Monitoring and Maintaining Sow Condition

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Introduction

The conditions under which sows were maintained in the wild allowed them to gain large amounts of weight in gestation in preparation for the upcoming lactation. During lactation sows nursed their litters for 6 to 7 weeks, during which time the accumulated weight was mobilized to support milk production for their litter. In general sows produced one litter per year of 4 to 8 pigs. However, the breeding female of today is very different than her counterpart of 30 years ago, and has been selected more intensely for certain traits which have made her different in a number of important respects:

- Greater mature body size
- Reduced appetite potential
- Higher milk yield
- Change in body composition; higher lean:fat ratio
- Higher litter size and litter growth rates
- More vulnerable to nutritional, management and environmental stressors

Added to this we have imposed management changes such as shorter lactation length, earlier breeding, increased use of AI and larger unit size. The result of all these changes has greatly reduced the margin of error in terms of feeding and management of the modern sow. It is clear that some production systems cannot cope with these changes as indicated by levels of sow mortality, replacement and culling rates (**Table 1**).

Table 1. Performance data for average, bottom and top 10% of herds 2003[1]

Performance ranking	Top 10%	Average	Lowest 10%
Unit size, # sows	**205**	**1110**	**2621**
Sow mortality, %	2.5	7.1	12.5
Replacement rate, %	33	60	86
Culling rate, %	23	41	60
Pigs weaned/sow/year	17.7	21.5	25.2
Non-productive days	42	69	106

[1] Adapted from Deen and Anil, 2003

▪ The Role of Nutrition

Proper feeding and management of the breeding herd is crucial to the overall success and efficiency of pig production systems. Meeting production targets with as little as possible variation around these targets is a very important determinant of profitability. A recent survey from Denmark (Ramussen, 2004) which reported number of pigs produced per litter in the major pig producing countries in the world, highlighted the gap in reproductive efficiency that Canada has to close if it is to compete with the more productive European sow herds (**Figure 1**). Although sow feed costs only account for 12% of the total feed cost, the feeding and nutrition of the sow can, nevertheless, greatly influence the profitability of a system through its effects on sow productivity. The Danish survey and current Pig Champ records show that the number of pigs marketed per sow lifetime (45 vs. 65, respectively), and sow replacement rates (65% vs. 45%, respectively), are much poorer in Canada than in France, Denmark and Ireland.

The feeding and management of the modern sow must be adapted to account for these changes if sow longevity and productivity are to be optimized. A recent large scale study from Australia (Hughes and Smits, 2002), and data from other studies, showed that only 20% of the sow herd reached an age/parity at which a conscious decision to cull was made. In other words, 80% of the herd was being culled early. Factors contributing to such high sow wastage are lack of skilled labor, increase in farm size, genetics, disease levels, over-emphasis on profit margins and general management practices. It has been suggested that an increase in farm size may result in animals losing their individuality and relative value. Less time is spent on one-to-one observation and, therefore, an animal that is getting sick or is injured or losing weight may not be recognized early. In addition, emphasis on output may lead to excessive inventories and efforts to maximize output. These conditions can lead to overcrowding of animals and insufficient quality space for injured or sick animals. Shortage of labor, and especially skilled, knowledgeable, experienced workers, can lead to inadequate care and management of animals and result in increase in sow mortality and culling rate. However, most surveys also show that a proper feeding program is essential to achieving improved sow productivity and longevity.

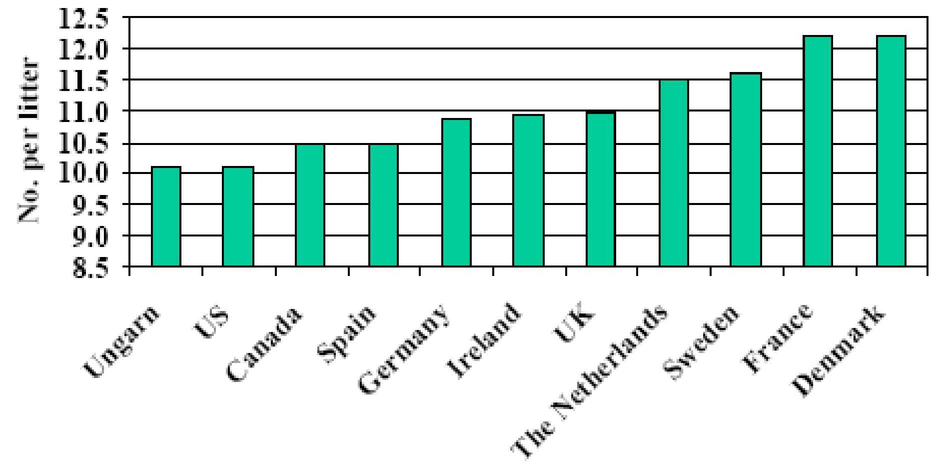

Figure 1. Number of liveborn piglets per litter by country, 2002 (Ramussen, 2004)

▪ Monitoring Sow Condition

In the majority of commercial production systems today there are two methods of setting feeding levels for gestating sows: visual appraisal and feeding based on body condition score. For the visual appraisal method, sow feeding levels are set based on a visual observation of the sow and adjusting feeding level accordingly. This is very subjective, has no scientific basis, and generally leads to feed wastage and considerable variation in sow condition at farrowing.

In many herds, body condition scoring is used to determine the feeding level of the pregnant sow. It is assumed that condition score reflects the level of fatness of the sow and that backfat thickness is a good guide to the fat status and metabolic status of the sow. Usually sows are assigned one of five body condition scores (1 being very thin (emaciated), 3 in acceptable condition, and 5 being very fat) as judged by visual assessment and palpation of the hip bones. A condition score of 3 is considered optimal. A feed allowance based on experience is assigned to these sows. If a sow has a condition score above or below this target, the daily feed allowance is adjusted accordingly (**Table 2**).

Table 2. Feeding adjustment based on condition score (Aherne and Foxcroft, 2000)

Condition score	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**
Change in feed, kg/d	+0.6	+0.4	+0.3	+0.2	0.0	-0.2	-0.3	-0.4	-0.5

Sow condition may be re-evaluated approximately every two weeks and feeding levels are adjusted accordingly. There are a number of important pitfalls with this system of monitoring sow condition. Firstly, several studies have shown that body condition score and backfat are poorly associated. Sows assigned a condition score of 3 (good condition) ranged in backfat from 8 to 31 mm (Hughes and Smits, 2002; Young et al., 2001). In the study of Young et al. a large range in backfat was observed at each condition score (**Figure 2**). The second problem with body condition scoring sows is that different evaluators will assign different condition scores and feeding levels to the same sows and the scores assigned are influenced by overall condition of the herd. Thirdly, there is no scientific basis for the assignment of feeding levels to a particular condition score. Approximately 75 to 85% of the sow's energy requirements in gestation represent maintenance, thus an accurate estimate of weight is important; however, with condition scoring weight is not taken into account. For example, 150, 225, and 300 kg sows with a condition score of 3 would all be assigned the same feeding level; however, feeding level would need to increase by in excess of 0.5 kg per day for each weight increment increase just to maintain body weight (**Figure 3**).

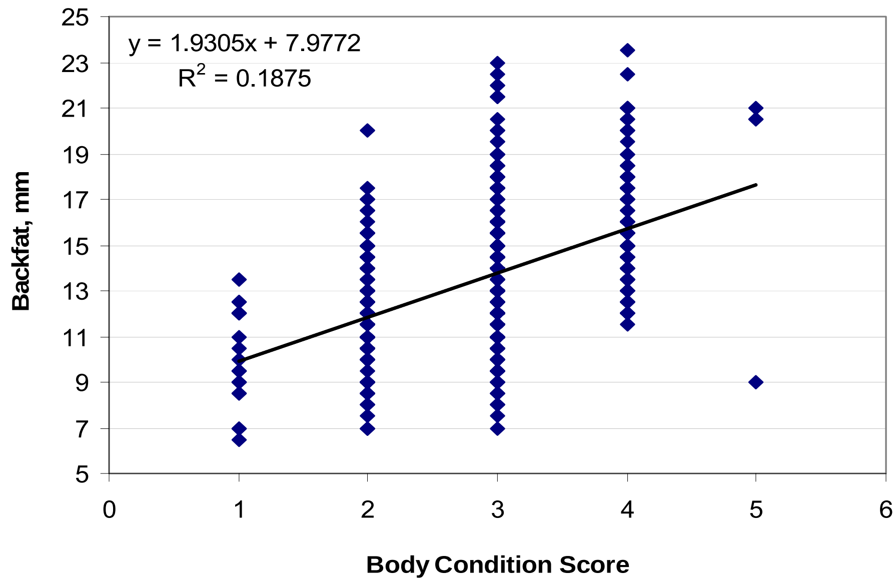

Figure 2. **Relationship between body condition score and backfat thickness for gestating sows.** A total of 731 sows were ultrasonically scanned at the last rib and correlated with a body condition score (1 = thin; 5 = fat) that was assigned by the farm manager.

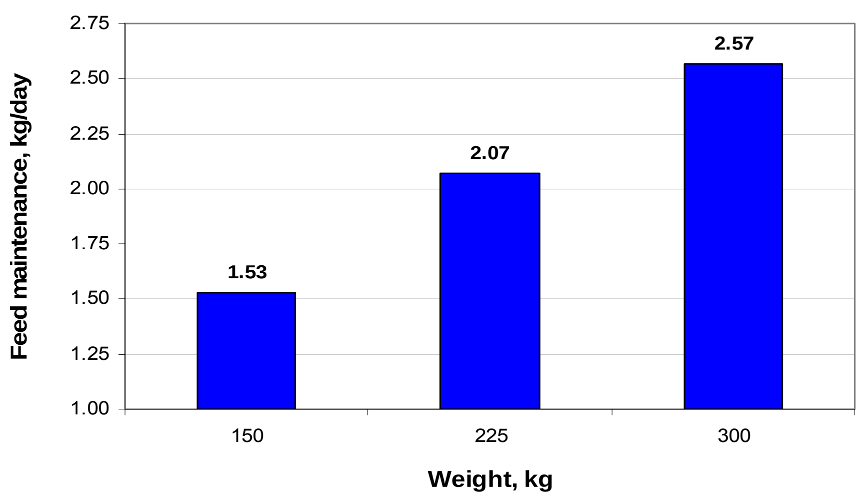

Figure 3. **Influence of weight on maintenance requirements of sows.** Assumes diet 3.0 Mcal ME.

It is obvious that a more accurate means of monitoring sow condition is required if sow condition is to be accurately managed and an appropriate feed allowance system developed. Recently, researchers at Kansas State University have developed a more objective method of feeding gestating sows based on an estimate of weight and a measurement of backfat thickness. Using backfat thickness as a means of monitoring sow condition is an objective, practical, and relatively inexpensive means of monitoring sow condition and a guide to determining appropriate feed allowances. Also, it is much easier to train staff to measure backfat than to condition score sows. The time required to measure backfat is relatively similar to that required to condition score sows. So what is involved with this new proposed method of monitoring condition and feeding sows in gestation?

Feeding Based on Backfat and Estimated Weight

Energy requirements of the sow can be derived factorially from the summation of energy requirements for maintenance, maternal weight gain, and fetal growth. During gestation, maintenance represents 75-85% of the total energy requirement and, therefore, an accurate estimate of sow weight is important. Because weighing sows is not feasible on many farms, an easy estimate of weight can be obtained by taking a flank-to-flank measurement using a cloth tape to categorize sows into weight groups. The flank-to-flank measurement is taken where the rear leg intersects with the body on one side of the sow to the same position on the other side of the sow (**Figure 4**). Weight gain of the sow in gestation constitutes the next biggest requirement, with requirements for fetal growth representing the smallest proportion.

A Lean-Meater (Renco Corp., Minneapolis, MN) is used to measure backfat, as it is relatively inexpensive and durable machine for use in the barns. Adequate training is required for the person taking the measurements on how to use the machine and where to take the measurements on the sow. Backfat measurements are taken at the last rib 7 to 9 cm off the midline (**Figure 5**). Measurements should be taken on both sides of the backbone and the maximum value taken. The Lean-Meater will never over read backfat but may under read if the angle of the probe is not perpendicular to the surface of the skin. It is easy to train a person to use a Lean-Meater as it is to condition score sows and the time required for either method is not very different.

Figure 4. Pictorial illustrating flank to flank measurement

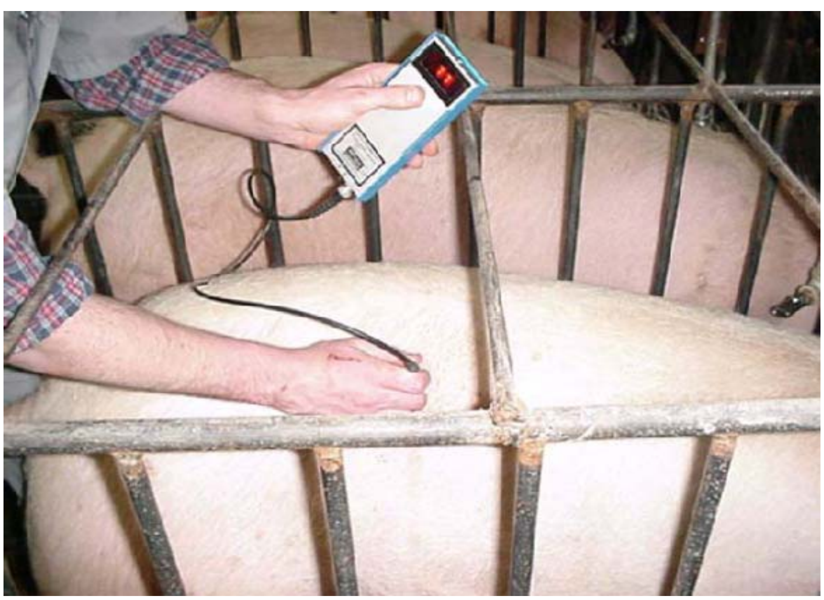

Figure 5. Illustration of Renco Lean Meater being used to measure backfat thickness

Calculating Feeding Levels

The nutrient and energy requirements of a gestating sow will depend on her weight, backfat level and target gain needed to achieve a backfat of 19 mm at farrowing. Why target 19 mm of backfat at farrowing? We target 19 mm of backfat at farrowing, because if we targeted 16-17 mm of backfat and a sow loses 3-4 mm in lactation they drop to ≤ 13 mm at weaning. Data from several studies have shown that low backfat levels (< 14 mm) compromise subsequent reproductive performance (Young et al., 1991; Hughes, 1993; Tantasuparuk et al., 2001). Targeting an average backfat at farrowing of 21 mm would result in a high percentage of sows with 23-24 mm of backfat at farrowing which has been well documented to decrease lactation feed intake and reduce subsequent reproductive performance. Equations are used to determine the energy requirements for maintenance, maternal weight gain, and fetal gain. Results of these equations, which are converted into daily requirements, are presented in **Table 3**.

Table 3. Daily gestation energy requirements for a 200 kg sow with a litter birth weight of 18 kg.

Target weight gain, kg	**35**	**27**	**20**	**13**
Target backfat gain, mm	**9**	**6**	**3**	**0**
ME, Mcal				
Maintenance	6.34	6.26	6.18	6.10
Maternal gain	2.29	1.63	0.98	0.34
Uterine gain	0.36	0.36	0.36	0.36
Total	8.99	8.25	7.52	6.80
Feeding level, kg/d[1]	3.00	2.75	2.51	2.27

[1] Based on a diet metabolizable energy content of 3.0 Mcal/kg

An excel spreadsheet is used to outline these calculations to determine daily feeding levels for different weight and backfat categories which are presented in **Table 4**. Feeding levels in Table 4 can be put on a chart that can be laminated and left in the barn for use. These feeding levels assume that the breeding and/or gestation barn temperature is maintained at or above 20°C for individually stalled sows on totally slatted floors. For each 1°C below 20°C feeding levels should be increased approximately 0.1 kg/d. Using a standard gestation diet, 0.6% lysine and 3.0 Mcal ME, and the feeding levels in Table 4 would exceed the nutrient requirement recommendations of NRC 1998 for gestating sows and gilts in each of the weight and backfat groups, but does add an acceptable margin of safety. Details of the equations can be obtained from the author.

Determining Feeder Settings

On one day per week sows and gilts served the previous week will be scanned for backfat thickness and weight group determined by taking flank to flank measurements, which will be written on the sow card. Using the weight group and backfat category the feeding level will be adjusted for each sow (**Table 4**). A feeding table will be developed for each barn based on the diet energy density and volume of feed delivered by their feed boxes.

Table 4. Feeding levels (kg/d) for gestating sows based on backfat and weight group at breeding[1,2]

Flank to flank, cm	Weight category	Estimated Weight, kg	Backfat at breeding, mm < 12	12 to 14.9	15 to 18	> 18
			Estimated feed level, kg/d			
83 to 90	Very light	115 to 150	2.4	2.1	1.9	1.7
91 to 97	Light	150 to 180	2.7	2.4	2.1	1.9
98 to 104	Medium	180 to 215	2.9	2.6	2.4	2.1
105 to 112	Heavy	215 to 250	3.1	2.9	2.6	2.4
113 to 127	Very heavy	250 to 300	3.3	3.1	2.9	2.6

[1] Diet energy content 3.0 Mcal ME/kg. Feeding level to be increased 1 kg/d on day 101 of gestation.

[2] Assumes barn temperatures is maintained at or above 20^{o}C.

In mid-gestation, gestating rows are examined and thin sows that appear not to be gaining weight should be marked and scanned for backfat thickness to assess whether target backfat gains are being achieved. It is estimated that approximately 10-15% of sows will need to be scanned in mid-gestation. If sows are not reaching target backfat gains (e.g. sow 11 mm at initial scanning and 13 mm at mid-gestation) feeding levels should be increased 0.5 kg/d. On day 101, feeding level is increased 1 kg/d for all sows for the last 2 weeks of gestation. There are three reasons why we increase feeding level, firstly, to prevent sows from going into negative energy balance in late gestation. Failure to increase feed intake during this period results in sows in an extremely catabolic state at farrowing. The catabolic state contributes to gorging, and sows going off feed during lactation. Secondly, to stimulate enzymes in the liver and intestines in preparation for the upcoming lactation to increase feed intake. Thirdly, to increase clearance of progesterone which will allow prolactin to increase at a faster rate and result in increased lactogenesis/milk production. Furthermore, protein needs increase in late gestation. Nitrogen retention is estimated to increase from 9-10 g/d in mid-gestation to 17-18 g/d in late gestation (Noblet et al., 1985). Protein deposition increases two-fold in the conceptus and three-fold in the mammary tissue from day 100 to farrowing (Boyd et al., 2000).

The proposed feeding system is relatively simple and easy to implement. However, there are a number of issues critical for the success for this feeding program:

- A person must be trained to scan sows for backfat and estimate weight groups.
- The energy content of the gestation diet must be known.
- The volume of feed delivered at each feed box setting must be known.
- You must have a machine to measure backfat (Renco, Lean meater).

▪ Maintaining Sow Condition

Having determined an accurate and objective means of monitoring sow condition, the next step is maintaining condition over many parities to maximize sow productivity and longevity. It is important to remember the overall goals of the feeding program for gestating sows: a) prepare sow to be in proper body condition at farrowing; b) maximize reproductive performance (farrowing rate and litter size); and c) meet the daily nutrient requirements at the lowest possible cost (cost per sow per day). Overfeeding sows in gestation is associated with a number of the problems: Firstly, unnecessary feed costs associated with putting the additional weight and backfat on the sow. Secondly, high energy intake between day 75 and 100 of gestation may result in increased fat deposition in the mammary gland, and reduced milk production and litter growth rate in the subsequent lactation (Head and Williams, 1991; Weldon et al., 1991). Finally, the influence of high backfat at farrowing on lactation feed intake and subsequent litter size has been demonstrated once again in a study by Young et al. (2004a) (**Figure 7**). In the past over-conditioned sows have been a problem on many sow farms; however, in more recent times thin sows have become a more prevalent problem. Poor body condition can reduce reproductive performance and result in greater sow culling and mortality.

Gestation Feeding Study

The feeding system previously outlined was evaluated in a recent larger scale study on a commercial sow farm. The results illustrated that feeding sows in gestation based on backfat and weight resulted in a higher proportion of sows in the target backfat range (17-21 mm) and fewer over conditioned sows (> 21 mm) at farrowing, compared with feeding based on body condition score (**Figure 6**; Young et al., 2004a).

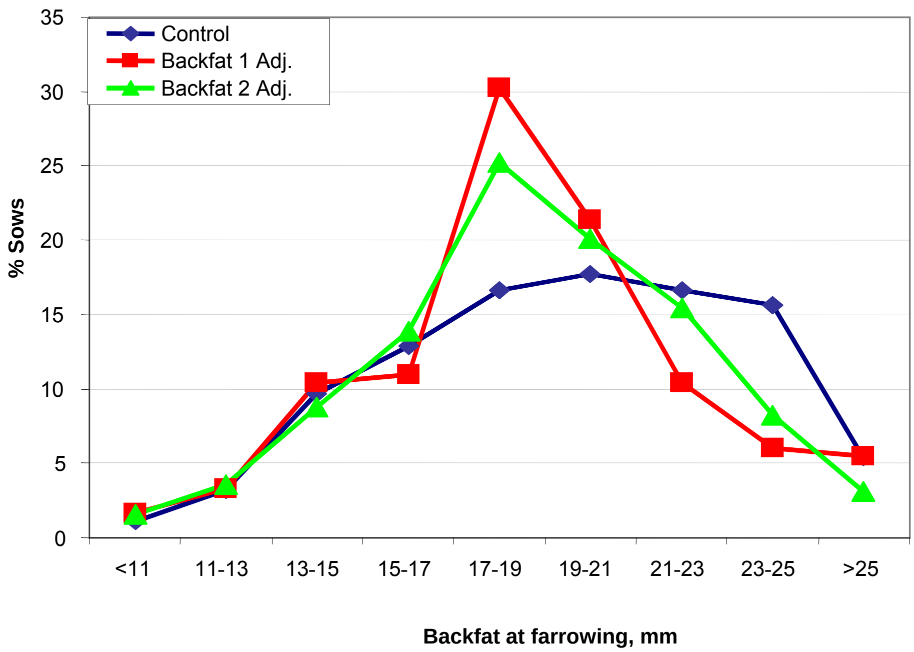

Figure 6. **Influence of feeding method in gestation on the percentage of sows in each backfat group at farrowing.** Control sows were fed based on body condition score. Backfat 1 and 2 adjustment sows were fed based on weight at weaning and backfat at service.

It has been well documented that high backfat levels at farrowing (> 21 mm) will reduce lactation feed intake, increase sow weigh loss and reduce subsequent reproductive performance (**Figure 7**; Dourmad, 1991; Young et al., 2004a). Any system that reduces excessive fatness at farrowing will increase lactation feed intake and reduce protein and weight loss. The new feeding method also resulted in lower feed cost per sow by approximately $10 per year compared with feeding based on body condition. In addition, feeding level based on backfat and sow weight resulted in no difference in the percentage of thin (< 17 mm) sows. A very interesting observation from this study was that sows targeted to gain large amounts of backfat (6 to 9 mm) failed to achieve target backfat gains with feeding based on backfat and body condition score.

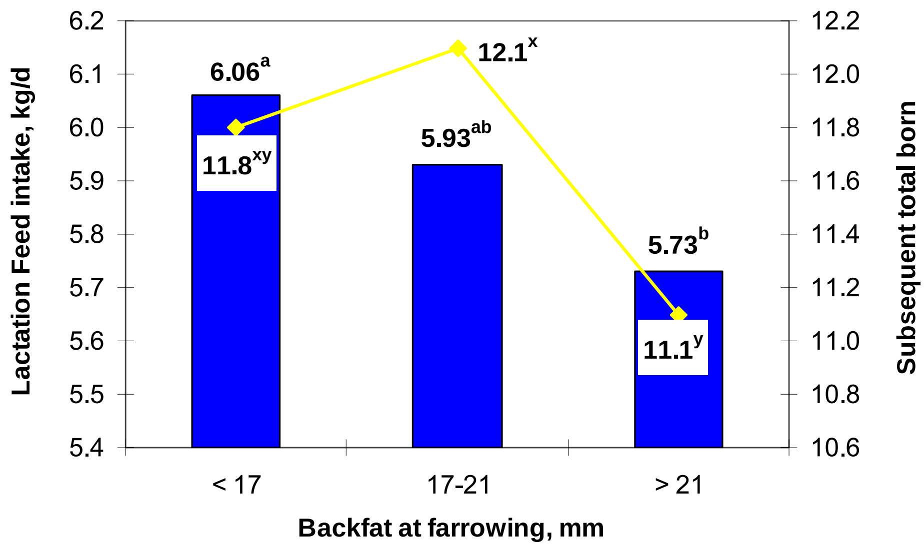

Figure 7. Influence of high backfat at farrowing on lactation feed intake and subsequent litter size. Means with different superscripts letters (a,b,c and x,y,z) differ significantly ($P < 0.05$).

Sows with low levels of backfat at service (< 13 mm) have lower insulation levels, tend to lose more energy in the form of heat, and require more feed to achieve target backfat gains. Furthermore these thin sows have much higher activity levels than other sows (Bergeron and Gonyou, 1997). The time a sow spends standing has been recorded to vary from 80 to 500 minutes/day (Young et al., 2004b). The energy cost for a sow (200 kg) standing for 80 min is 0.31 Mcal ME/day, whereas the energy cost for a sow standing for 500 minutes/day would be 1.91 Mcal ME/day. For a sow getting 5.7 Mcal ME/day, between 5 to 34% of energy intake could be used for activity. The difference in energy utilization for standing activity for the two standing durations is equivalent to more than 0.5 kg/day of a 3.0 Mcal ME gestation diet (**Figure 8**). Failure in previous studies for thin sows to gain the prescribed amount of backfat appears to have been a result of a lack of understanding of the higher maintenance requirements of these thin sows due to their higher activity levels.

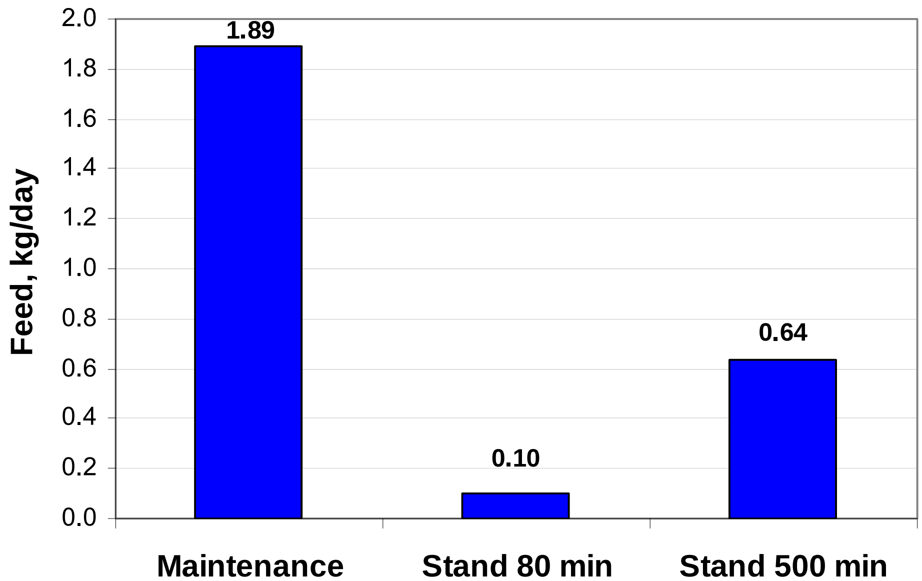

Figure 8. **Quantity of feed required for maintenance and standing activity for 80 and 500 minutes per day for a 200 kg sow**. Diet ME 3.0 Mcal.

Implementation of the Feeding Program

Inevitably, the success of any feeding program depends on proper implementation and monitoring, and people obviously play a critical role in the successful implementation of the program. Within any system there is always some resistance to change until the benefits of the changes can be seen within that system. For the new proposed feeding program to get adopted in the field requires: a sense of urgency that a change is needed, a clear understanding of the benefits the new program has to offer your system, knowledge and enthusiasm of staff to implement the new program, and finally demonstration of the benefits the program achieves over time. The time commitment for feeding based on backfat and estimated weight is similar compared with the commonly used feeding system based on body condition score. The program has been developed to be practical and can be easily implemented in the barn.

Conclusion

Feeding strategies in gestation for the sow must not be considered in isolation from those in lactation. An essential part of any strategy to optimize sow reproductive performance, increase efficiency of feed usage and lower culling rate, is to control weight and backfat gain during gestation and weight and backfat loss in lactation. Large changes in weight and backfat in gestation and lactation over several parities will inevitable lead to increased fallout rate. Excessive weight gain results in heavier sows which are likely to be too big for stalls and crates, may lead to increased locomotor problems and culling rate. Current survey data on sow reproductive performance and herd replacement rates suggest that many herds have problems in the breeding herd. Our research has shown that adaptation of a gestation feeding program based on an estimate of sow weight and a measurement of backfat will reduce percentage fat sows and reduce variation in sow weight and backfat levels at farrowing, which should help to reduce sow weight loss in lactation and improve sow reproductive efficiency.

In is increasingly evident that we cannot just feed to the meet the requirements of the average sow in the herd as this will lead to increase variation in sow condition and performance. It is the extremes of very thin and very fat sows that results in reduced performance and longevity. Inevitably, systems that do not allow for individual animal attention will suffer the consequences of higher culling and mortality, and lower productivity. The proposed method of monitoring and maintaining sow condition will allow individual animal attention, more precisely feed sows and thus help to reduce variation in condition and performance.

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