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Comparison of three methods of feeding sows in gestation and the subsequent effects on lactation performance

Abstract

A total of 684 sows from breeding groups over six weeks were used to compare three methods of feeding during gestation and to assess the subsequent effects on lactation performance. Control gilts and sows were fed according to body condition based on a scale of 1 to 5, (1=thin, 5=fat). Sows were visually assessed for body condition at breeding and were assigned a daily feed allowance to achieve a body condition score of 3 at farrowing. Sow body condition was evaluated every two weeks throughout gestation, and feed allowance was adjusted as required. Treatment two used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or weight at service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing. Sow feeding level remained constant from d 0 to 101 of gestation. Feed allowances were based on modeled calculations of energy and nutrient requirements to achieve target sow maternal weight and backfat gain. Treatment three was identical to treatment two except that feeding pattern was altered for thin sows and gilts (<15 mm at>service) in an attempt to reach 19 mm by d 36 of gestation. Sows were weighed at the previous weaning and gilts at-service and again between d 112 and 114 of gestation. Backfat was measured between d 0 and 5 and again between d 108 and 113 of gestation. Sows on treatments two and three achieved backfat of 19 and 19.1 mm at farrowing, respectively, while control sows numerically tended to have greater backfat at farrowing (20 mm). On average, sows targeted to gain large amounts (6 to 9 mm) of backfat in gestation failed to achieve target gains regardless of feeding method. Feeding sows in gestation based on backfat (treatments two and three) resulted in a higher proportion of sows in the target backfat range of 17 to 21 mm at farrowing and a lower percentage of fat sows (>21 mm) but no difference in the percentage of thin sows (<17 >mm) compared to the standard method of feeding based on body condition. Gestation feeding method had no effect on performance during lactation. Feed intake in lactation was lower for high backfat sows (>21 mm) at farrowing compared to sows with <21 mm. The high proportion of sows in the optimum backfat category demonstrates that feeding based on backfat and body weight has potential for facilitating more precise gestation>feeding.; Swine Day, 2003, Kansas State University, Manhattan, KS, 2003

Keywords

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COMPARISON OF THREE METHODS OF FEEDING SOWS IN GESTATION AND THE SUBSEQUENT EFFECTS ON LACTATION PERFORMANCE

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Summary

A total of 684 sows from breeding groups over six weeks were used to compare three methods of feeding during gestation and to assess the subsequent effects on lactation performance. Control gilts and sows were fed according to body condition based on a scale of 1 to 5, (1=thin, 5=fat). Sows were visually assessed for body condition at breeding and were assigned a daily feed allowance to achieve a body condition score of 3 at farrowing. Sow body condition was evaluated every two weeks throughout gestation, and feed allowance was adjusted as required.

Treatment two used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or weight at service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing. Sow feeding level remained constant from d 0 to 101 of gestation. Feed allowances were based on modeled calculations of energy and nutrient requirements to achieve target sow maternal weight and backfat gain.

Treatment three was identical to treatment two except that feeding pattern was altered for thin sows and gilts (<15 mm at service) in an attempt to reach 19 mm by d 36 of gestation. Sows were weighed at the previous weaning and gilts at-service and again between d 112 and 114 of gestation. Backfat was measured between d 0 and 5 and again between d 108 and 113 of gestation.

Sows on treatments two and three achieved backfat of 19 and 19.1 mm at farrowing, respectively, while control sows numerically tended to have greater backfat at farrowing (20 mm). On average, sows targeted to gain large amounts (6 to 9 mm) of backfat in gestation failed to achieve target gains regardless of feeding method. Feeding sows in gestation based on backfat (treatments two and three) resulted in a higher proportion of sows in the target backfat range of 17 to 21 mm at farrowing and a lower percentage of fat sows (>21 mm) but no difference in the percentage of thin sows (<17 mm) compared to the standard method of feeding based on body condition.

Gestation feeding method had no effect on performance during lactation. Feed intake in lactation was lower for high backfat sows (>21 mm) at farrowing compared to sows with <21 mm. The high proportion of sows in the

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optimum backfat category demonstrates that feeding based on backfat and body weight has potential for facilitating more precise gestation feeding.

(Key Words: Sows, Backfat, Body Condition Score)

Introduction

Maintaining adequate body tissue reserves throughout a sow's lifetime is thought to be important to maximize herd productivity. Concern has increased regarding the fat and muscle mass with which the young gilt begins her reproductive life. However, research investigating the relationship between gilt body composition at breeding and subsequent sow longevity has produced conflicting results. A large study using 1,072 large white sows, reported that backfat depth at mating was positively related to lifetime productivity. In contrast, there are ample experimental data, using various genetic lines and in different production systems, indicating that body condition of gilts at first successful breeding has no relationship with culling rate over three or four parities.

One common method of feeding gestating gilts and sows on commercial farms is to provide them with an amount of feed throughout gestation to achieve a visual body condition score (BCS) of 3 at farrowing on a scale of 1 to 5 (1 very thin to 5 very fat). Daily feed allowances are based on body condition using some arbitrary scale. Body condition score and backfat have been shown to be poorly comparable. In spite of the considerable research, there is a lack of consensus as to the best strategy for feeding pregnant sows.

Modern sows are younger and leaner at the time of mating, have poorer appetites, are more fertile, and produce more milk than sows of 5 to 10 years ago. The challenge is to develop feeding programs that support this new level of performance. Thus, our objectives were to compare three methods of feeding sows in gestation over one parity and to monitor subsequent lactation performance.

Procedures

The experiment was conducted on a 2,500 sow farrow-to-wean operation in Missouri. A total of 684 sows (Camborough 22; PIC USA, Franklin, Kentucky) sows were randomly allotted to treatments within the first 5 days after service. During gestation, sows were fed a corn-soybean meal based diet formulated to contain 0.6% lysine, 0.98% calcium and 0.67% P (Table 1).

There were three experimental treatments. Control gilts and sows were fed following the farm's normal procedure of feeding sows based on body condition score (Control; Table 2). A body condition score was visually determined and sows were assigned condition scores ranging from 1 to 5, (1 being very thin (emaciated), 3 in condition, and 5 very fat). Treatment two used feeding levels based on backfat thickness, measured between d 0 and 5 after breeding, and initial weight for sows and weight at service for gilts. The assigned feeding level remained constant from d 0 to 101 of gestation (Table 3). Backfat was measured at the P2 position (last rib, 2.5 inches from the center line of the back) on both sides of the backbone using a Lean-Meater (Renco Corporation, Minneapolis, Minnesota). Values from the two measurements were averaged to obtain a single backfat measurement. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing. Feeding levels for sows assigned to treatment three were based on backfat thickness measured between d 0 and 5 after breeding and initial weight for sows and weight at service for gilts. But thin sows and gilts with less than 15 mm of backfat at breeding had their feed level adjusted again on d 36 of gestation (Tables 4 and 5). The objective of this strategy was to target 19 mm of backfat for thin sows and gilts (P2 <15 mm) on d 36 of gestation. For the last 2 weeks of gestation (d 102 to 115), all gilts and sows on all three feeding methods received 2 lb of feed per d in addition to d 100 feed level.

Feed allowances for treatments two and three were based on modeled calculations of energy and nutrient requirements to achieve target sow maternal weight and backfat gain. The gestational energy requirements were determined by calculating the daily energy requirement for maintenance (ME_M) multiplied by 115 days, plus energy for maternal gain, and energy for products of conceptus and uterine gain, and summing these to give the total gestation energy requirement. The calculations used were:

ME_M (MJ) = $0.45 \times BW^{0.75}$, kg
Energy maternal gain (MJ) = $9.7 \times$ BW gain, kg + $54 \times$ P2 gain, mm
Energy uterus gain (MJ) = ($4.8 \times$ fetus BW gain, kg) $\div 0.5$

Where BW is average body weight of the sow, which is calculated as weight at service plus one half targeted maternal weight gain plus one half products of conceptus and uterine gain in gestation. P2 gain is the targeted increase in required backfat to achieve a target backfat of 19 mm at farrowing.

The gestation feed box (Chore-Time Equipment, Milford, Indiana) could feed up to 10 lb in one delivery, and feed was delivered once daily at 7 a.m. The feed box setting for all sows was recorded to determine total gestation feed consumption. Prior to the start of the experiment, a representative sample of feed boxes was tested over a variety of different feed allowances (2 through 10 lb of feed). To provide 4 lb of feed the feed box was set at 3.7 lb (Target feed level, lb = $0.886 \times$ actual feed level + 0.168). This regression equation was then used to adjust the feed box settings to provide the correct amount of feed.

Sows and gilts were weighed again between d 112 and 114 of gestation when entering the farrowing barn. Backfat measurements were also taken between d 108 and 113 of gestation. Protein and fat mass was estimated using published prediction equations (Dourmad et al., 1997). Three temperature recorders (Hobo, Animal Environment Specialists Inc, Marysville, Ohio) were placed in the gestation barn to monitor barn temperatures throughout gestation. For the first 35 days of gestation, all sows were housed in the breeding barn in individual gestation sow stalls (2×7 ft). After pregnancy confirmation, they were moved to the gestation barn where they were also housed in individual gestation sow stalls for the remainder of gestation. Both the breeding and gestation barns were double-curtain sided, fully-slatted barns.

Sows were fed ad libitum using the Quincy Development and Manufacturing ad libitum feeder (Hog Slat, PO Box 300, Newton Grove, NC 28366), which had a hopper with a capacity of up to 11 lb and was filled twice daily at 9 a.m. and 2:30 p.m. Sows were fed a corn-soybean meal, added fat diet formulated to contain 1.0% lysine, 0.91% ca and 0.71% P (Table 2). Feed intake was determined by recording the number of containers containing 4 lb of feed that was used to fill the sow feeders. Any feed removed from the feeder was recorded. Total numbers of pigs born, born alive, born dead, mummified, and fostered were recorded. At weaning, the number of pigs weaned and date of weaning were recorded on the feed intake card. Sows were weighed and backfat was measured at weaning. The date of weaning and estrus was recorded and used to calculate the percent of sows returning to estrus by 7 days post weaning.

Data were analyzed as a completely randomized design using the MIXED procedure of SAS. Sow was the experimental unit of analysis. Treatment (n=3) was the main effect tested. A chi square statistic was used to determine if there was evidence of significant differences in the number of sows removed from the experiment and the percent of sows returning to estrus in 7 days post weaning across treatments.

Results and Discussion

Gestation barn temperatures averaged 67.6 ± 4.8°F for the duration of the trial. Between service (initiation of the experiment) and entry to the farrowing house, 18.9, 20, and 16 % of sows started on the experiment were removed on the control and treatments two and three. From farrowing to weaning 3.2, 2.8, and 2.6 % of sows were removed from the experiment on control and treatments two and three.

Average daily feed intake for gestation was greater ($P<0.05$) for control sows at 5.7 lb, compared to sows on treatments two and three at 5.1 lb. Sow initial and farrowing weight did not differ ($P>0.10$) among the three treatment groups (Table 6). From the start of the experiment to entering the farrowing house, control sows gained more ($P<0.01$) weight than sows on treatments two and three. Sows on treatments two and three had an average backfat of 19 and 19.1 mm at farrowing, respectively. This was close to the target backfat of 19 mm at farrowing. However, control sows tended to have greater ($P=0.07$) backfat at farrowing (20 mm) than sows on treatments two and three. Also, control sows had greater ($P<0.01$) backfat gain during gestation than those on treatment two, and tended to have greater backfat gain than those on treatment three ($P<0.06$). The standard deviation of backfat from the start of the experiment to farrowing increased for the control and treatment two sows from 3.6 and 3.3 mm to 3.9 and 3.6 mm respectively, while the standard deviation of backfat for treatment three remained unchanged at 3.6 mm. Predicted maternal weight gain, using the NRC (1998) model, was similar to the actual maternal weight gains (± 1.8). Using estimated protein and fat mass gain from initiation of the experiment to entering the farrowing house, control sows gained more ($P<0.03$) protein and fat mass than sows on treatments two and three.

On average, sows on treatments two and three that were predicted to gain no backfat, actually gained 1.9 mm of backfat (Table 7). Sows predicted to gain 3 mm of backfat gained 2.9 mm. Sows predicted to gain 6 and 9 mm of backfat gained only 3.5 and 4.7 mm, respectively. Control sows that needed to gain 6 and 9 mm of backfat also failed to meet these targets. Estimated maternal weight gains were in excess of predicted weight gains for the 28 and 44 lb predicted maternal weight gain groups on feeding methods two and three. However, sows predicted to gain 60 and 77 lb of maternal weight failed to achieve predicted gains.

From service to farrowing, the percentage of sows with <17 mm of backfat decreased and the percentage of sows within the backfat range of 17 to 21 mm increased for all three feeding methods (Table 8). The largest increase in the percentage of sows between 17 to 21 mm was achieved with treatment three at 19.6%; for treatment two the increase was 17.0%; while for control sows the percentage was increased by 7.6%. From service to farrowing, the percentage of fat sows (>21 mm) increased for all three treatments. There were 28.3% more control sows in this category at farrowing compared with service. In contrast, for treatments two and three, the increase was 14.3 and 19.6%, respectively. Feeding sows in gestation based on backfat (treatments two and three) resulted in a higher percentage of sows (53%) at farrowing in the target backfat range of 17 to 21 mm, and fewer (22 to 27.3%) very fat (>21 mm) sows at farrowing compared to feeding based on body condition score (control; Figure 1).

Sows with <17 mm of backfat at farrowing represented 21.6, 23.3 and 21.7% of control sows and sows on treatments two and three, respectively (Table 9). It is desirable to have sows ≥17 mm at farrowing to allow sows to lose 3 to 4 mm of backfat and not fall below 13 mm of backfat at their subsequent service. The percentage of low-backfat sows was evenly distributed across parities for the three treatments. For estimated maternal weight and backfat gains, thin sows that had less than 17 mm of backfat at farrowing failed to achieve predicted maternal weight and backfat gains, regardless of treatment.

Average daily feed intake in lactation was not affected by gestation feeding method (Table 10). Performance in lactation and from weaning-to-estrus was not affected (*P*>0.10) by gestation feeding method. Backfat at farrowing was higher and at weaning tended to be higher (*P* = 0.07) for the control sows compared with sows on treatments two and three. Sows on treatment three had greater (*P*<0.05) subsequent total born and born alive compared to sows on control and treatment two.

Feed intake in lactation was decreased for sows with >21 mm of backfat at farrowing. Sows in the <17 mm and 17-21 mm backfat categories at farrowing had greater (*P*<0.05) feed intake in lactation compared to sows with >21 mm of backfat at farrowing (Table 11). As parity increased, feed intake in lactation increased (*P*<0.05), while backfat loss decreased. Estimated fat mass loss was greater for parity 1 compared to parity 2 sows (*P*<0.05). There was a decrease (*P*<0.05) in total born and born alive between parity 1 and 2 sows. The number of mummies was higher (*P*<0.05) for parity 1 sows compared to parity 2 and 3+ sows. There was no difference in the subsequent total born, born alive, born dead, and mummies between the control and treatments two and three.

Sows that were thin (<17 mm) at farrowing had lower weight at farrowing and weaning (*P*<0.01; Table 11) relative to sows in the target backfat range (17-21 mm) and fat sows (>21 mm) at farrowing. Also, thin sows tended to lose less weight (*P*<0.07) in lactation compared to sows in the target backfat range and fat sows. As expected, sow backfat loss in lactation was lower (*P*<0.01) for the thin sows compared to sows in the target backfat range and fat sows at farrowing. There was no difference in total number of pigs born, born alive, born dead, mummified, fostered and weaned between the thin and other sows. Fat sows (>21 mm) at farrowing had significantly lower subsequent total born and born alive than sows in the target backfat range, and tended (*P*=0.09) to have lower subsequent total born and born alive than thin sows.

Feeding sows in gestation based on backfat (treatments two and three) compared to the standard system of feeding based on body condition (control) resulted in a higher proportion of sows in the target backfat range of 17 to 21 mm at farrowing with a lower percentage of fat sows (>21 mm), but no difference in the percentage of thin sows (<17 mm). It is desirable to have sows ≥17 mm at farrowing to allow sows to lose 3 to 4 mm of backfat and not fall below 13 mm of backfat at their subsequent service. Data from several studies have shown that low backfat levels at weaning (<14 mm) compromise subsequent performance. Gestation feeding method had no effect on sow performance in lactation in our experiment. Sows with high backfat at farrowing (>21 mm) had lower feed intake in lactation. This agrees with previous research where a negative relationship has been established between backfat depth at farrowing and lactation feed intake.

There are critical factors in any gestation-feeding program that can lead to inaccuracies, although we believe using a feeding method based on backfat measurements is a viable alternative. A high proportion of sows targeted to gain 6 and 9 mm of backfat on all three treatments failed to gain predicted backfat. Thin sows (sows targeted to gain 6 and 9 mm) tend to be more active (standing-up more often) thereby expending more energy. Thin sows that failed to gain target backfat in gestation are a major concern. We believe that backfat may need to be measured again during mid-gestation in these thin sows and their feed allowance adjusted accordingly. It is also possible that the amount of daily feed intake required to achieve large gains in backfat may be greater than the sow's normal appetite. A strategy may need to be developed for sows needing to gain 6 to 9 mm to allow them to achieve the large backfat gain over two parities instead of one. Also some of these sows may never gain enough backfat, no matter how much feed they receive, and possibly will continue to lose backfat over successive parities until they are removed from the herd. Irrespective of kinetics of energy (feed) supply, high feed level in early gestation (treatment three sows <15 mm at service) or a constant feeding level (treatment two) throughout gestation, there was no effect on performance in gestation or lactation.

In conclusion feeding gestating sows based on modeled nutrient requirements from weight at weaning and backfat at service appears to be a viable alternative to the commonly used visual body scoring systems. Feeding based on backfat and weight resulted in a lower proportion of sows too fat at farrowing and a similar percentage of thin sows compared to the visual body scoring system. Gestation feeding method had no effect on performance in lactation. Thin sows (targeted to gain 6 and 9 mm) failed to gain their targeted backfat in gestation regardless of feeding method.

Table 1. Composition of the Gestation and Lactation Diets (As-fed Basis)

Ingredient, %	Gestation	Lactation
Corn	83.56	68.19
Soybean meal (48% crude protein)	12.50	23.80
Choice white grease	-	3.45
Di-calcium phosphorous	1.70	1.68
Limestone	1.47	1.19
Salt	0.50	0.50
Dynamate	-	0.75
Lysine	-	0.13
Methionine	-	0.06
Mineral and vitamins	0.27	0.25
Nutrient composition		
Lysine, %	0.60	1.00
Calcium, %	0.98	0.91
Phosphorous, %	0.67	0.71
ME, kcal/lb	1,487	1,561

Table 2. Feed Level (lb/d) for Sows and Gilts on the Control Treatment Based on Body Condition Scoring[a]

Day of gestation	Condition score	Sows	Gilts
1-4		4.5	4.0
5-35	1	8-10.0	7.5-9.5
	2	6.0	5.5
	3	5.0	4.5
	4	4.5	4.0
	5	4.5	4.0
36-101	≥3	4.5	4.0
	<3	5.0	4.5

[a]From d 102 to 115 all sows received 2 lb/d in addition to d 100 feed level.

Table 3. Feeding Level (lb/d) for Sows on Treatment Two from Day 0 to 101[a]

	P2 at Breeding, mm			
Weight, lb	<12	12 to 14.9	15 to 17.9	≥ 18
<325	4.8	4.3	3.8	3.3
325-400	5.2	4.8	4.3	3.8
400-475	5.7	5.2	4.7	4.2
> 475	6.2	5.7	5.2	4.7

[a]From d 102 to 115 all sows received 2.0 lb/d in addition to d 100 feed level.

Table 4. Feeding Level (lb/d) for Sows on Treatment Three with < 12 mm or 12 to 14.9 mm of Backfat[a]

	Day of Gestation		
	0 to 35		36 to 101
Weight, lb	< 12 mm	12 to 14.9 mm	
<325	6.4	4.8	4.0
325-400	8.0	6.4	4.0
400-475	7.2	5.6	5.0
> 475	8.8	7.2	5.0

[a]From d 102 to 115 all sows received 2.0 lb/d in addition to d 100 feed level.

Table 5. Feeding Level (lb/d) for Sows on Treatment Three with 15 to 17.9 mm or ≥ 18 mm of Backfat[a]

	Day of Gestation	
	0 to 101	0 to 101
Weight, lb	15 to 17.9 mm	≥18 mm
<325	3.8	3.3
325-400	4.3	3.8
400-475	4.7	4.2
> 475	5.2	4.7

[a]From d 102 to 115 all sows received 2.0 lb/d in addition to d 100 feed level.

Table 6. Effect of Feeding Method on Weight, Backfat, Estimated Protein and Fat Mass Gain in Gestation

		Treatment			
Item	Control	Two	Three	SE	P<
Number of sows	185	180	194	-	-
Average parity	2.9	3.3	3.0	0.30	0.51
Daily feed intake, lb	5.7[a]	5.1[b]	5.1[b]	0.07	0.01
Sow weight, lb					
Initial	469.7	482.3	477.7	11.87	0.59
Farrowing	579.3	576.9	571.2	10.80	0.75
Weight gain	109.1[a]	93.4[b]	92.8[b]	4.54	0.01
Estimated post-farrowing[c]	532.8	530.8	525.5	10.78	0.79
Estimated maternal gain lb[d]	62.6[a]	47.3[b]	47.1[b]	4.54	0.01
Sow backfat, mm					
Service	16.3	16.4	16.1	0.37	0.71
Farrowing	20.0	19.0	19.1	0.40	0.07
Gain	3.6[a]	2.6[b]	2.9[ab]	0.26	0.01
Predicted gains					
Maternal weight gain, lb[e]	64.0[a]	46.8[b]	48.9[b]	2.71	0.01
Total weight gain, lb[f]	109.3	93.6	93.0	-	-
Backfat gain, mm[e]	6.4[a]	3.3[b]	3.7[b]	0.48	0.01
Estimated protein mass, lb[g]					
Initial	76.6	78.8	78.3	1.99	0.55
Farrowing	85.2	85.5	84.5	1.89	0.88
Gain	8.5[a]	6.5[b]	6.2[b]	0.76	0.03
Estimated fat mass, lb[h]					
Initial	93.6	96.5	94.6	3.20	0.67
Farrowing	118.2	115.0	114.0	2.81	0.34
Gain	24.3[a]	18.0[b]	19.0[b]	1.48	0.01

[ab]Means with different superscripts on the same row differ ($P<0.05$).
[c]Farrowing weight – (Total born × 4.1 lb).
[d]Post-farrowing weight – Initial weight.
[e]Predicted based on actual feeding levels provided in gestation (NRC, 1998).
[f]Maternal weight gain plus uterine weight gain (Total born × 4.1 lb).
[g]Prediction equation from Dourmad et al. (1997), 2.28 + 0.178 × (liveweight, kg) – 0.333 × (backfat, mm).
[h]Prediction equation from Dourmad et al. (1997), -26.40 + 0.221 × (liveweight, kg) + 1.331 × (backfat, mm).

Table 7. Target Versus Actual Backfat, Estimated Maternal Weight Gain, Estimated Protein and Fat Mass Gains for Treatments Two and Three

	Target P2 gain, mm ± SD			
Item	0	3	6	9
Number of sows				
Treatment two	51	68	51	10
Treatment three	49	74	47	24
Actual P2 gain, mm				
Treatment two	1.7 ± 2.9	2.9 ± 2.6	2.9 ± 2.4	4.9 ± 2.9
Treatment three	2.0 ± 2.1	2.8 ± 2.4	4.0 ± 2.7	4.5 ± 2.8
	Target maternal weight gain, lb ± SD			
	28	44	60	77
Estimated maternal weight gain, lb				
Treatment two	33.5 ± 48.5	59.7 ± 34.4	43.9 ± 44.1	65.9 ± 50.5
Treatment three	31.7 ± 38.6	52.9 ± 45.4	52.0 ± 51.4	63.7 ± 38.1
Estimated protein mass gain, lb				
Treatment two	5.5 ± 8.6	10.4 ± 6.2	7.5 ± 7.9	11.5 ± 9.0
Treatment three	5.3 ± 6.8	9.0 ± 8.2	9.0 ± 9.0	11.0 ± 6.8
Estimated fat mass gain, lb				
Treatment two	12.1 ± 15.4	21.6 ± 12.8	17.9 ± 13.7	28.7 ± 15.4
Treatment three	12.6 ± 11.7	19.6 ± 14.8	23.1 ± 17.0	27.1 ± 14.3

Table 8. Percentage of Sows at Service and Farrowing in Each Backfat Range[a]

	Service			Farrowing		
Treatment	Control	Two	Three	Control	Two	Three
Backfat, mm						
<17	58.2	56.6	59.3	22.3	24.7	20.1
17-21	32.6	36.3	33.0	40.2	53.3	52.6
>21	9.2	7.7	7.7	37.5	22.0	27.3

[a]Values represent 185 control sows, 180 sows on treatment two, and 194 sows on treatment three.

Table 9. Low Backfat Sows (<17 mm) at Farrowing by Parity, Weight and Backfat

		Treatment			
Item	Control	Two	Three	SE	P<
Number of sows	40	42	42	-	-
Percent of sows	21.6	23.3	21.7	-	-
Average parity	3.1	3.1	3.0	0.65	0.99
Percentage of sows within each parity that had backfat of less than 17 mm					
Parity 0	3.8	3.9	2.6	-	-
Parity 1	5.9	5.0	7.2	-	-
Parity 2	2.2	4.4	2.6	-	-
Parity 3+	9.7	10.0	9.3	-	-
Daily feed intake, lb	5.9	5.5	5.6	0.17	0.09
Sow weight, lb					
Initial	470.6	460.6	459.5	22.50	0.89
Farrowing	554.4	546.7	541.7	18.21	0.79
Weight gain	84.9	86.5	82.7	10.46	0.94
Estimated post-farrowing[a]	507.9	500.6	496.0	18.21	0.81
Estimated maternal gain, lb[b]	38.4	40.4	37.0	10.46	0.95
Sow backfat, mm					
Service					
Farrowing	13.0	13.2	12.7	0.50	0.53
Backfat gain	14.5	14.4	14.3	0.39	0.85
Predicted					
Maternal weight gain, lb[c]	69.2	57.9	62.5	5.09	0.15
Total weight gain, lb[d]	85.1	86.7	82.9	-	-
Backfat gain, mm[c]	7.3	5.3	6.1	0.90	0.14
Estimated Protein mass, lb[e]					
Initial	79.2	77.1	77.4	4.00	0.86
Farrowing	84.8	83.5	82.8	3.30	0.84
Gain	5.8	6.5	5.5	1.71	0.81
Estimated Fat mass, lb[f]					
Initial	84.0	83.1	80.9	5.39	0.82
Farrowing	96.7	94.6	93.4	3.90	0.68
Gain	12.3	12.7	13.1	3.25	0.95

[a]Farrowing weight – (Total born × 4.1 lb).
[b]Post-farrowing weight – Initial weight.
[c]Predicted based on the actual feed levels provided in gestation (NRC, 1998).
[d]Maternal weight gain plus uterine weight gain (Total born × 4.1 lb).
[e]Prediction equation Dourmad et al. (1997), 2.3 + 0.178 × (liveweight, kg) – 0.33 × (backfat, mm).
[f]Prediction equation Dourmad et al. (1997), -26.40 + 0.221 × (liveweight, kg) + 1.33 × (backfat, mm).

Table 10. Effect of Gestation Feeding Method on Lactation and Subsequent Performance

		Treatment			
Item	Control	Two	Three	SE	P<
Number of sows[a]	179	175	189	-	0.93
Average parity	3.8	4.2	3.9	0.29	0.33
Daily feed intake, lb	13.4	13.3	13.5	0.27	0.70
Sow weight, lb					
Farrowing	580.9	568.8	571.4	5.62	0.08
Weaning	519.4	511.4	513.9	5.80	0.38
Weight loss	60.6	56.0	57.4	3.81	0.49
Estimated post-farrowing[b]	534.3	523.2	524.9	7.40	0.32
Estimated maternal weight loss, lb[c]	14.1	9.9	11.7	3.89	0.59
Estimated protein mass, lb[f]					
Farrowing	85.5	84.3	84.5	1.28	0.60
Weaning	85.4	84.3	84.9	1.04	0.60
Loss	0.1	-0.4	-0.2	0.65	0.78
Estimated fat mass, lb[g]					
Farrowing	118.6	113.1	113.9	2.11	0.06
Weaning	106.2	102.5	101.7	2.70	0.25
Loss	12.3	10.8	12.4	1.45	0.50
Sow backfat, mm					
Farrowing	20.0[d]	19.0[e]	19.1[e]	0.38	0.02
Weaning	16.8	16.2	15.9	0.40	0.07
Loss	3.2	2.8	3.2	0.32	0.40
Total born	11.4	11.3	11.2	0.32	0.78
Born alive	10.6	10.3	10.4	0.32	0.73
Born dead	0.5	0.6	0.5	0.11	0.37
Mummies	0.3	0.3	0.3	0.07	0.80
Fostered[h]	11.0	11.2	11.1	0.11	0.52
Pigs weaned	9.6	9.7	9.8	0.18	0.42
% sows returning estrus in 7 days[a]	95.7	93.8	95.3	-	0.70
Subsequent performance					
Number of sows	141	133	150	-	0.72
Average parity	4.3	4.7	4.5	0.29	0.32
Total born	11.4[d]	11.1[d]	12.3[e]	0.35	0.01
Born alive	10.2[d]	10.1[d]	11.3[e]	0.36	0.01
Born dead	0.9	0.7	0.5	0.14	0.06
Mummies	0.4	0.4	0.4	0.10	0.91
Fallouts[a]	38	42	39	-	0.72

[a]Tested for differences using the chi square analysis.
[b]Farrowing weight – (Total born × 4.1).
[c]Post farrowing weight – weaning weight.
[de]Means with different superscript on the same row differ (P<0.05).
[f]Prediction equation Dourmad et al. (1997), 2.3 + 0.178 × (liveweight, kg) – 0.33 × (backfat, mm).
[g]Prediction equation from Dourmad et al. (1997), -26.40 + 0.221 × (liveweight, kg) + 1.33 × (backfat, mm).
[h]Values represent average litter size 24 hours post-farrowing.

Table 11. Effect of Parity and Backfat at Farrowing on Feed Intake, Performance of Sows in Lactation and Subsequent Performance

	Parity			P2 Backfat at farrowing, mm				P<	
Item	1	2	3+	<17	17-21	> 21	SE	Parity	P2 group
Number of sows[a]	102	117	324	123	258	162	-	0.67	0.16
Average parity	1.0^{a}	2.0^{b}	5.7^{c}	2.9	3.0	2.7	0.22	0.01	0.32
Daily feed intake, lb	11.1^{b}	13.4^{c}	14.2^{d}	13.2^{x}	12.9^{x}	12.5^{y}	0.30	0.01	0.03
Sow weight, lb									
Farrowing	515.7^{b}	538.7^{c}	601.2^{d}	529.6^{x}	553.3^{y}	572.8^{z}	5.69	0.01	0.01
Weaning	456.2^{b}	487.3^{c}	542.7^{d}	479.1^{x}	493.9^{y}	513.3^{z}	6.01	0.01	0.01
Weight loss	60.3	51.1	58.6	50.7	58.7	60.5	4.68	0.13	0.08
Estimated post-farrowing[e]	469.6^{b}	492.6^{c}	555.1^{d}	483.5^{x}	507.2^{y}	526.6^{z}	5.69	0.01	0.01
Estimated maternal weight loss, lb[f]	6.2	2.1	5.5	1.9	5.6	6.3	2.13	0.13	0.08
Estimated protein mass, lb[g]									
Farrowing	74.6^{b}	78.9^{c}	89.9^{d}	80.5	81.4	81.5	1.00	0.01	0.54
Weaning	75.0^{b}	80.3^{c}	89.7^{d}	80.9	81.4	82.7	1.02	0.01	0.14
Loss	-0.37	-1.20	0.16	-0.50	0.00	-0.90	0.79	0.25	0.39
Estimated fat mass, lb[h]									
Farrowing	102.1^{b}	106.1^{c}	120.5^{d}	91.3^{x}	109.8^{y}	127.7^{z}	1.50	0.01	0.01
Weaning	97.8^{b}	96.5^{c}	109.4^{d}	84.6^{x}	97.7^{y}	111.5^{z}	2.00	0.01	0.01
Loss	14.2^{b}	9.7^{c}	11.3^{bc}	6.6^{x}	12.0^{y}	16.6^{z}	0.77	0.05	0.01
Sow backfat, mm									
Farrowing	19.3	18.9	19.1	14.5^{x}	19.1^{y}	23.7^{z}	0.22	0.25	0.01
Weaning	15.6	16.0	16.3	12.7^{x}	16.0^{y}	19.1^{z}	0.40	0.33	0.01
Backfat loss	3.7	2.9	2.9	1.9^{x}	3.0^{y}	4.6^{z}	0.38	0.09	0.01
Total born	11.9^{b}	10.2^{c}	11.4^{b}	11.0	11.2	11.3	0.39	0.01	0.83
Born alive	11.0^{b}	9.6^{c}	10.5^{b}	10.2	10.5	10.4	0.38	0.01	0.62
Born dead	0.4	0.4	0.6	0.5	0.4	0.5	0.13	0.21	0.76
Mummies	0.5^{b}	0.2^{c}	0.3^{c}	0.4	0.3	0.3	0.08	0.01	0.66
Fostered[i]	11.0	11.1	11.2	11.1	11.1	11.0	0.14	0.45	0.66
Pigs weaned	9.8	9.5	9.7	9.8	9.6	9.7	0.21	0.45	0.75
% sows returning 7 days[a]	95.8	93.8	95.2	91.9	95.7	96.1	-	0.79	0.24
Subsequent performance									
Number of sows	92	106	226	93	200	131	-	0.01	0.54
Average parity	2.0^{b}	3.0^{c}	6.1^{d}	3.7	3.8	3.6	0.21	0.01	0.25
Total born	11.6	11.9	11.4	11.8^{xy}	12.1^{x}	11.1^{y}	0.44	0.56	0.02
Born alive	10.6	11.0	10.2	10.7^{xy}	11.0^{x}	10.0^{y}	0.45	0.26	0.02
Born dead	0.6	0.7	0.8	0.7	0.6	0.7	0.17	0.64	0.94
Mummies	0.3	0.2	0.4	0.3	0.4	0.4	0.11	0.28	0.43
Number fallouts[a]	10	11	98	30	58	31	-	0.01	0.54

[a]Tested for differences using the chi square analysis. [bcd]Means with different superscripts on the same row differ (P<0.05). [xyz]Means with different superscripts on the same row differ (P<0.05). [e]Farrowing weight – (Total born × 4.1 lb). [f]Post-farrowing weight –weaning weight. [g]Prediction equation from Dourmad et al. (1997), 2.3 + 0.178 × (liveweight, kg) – 0.33 × (backfat, mm). [h]Prediction equation from Dourmad et al. (1997), -26.40 + 0.221 × (liveweight, kg) + 1.33 × (backfat, mm). [i]Values represent average litter size 24 hours after farrowing.

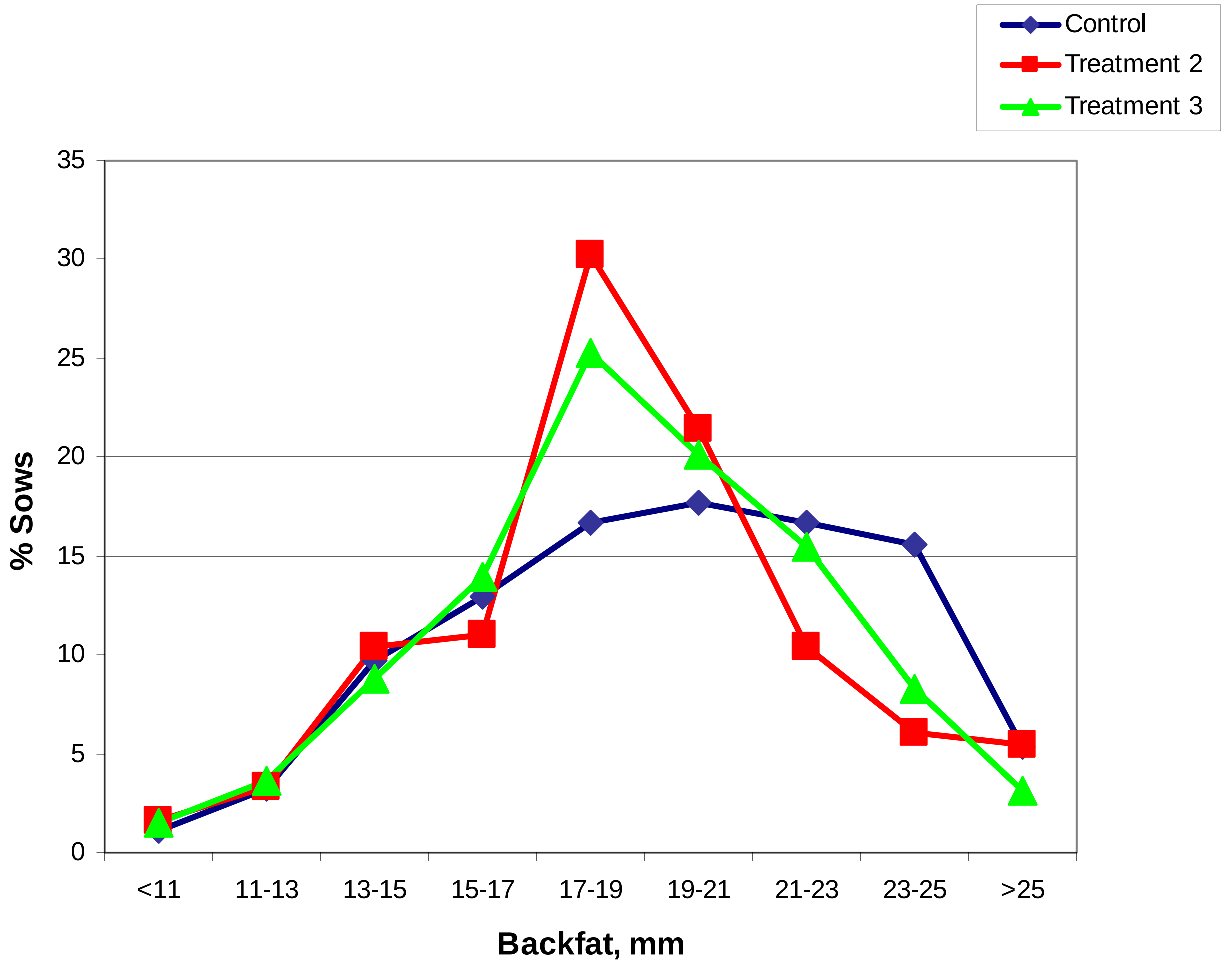

Figure 1. Plot of backfat by percentage of sows at farrowing. Values represent 185 control sows, 180 sows on treatment two, and 194 sows on treatment three.