestock purchases and feed costs will account for in the range of 80-90% of total costs.

Investment decisions

COP information shows what the farm can afford to pay for capital assets. Longer term investment decisions in capital like land, machinery and buildings should be made with COP in mind. One approach is to calculate your revenue minus all other costs so you know what you can afford to pay for additional capital investments like new barn construction.

OMAFRA COP information and resources

- OMAFRA Swine Enterprise Budgets – published bi-monthly in OMAFRA’s Pork News and Views newsletter and available online:
www.omafra.gov.on.ca/english/livestock/swine/finmark.html
or by email subscription (example appended).
- Guide to Cost of Production Budgeting, Order No. 08-055
- Lease Agreements for Farm Buildings, Order No. 13-055
- 2019 Field Crop Budgets – Publication 60
- Guide to Custom Farmwork and Short-Term Equipment Rental, Order No. 16-035
(2018 custom farmwork rates coming soon)
- Leasing Farm Equipment, Order No. 13-059
- Budgeting Farm Machinery Costs, Order No. 01-075
www.ontario.ca/agbusiness

E-Newsletters

Ontario Hog Market Price Trend Report

Subscribe to receive the weekly Ontario Hog Market Price Trend Report providing updates on market activity.

Hog Market Facts

Subscribe to receive the weekly Hog Market Facts and get information on market trends and prices.

www.omafra.gov.on.ca/english/subscribe/index.html#facts

Online Resources

Ontario Enterprise Budgets - OMAFRA Agricultural Business Management

Enterprise budgets for crop and livestock enterprises in Ontario available in Excel format

www.omafra.gov.on.ca/english/busdev/bear2000/Budgets/oeb.htm

Farm Business Decision Calculators - OMAFRA Agricultural Business Management

Excel spreadsheet tools to assess the costs of various management decisions, perform financial analysis and evaluate capital investment decisions.

www.omafra.gov.on.ca/english/busdev/downtown.htm

Income (\$/pig)	Farrow to Wean	Nursery	Grow-Finish	Farrow to Finish
Market Pig @ 101% of Base Price \$135.65/ckg, 110 index, 105.19 kg plus \$2 premium				\$160.53

Variable Costs (\$/pig)

Breeding Herd Feed @ 1,100 kg/sow	\$14.26			\$15.64
Nursery Feed @ 33.5 kg/pig		\$16.39		\$17.27
Grower-Finisher Feed @ 287 kg/pig			\$87.75	\$87.75
Net Replacement Cost for Gilts	\$2.86			\$3.13
Health (Vet & Supplies)	\$2.16	\$2.10	\$0.45	\$5.03
Breeding (A.I. & Supplies)	\$1.80			\$1.98
Marketing, Grading, Trucking	\$0.90	\$1.50	\$5.76	\$8.33
Utilities (Hydro, Gas)	\$2.35	\$1.38	\$2.13	\$6.17
Miscellaneous	\$1.00	\$0.10	\$0.20	\$1.40
Repairs & Maintenance	\$1.26	\$0.61	\$2.15	\$4.19
Labour	\$6.27	\$1.85	\$4.00	\$12.83
Operating Loan Interest	\$0.31	\$0.39	\$1.32	\$2.06
Total Variable Costs	\$33.18	\$24.32	\$103.76	\$165.77

Fixed Costs (\$/pig)

Depreciation	\$4.22	\$2.04	\$7.18	\$13.95
Interest	\$2.36	\$1.14	\$4.02	\$7.81
Taxes & Insurance	\$0.84	\$0.41	\$1.44	\$2.79
Total Fixed Costs	\$7.42	\$3.59	\$12.64	\$24.55

Summary of Costs (\$/pig)

Feed	\$14.26	\$16.39	\$87.75	\$120.66
Other Variable	\$18.91	\$7.93	\$16.01	\$45.11
Fixed	\$7.42	\$3.59	\$12.64	\$24.55
Total Variable & Fixed Costs	\$40.60	\$27.91	\$116.40	\$190.33

Summary	Farrow to Wean	Feeder Pig	Wean to Finish	Farrow to Finish
Total Cost (\$/pig)	\$40.60	\$70.16	\$145.80	\$190.33
Net Return Farrow to Finish (\$/pig)				-\$29.80
Farrow to Finish Breakeven Base Price (\$/ckg, 100 index) includes 101% Base Price & \$2 Premium				\$161.15
Farrow to Finish Breakeven Base Price (\$/ckg, 100 index) excludes 101% Base Price & \$2 Premium				\$164.49

This is the estimated accumulated cost for a market hog sold during the month of January 2019. The farrow to wean phase estimates the weaned pig cost for August 2018 and the nursery phase estimates the feeder pig cost for October 2018. For further details, refer to the "2019 Budget Notes" posted at <http://www.omafr.gov.on.ca/english/livestock/swine/finmark.html>.