Comparison of three methods of feeding sows in gestation and the subsequent effects on lactation performance[1]

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ABSTRACT: A total of 684 sows from breeding groups over 6 wk was used to compare three methods of feeding during gestation on gestation and 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 BCS of 3 at farrowing. Treatment 2 used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing, and 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 gains. Treatment 3 was identical to Treatment 2, 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 were weighed at service, with both weighed 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. At farrowing, sows on Treatments 2 and 3 had 19 and 19.1 mm of backfat, respectively, whereas control sows tended to have greater ($P < 0.07$) backfat (20 mm). On average, sows targeted to gain 6 to 9 mm of backfat failed to reach target gains regardless of feeding method. Feeding sows in gestation based on backfat (Treatments 2 and 3) resulted in a numerically higher proportion of sows in the target backfat range of 17 to 21 mm (40.2, 53.3, and 52.6% for control and Treatments 2 and 3, respectively) at farrowing and a numerically lower percentage of fat sows (>21 mm), but no difference in the percentage of thin sows (<17 mm) compared with feeding based on body condition. In conjunction with this observation, sows fed based on BCS were fed higher ($P < 0.05$) feeding levels in gestation than were sows fed based on backfat depth. Gestation feeding method had no effect on performance during lactation. Feed intake in lactation was lower ($P < 0.05$) for high backfat sows (>21 mm) at farrowing compared with sows with <21 mm. The high proportion of sows in the optimal backfat category demonstrates that feeding based on backfat and BW has potential for facilitating more precise feeding during gestation.

Key Words: Backfat, Body Condition Score, Sows

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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 (Rozeboom, 1999). However, research investigating the relationship between gilt body composition at breeding and subsequent sow longevity has produced conflicting results. A study using 1,072 Large White sows reported that backfat depth at mating was positively related to lifetime productivity (Gaughan et al., 1995). Survey data from Gueblez et al. (1985) indicate a positive relationship between gilt backfat depth at 100 kg and ability to farrow four litters. In contrast, there is 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 (Young et al., 1991; Newton and Mahan, 1993; Rozeboom et al., 1996).

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Table 1. Condition scoring system for the control sows

BCS	Description
1	Poor = Hips and backbone are prominent
2	Moderate = Hips and backbone are easily felt without applying palm pressure
3	Good = Hips and backbone can only be felt with firm palm pressure
4	Very good = Hips and backbone cannot be felt
5	Fat = Hips and backbone are heavily covered

One common method of feeding gestating gilts and sows is to provide them with an amount of feed throughout gestation to achieve a visual BCS of 3 (based on a scale of 1 to 5, with 1 = very thin, and 5 = very fat; Table 1) at farrowing. Daily feed allowances are based on body condition using an arbitrary scale. Body condition score and backfat have been shown to be poorly associated (Young et al., 2001; Hughes and Smits, 2002). In spite of considerable research, there is a lack of consensus as to the best strategy for feeding gestating 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 yr ago (Whittemore, 1996). 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 during one parity and to monitor subsequent lactation performance.

Materials and Methods

Animals

This experiment was conducted on a commercial 2,500 sow, farrow-to-wean operation in Missouri. A total of 684 sows (Camborough 22; PIC U.S.A., Franklin, KY) were used. Sows were randomly allotted to treatments using a random number generator (Microsoft Excel, Seattle, WA). During 6 wk, within the first 5 d after service, sows were placed on test and remained on the same treatment for one gestation period. The total number of sows within treatment by parity is outlined in Table 2. Approximately 114 sows (38 per treatment) were placed on test each week. Sows were fed a corn-soybean meal diet formulated to contain 0.60% lysine, 0.98% Ca, 0.63% P, and 3.28 Mcal/kg of ME throughout gestation (Table 3). All animal care and handling procedures followed the farms written guidelines in accordance with guidelines set forth by FASS (1999). The average weight and backfat of gilts at service were 157 kg and 16.6 mm, respectively. Although the exact age of the gilts could not be determined, in this production system, gilts were typically bred at 224 d of age.

Treatments

There were three experimental treatments. Control gilts and sows were fed following the farm's normal procedure of feeding sows based on BCS (Control; Table 4). A BCS was visually determined and sows were assigned condition scores ranging from 1 to 5 (1 = very thin [emaciated], 3 = acceptable condition, and 5 = very fat; Table 1). Sows were fed 2.0 kg/d, and gilts were fed 1.8 kg/d from service to 4 d postservice. For the subsequent 4 wk, sows in good condition (condition score 4 or 5) were fed 2.0 kg/d. Sows in acceptable condition (condition score 3) were fed 2.3 kg/d. Thin sows (condition score 2) were fed 2.7 kg/d, and very thin sows (condition score 1) were fed 3.6 to 4.5 kg/d. From d 36 to 101 of gestation, sows were fed between 2.0 and 2.3 kg/d based on body condition. (All feeding levels are on an as-fed basis.)

Treatment 2 used feeding levels based on backfat thickness measured between d 0 and 5 after breeding, and weight at weaning for sows and weight at service for gilts. The assigned feeding level remained constant from d 0 to 101 of gestation (Table 5). Backfat was

Table 2. Number of sows by parity and treatment at service, farrowing, and subsequent farrowing

	Service				Farrowing				Subsequent farrowing			
Treatment:	Control	2	3	Total	Control	2	3	Total	Control	2	3	Total
Parity												
0	39	39	36	114	35	36	34	105	—	—	—	
1	50	37	52	139	43	30	46	119	32	32	29	93
2	25	25	27	77	16	23	22	61	39	24	41	104
3	34	31	33	98	28	26	29	83	15	20	21	56
4	19	23	20	62	12	20	13	45	21	18	22	61
5	20	15	20	55	18	9	16	43	8	14	10	32
6+	41	55	43	139	33	36	34	103	26	25	27	78

Table 3. Composition of the gestation and lactation diets, as-fed basis

Item	Gestation	Lactation
Ingredient, %		
Corn	83.56	68.19
Soybean meal (48% CP)	12.50	23.80
Choice white grease	—	3.45
Dicalcium phosphate	1.70	1.68
Limestone	1.47	1.19
Salt	0.50	0.50
Dynamate[a]	—	0.75
L-Lysine HCl	—	0.13
DL-Methionine	—	0.06
Minerals and vitamins[b]	0.27	0.25
Nutrients calculated		
Lysine, %	0.60	1.00
Ca, %	0.98	0.91
P, %	0.67	0.71
ME, MJ/kg	13.72	14.40
Nutrients analyzed		
DM, %	86.30	87.19
CP, %	12.71	17.46
Crude fiber, %	3.20	4.31
Fat, %	2.73	6.71
GE, MJ/kg	16.75	18.13

[a]Provided 1.65 mg of sulfur, 1.35 mg of potassium, and 0.83 mg of Mg/kg of feed (IMC, Lake Forest, IL).

[b]Provided per kilogram of feed in gestation: 11,025 IU of vitamin A; 1,654 IU of vitamin D_3; 44.1 IU of vitamin E; 4.4 mg of menadione sodium bisulfite; 8.3 mg of riboflavin; 28.7 mg d-pantothenic acid (as d-calcium pantothenate); 49.6 mg of niacin; 551.4 mg of choline; 0.03 mg of vitamin B_{12}; 1.65 mg of folic acid; 0.11 mg of d-biotin; 39.7 mg of Mn (Mn oxide); 165.4 mg of Fe (Fe sulfate); 165 mg Zn (Zn oxide); 16.5 mg of Cu (Cu sulfate); 0.30 mg of I (Ca iodate); and 0.30 mg of Se (Na selenite). Provided per kilogram of feed in lactation: 7,275 IU of vitamin A; 1,090 IU of vitamin D_3; 30.0 IU of vitamin E; 2.9 mg of menadione sodium bisulfite; 5.4 mg of riboflavin; 18.9 mg d-pantothenic acid (as d-calcium pantothenate); 32.9 mg of niacin; 220.4 mg of choline; 0.02 mg of vitamin B_{12}; 1.09 mg of folic acid; 0.11 mg of d-biotin; 39.7 mg of Mn (Mn oxide); 165.4 mg of Fe (Fe sulfate); 165 mg Zn (Zn oxide); 16.5 mg of Cu (Cu sulfate); 0.30 mg of I (Ca iodate); and 0.30 mg of Se (Na selenite).

Table 4. Feeding level (kg/d) for sows and gilts on the control treatment based on body condition scoring (as-fed basis)[a]

Day of gestation	Condition score[b]	Sows	Gilts
1 to 4		2.0	1.8
5 to 35	1	3.6 to 4.5	3.4 to 4.3
	2	2.7	2.5
	3	2.3	2.1
	4	2.0	1.8
	5	2.0	1.8
36 to 101	≥3	2.0	1.8
	<3	2.3	2.1

[a]From d 102 to 115, all sows received 0.9 kg/d in addition to the d 100 feed level.

[b]Scored on a scale of 1 to 5 (1 = very thin [emaciated], 3 = acceptable condition, and 5 being very fat).

Table 5. Feeding level (kg/d) for sows on Treatment 2 from d 0 to 101 (as-fed basis)[a]

	Backfat at breeding, mm			
Weight, kg	<12	12 to 14.9	15 to 17.9	≥18
<147	2.1	1.9	1.7	1.5
147 to 181	2.4	2.1	1.9	1.7
181 to 215	2.6	2.4	2.1	1.9
>215	2.8	2.6	2.4	2.1

[a]From d 102 to 115, all sows received 0.9 kg/d in addition to d 100 feed level.

measured at the P2 position (last rib, 65 mm from the center line of the back) on both sides of the backbone using a Lean-Meater (Renco Corp., Minneapolis, MN). 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 with a range of 17 to 21 mm at farrowing.

Treatment 3 was also based on backfat thickness measured between d 0 and 5 after breeding and weight at weaning for sows and service for gilts to determine feeding level. Thin sows and gilts with less than 15 mm of backfat at breeding had their feeding level adjusted again on d 36 of gestation (Tables 6 and 7). 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 wk of gestation (d 102 to 115), all gilts and sows on all three feeding methods received 0.9 kg of feed per day in addition to d-100 feed level. Feeding levels were increased to meet more closely the increased energy and protein requirements due to the exponential fetal growth in the last 2 wk of gestation in an attempt to prevent sows from mobilizing body reserves to meet the increased nutrient requirements.

Target maternal weight gains (total weight gain minus fetal and uterine gain) were set at 12.7, 20.0, 27.5, and 35.0 kg for 0, 3, 6, and 9 mm of backfat gain, per Aherne (1999). Feeding levels for Treatments 2 and 3 were determined using the equations of Noblet and Etienne (1987; energy requirement for maintenance, ME_m, MJ = 0.45 × $BW^{0.75}$, kg), Dourmad et al. (1996, 1997, 1998; energy for maternal gain, MJ = [9.7 × BW gain, kg + 54 × P2 gain, mm]/0.75), and Noblet et al. (1985; energy uterus gain MJ = [4.8 × fetus BW gain,

Table 6. Feeding level (kg/d) for sows on Treatment 3 with <12 mm or 12 to 14.9 mm of backfat (as-fed basis)[a]

	Day of gestation:	0 to 35		
Weight, kg	Backfat, mm:	<12	12 to 14.9	36 to 101
<147		2.9	2.2	1.8
147 to 181		3.6	2.9	1.8
181 to 215		3.3	2.5	2.3
>215		4.0	3.3	2.3

[a]From d 102 to 115, all sows received 0.9 kg/d in addition to d 100 feed level.

Table 7. Feeding level (kg/d) for sows on Treatment 3 with 15 to 17.9 mm or ≥ 18 mm of backfat (as-fed basis)[a]

	Day of gestation:	0 to 101	0 to 101
Weight, kg	Backfat, mm:	15 to 17.9	≥18
<147		1.7	1.5
147 to 181		1.9	1.7
181 to 215		2.1	1.9
>215		2.4	2.1

[a]From d 102 to 115, all sows received 0.9 kg/d in addition to d 100 feed level.

kg]/0.5). For these equations, BW represents the average body weight of the sow, which is calculated as weight at service plus half the targeted maternal weight gain plus one half products of conceptus and uterine gain in gestation. Backfat gain is the targeted increase in required backfat to achieve a target backfat of 19 mm at farrowing. The gestational energy requirements were determined by calculating the daily energy requirement for maintenance multiplied by 115 d, 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 maximal capacity of the gestation feed box (Chore-Time Equipment, Mildford, IN) was 4.5 kg. The feed box setting for all sows was recorded to determine daily gestation feed consumption. Feed boxes were marked with settings ranging from 1 to 4.5 kg. Before the start of the experiment, representative samples of feed boxes (two boxes at each setting from 1 to 4.5 kg, at 0.45-kg increments) were selected, and the actual amount of feed delivered at each setting was weighed. A regression equation was developed to predict the weight of feed fed based on the feed box setting (gestation feed, kg = 0.886 × feed box setting + 0.168). This correction factor was taken into account when setting feed allowances for Treatments 2 and 3. Sows were fed once daily at 0700.

Sows and gilts were weighed again between d 112 and 114 of gestation when entering the farrowing barn. Postfarrowing weight was estimated by subtracting total born × 1.85 kg (fetus and conceptus; Aherne, 1999) from weight at farrowing. Backfat measurements were also taken between d 108 and 113 of gestation. Protein and fat mass was estimated using the prediction equations of Whittemore and Yang (1989), Everts and Dekker (1995), and Dourmad et al. (1997). Estimated protein mass at weaning and farrowing using the three equations was very similar, whereas estimated fat mass was numerically higher with the equations of Whittemore and Yang (1989) compared with those of Dourmad et al. (1997) and Everts and Dekker (1995). The differences among treatments were similar regardless of which prediction equations were used. Three temperature recorders (Hobo, Animal Environment Specialists Inc., Marysville, OH) were placed in the gestation barn to monitor barn temperatures throughout gestation. The temperature recorders were set to record temperature every 30 min, and were located on the east and west sides of the barn and in the center of the barn. For the first 35 d of gestation, all sows were housed in individual gestation sow stalls (0.61 m × 2.14 m). After pregnancy confirmation, they were moved to a second barn, where they were also housed in similar individual gestation sow stalls for the remainder of gestation. Both barns were naturally ventilated, double-curtain-sided, with fully slatted flooring.

Farrowing House

Sows were fed ad libitum using the Quincy Development and Manufacturing ad libitum feeder (Hog Slat, Newton Grove, NC), which has a hopper with a 4.9 kg capacity. To obtain feed, the sow turned a wheel on the bottom of the hopper. Sows were fed a corn-soybean meal, added-fat diet formulated to contain 1.00% lysine, 0.91% Ca, 0.71% P, and 3.44 Mcal/kg of ME throughout lactation (Table 3); the diet was added to the feeders twice daily at 0900 and 1430. Feed intake was determined by recording the number of containers containing 0.8 kg 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 the 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 percentage of sows returning to estrus by 7 d postweaning.

Statistical Analyses

Data were analyzed as a randomized block design using the MIXED procedure of SAS (SAS Inst., Inc., Cary, NC). Sows were blocked by week. Due to the effect of parity, a parity grouping was included in the model. Parity group included three groups: gilts, Parity 1 and Parity 2, and older sows. Thus, our statistical model included the fixed effects of treatment and parity group. Random effects included were week and treatment × week. Additionally a second analysis was conducted by categorizing sows by backfat group at farrowing (<17, 17 to 21, and >21 mm), irrespective of the treatment applied and parity. This model was setup similar to the previous model. Sow was the experimental unit of analysis. Treatment (n = 3) was the main effect tested. A χ^2 statistic was used to determine if there was evidence of significant differences in the number of sows removed from the experiment and the percentage of sows returning to estrus 7 d after weaning across treatments. Backfat at farrowing was regressed on weight change in lactation using the PROG REG procedure of SAS; parity effect was not significant, so it was not included in the model. Weight gain in gestation was regressed on lactation feed intake using the PROC REG

Table 8. Actual barn temperatures (°C ± SD) for the duration of the trial[a]

	Barn location			
Period	West	Middle	East	Average
January to March	17.5 ± 3.9	20.6 ± 1.9	17.8 ± 3.9	18.6 ± 3.2
April to June	21.2 ± 2.1	19.1 ± 3.3	22.5 ± 2.4	20.9 ± 2.6
January to June	19.4 ± 3.0	19.8 ± 2.6	20.1 ± 3.2	19.8 ± 2.9

[a]Average barn temperature for the January to June 2002 gestation period. Temperatures were recorded at three locations within the barn every 30 min, with the above values representing the average for the respective period.

procedure of SAS and adjusted for parity. Least squares means, protected by significant *F*-tests, were compared using least significant difference tests. We considered an alpha of $P < 0.05$ significant, and $P < 0.10$ to 0.06 to be a trend.

Results

Barn Temperatures

The experiment was conducted from January to July 2002. Gestation barn temperatures averaged 19.8°C for the duration of the trial, with an average of 18.6°C from January to March, and 20.9°C from April to June (Table 8).

Removals in Gestation and Lactation

Between service (start of the trial) and entry to the farrowing house, 43, 45, and 37 sows were removed from the experiment on the control and Treatments 2 and 3, respectively (Table 9). There was no difference ($P = 0.53$) in the number of sows removed from the experiment among the three treatments in gestation. Between farrowing and weaning, six, five, and five sows were removed from the experiment during lactation on control and Treatments 2 and 3, respectively. There was no difference ($P = 0.93$) in the number of sows removed from the experiment among the three treatments in lactation. The major reasons for removing sows from the experiment in lactation were sudden deaths, poor body condition, and low milk production. The number of sows removed from the experiment between weaning and subsequent farrowing was not different ($P = 0.72$) among treatments with 38, 42, and 39 sows removed for the control and Treatments 2 and 3, respectively.

Gestation Weight, Backfat, Protein, and Fat Mass Change

Feeding based on BCS resulted in control sows being fed more feed per d (2.56 kg; $P < 0.05$), compared with sows on Treatments 2 and 3 (2.31 and 2.34 kg, respec-

Table 9. Sow inventory at service, farrowing, and weaning

	Treatment[a]			
Item	Control	2	3	$P <$
No. of sows				
Service	228	225	231	—
Farrowing	185	180	194	0.40
Weaning	179	175	189	0.93
Subsequent farrowing	141	133	150	0.72
No. of removals[b]				
Total gestation	43	45	37	0.53
From d 0 to 35 of gestation	13	19	16	0.52
From d 35 to 115 of gestation	30	26	21	0.39
Died/culled/not pregnant	19	12	9	—
No recorded weight entering farrowing	14	14	12	—
Lactation[c]	6	5	5	0.93
Before subsequent farrowing	38	42	39	0.72

[a]Control sows were visually assessed and fed according to body condition based on a scale of 1 to 5 (1 = thin, 5 = fat) to achieve a BCS of 3 at farrowing. Treatment 2 used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing, and remained constant from d 0 to 101 of gestation. Treatment 3 was identical to Treatment 2 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.

[b]Using the χ^2 analysis there was no evidence that removal percent was different across treatments.

[c]Removal reasons included poor condition, died, not eating, low milk production, and lame.

Table 10. Effect of feeding method on weight, backfat, estimated protein and fat mass gain in gestation

	Treatment[a]				
Item	Control	2	3	SE	$P<$
No. of sows	185	180	194	—	—
Average parity	2.9	3.3	3.0	—	—
Daily feed intake, kg	2.56[b]	2.31[c]	2.34[c]	0.03	0.01
Sow weight, kg					
Initial	214.1	217.5	216.4	3.45	0.52
Farrowing	263.5	260.3	258.6	3.12	0.34
Weight gain	49.4[b]	42.9[c]	42.3[c]	1.80	0.01
Estimated postfarrowing[d]	242.4	239.4	237.9	3.12	0.39
Estimated maternal gain, kg[e]	28.3[b]	22.0[c]	21.6[c]	1.80	0.01
Sow backfat, mm					
Service	16.3	16.4	16.1	0.36	0.72
Farrowing	20.0	19.0	19.1	0.40	0.07
Gain	3.6[b]	2.6[c]	2.9[bc]	0.26	0.02
Predicted gains					
Maternal weight gain, kg[f]	28.5[b]	20.9[c]	21.8[c]	1.24	0.01
Total weight gain, kg[g]	48.6	41.8	42.5	—	—
Backfat gain, mm[f]	6.4[b]	3.3[c]	3.7[c]	0.50	0.01
Estimated protein mass, kg[h]					
Initial	34.9	35.5	35.4	0.55	0.54
Farrowing	38.8	38.5	38.3	0.53	0.67
Gain	3.8[b]	3.0[c]	2.9[c]	0.30	0.02
Estimated fat mass, kg[i]					
Initial	42.7	43.4	42.8	1.09	0.76
Farrowing	53.7	51.8	51.5	0.98	0.10
Gain	11.0[b]	8.3[c]	8.7[c]	0.64	0.01

[a]Control sows were visually assessed and fed according to body condition based on a scale of 1 to 5 (1 = thin, 5 = fat) to achieve a body condition score of 3 at farrowing. Treatment 2 used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing, and remained constant from d 0 to 101 of gestation. Treatment 3 was identical to Treatment 2 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.
[b,c]Means with different superscripts on the same row differ, $P < 0.05$.
[d]Farrowing weight − (total born × 1.85 kg).
[e]Postfarrowing weight − initial weight.
[f]Predicted based on actual feeding levels provided in gestation (NRC, 1998).
[g]Maternal weight gain plus uterine weight gain (total born × 1.85 kg).
[h]Prediction equation from Dourmad et al. (1997): 2.28 + 0.178 × (live weight, kg) − 0.333 × (backfat, mm).
[i]Prediction equation from Dourmad et al. (1997): −26.40 + 0.221 × (live weight, kg) + 1.331 × (backfat, mm).

tively). From the start of the experiment until entering the farrowing house, control sows gained more ($P < 0.05$) weight than sows on Treatments 2 and 3 (Table 10). Sows on Treatments 2 and 3 had an average backfat of 19 and 19.1 mm at farrowing, respectively. This was close to our target backfat of 19 mm at farrowing; however, control sows tended to have greater ($P < 0.07$) backfat at farrowing (20 mm). Also, control sows had greater ($P < 0.05$) backfat gain during gestation than those on Treatment 2, and tended to have greater backfat gain than those on Treatment 3 ($P < 0.06$). The standard deviation of backfat from weaning to farrowing numerically increased for the control (3.6 to 3.9 mm) and Treatment 2 sows (3.3 to 3.6 mm); however, the standard deviation of backfat for Treatment 3 remained unchanged at 3.6 mm. Predicted maternal weight gain, using the NRC (1998) model, was similar to the actual maternal weight gains at 28.5 vs. 28.3, 20.9 vs. 22.0, and 21.8 vs. 21.6, for the control and Treatments 2 and 3, respectively. There was no difference ($P > 0.10$) in estimated protein and fat mass at weaning and farrowing using the equations of Dourmad et al. (1997; Table 10). Using estimated protein and fat mass gain from weaning to entering the farrowing house, control sows gained more ($P < 0.05$) protein and fat mass than did sows on Treatments 2 and 3.

Target vs. Actual Gains

For Treatments 2 and 3, sows were classified into four backfat gain categories, 0, 3, 6, and 9 mm. On average, sows that were predicted to gain no backfat actually gained 1.9 mm (Table 11). 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 were fed feed

Table 11. Target vs. actual backfat, estimated maternal weight gain, estimated protein and fat mass gains for Treatments 2 and 3[a]

Item	Target P2 gain, mm ± SD			
	0	3	6	9
No. of sows				
Treatment 2	51	68	51	10
Treatment 3	49	74	47	24
Actual P2 gain, mm				
Treatment 2	1.7 ± 2.9	2.9 ± 2.6	2.9 ± 2.4	4.9 ± 2.9
Treatment 3	2.0 ± 2.1	2.8 ± 2.4	4.0 ± 2.7	4.5 ± 2.8
	Target maternal weight gain, kg ± SD			
	12.7	20.0	27.5	35.0
Estimated maternal weight gain, kg				
Treatment 2	15.2 ± 22.0	27.1 ± 15.6	19.9 ± 20.0	29.9 ± 22.9
Treatment 3	14.4 ± 17.5	24.0 ± 20.6	23.6 ± 23.3	28.9 ± 17.3
Estimated protein mass gain, kg				
Treatment 2	2.5 ± 3.9	4.7 ± 2.8	3.4 ± 3.6	5.2 ± 4.1
Treatment 3	2.4 ± 3.1	4.1 ± 3.7	4.1 ± 4.1	5.0 ± 3.1
Estimated fat mass gain, kg				
Treatment 2	5.5 ± 7.0	9.8 ± 5.8	8.1 ± 6.2	13.0 ± 7.0
Treatment 3	5.7 ± 5.3	8.9 ± 6.7	10.5 ± 7.7	12.3 ± 6.5

[a]Treatment 2 used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing, and remained constant from d 0 to 101 of gestation. Treatment 3 was identical to Treatment 2 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.

quantities designed to increase body condition and backfat failed to achieve large amounts of backfat gain. Estimated maternal weight gains were in excess of predicted weight gains for the 12.7 and 20 kg predicted maternal weight gain groups on feeding methods two and three. However, sows predicted to gain 27.5 and 35 kg of maternal weight gained 21.8 and 29.4 kg, respectively. Estimated protein mass gain averaged 2.5 and 4.4 kg, whereas estimated fat mass gain averaged 5.6 and 9.3 kg for the 12.7 and 20 kg predicted maternal weight gain groups. For the 27.5 and 35 kg predicted maternal weight gain groups, the estimated protein mass gain averaged 3.7 and 5.1 kg, while the estimated fat mass gain averaged 9.3 and 12.6 kg.

Percentage of Sows by Backfat Range

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 12). The largest increase in the percentage of sows between 17 to 21 mm was achieved with Treatment 3 at 19.6%; for Treatment 2, the increase was 17.0%, whereas 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 at service. In contrast, for Treatments 2 and 3, the increase was 14.3 and 19.6%, respectively. Feeding sows in gestation based on backfat (Treatments 2 and 3) resulted in a numerically higher percentage of sows (53%) at farrowing in the target backfat range of 17 to 21 mm, and numerically fewer (22 to 27.3%) fat (>21 mm) sows at farrowing compared with feeding based on body condition score (control).

Lactation Performance

Average daily feed intake (as-fed basis) in lactation was not affected by gestation feeding method. Control sows, and those on Treatments 2 and 3 had daily feed intakes of 6.1, 6.0, and 6.1 kg, respectively (Table 13). Performance in lactation and from weaning to estrus was not affected ($P > 0.40$) by gestation feeding method. Sow weight postfarrowing, weaning, and lactation weight loss did not differ ($P > 0.10$) among the three treatments. Estimated protein mass at farrowing, weaning, and estimated protein and fat mass loss in lactation were not affected ($P > 0.10$) by gestation feeding method. There was little relationship between backfat at farrowing and weight change in lactation (R^2 = 0.02).

Backfat at farrowing tended to be higher ($P < 0.06$) for the control sows compared with sows on Treatments 2 and 3. There was no difference in backfat loss in lactation among the three treatments, with backfat loss for control sows and those on Treatments 2 and 3 being 3.2, 2.8, and 3.2 mm, respectively. The total number of pigs born, born alive, born dead, mummified, and fostered pigs was not affected by gestation feeding method. There was no difference in the number of pigs

Table 12. Percentage of sows at service and farrowing in each backfat range

	Service			Farrowing		
Treatment[a]	Control	2	3	Control	2	3
Backfat, mm[b]						
<17	58.2	56.6	59.3	22.3	24.7	20.1
17 to 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]Control sows were visually assessed and fed according to body condition based on a scale of 1 to 5 (1 = thin, 5 = fat) to achieve a BCS of 3 at farrowing. Treatment 2 used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing, and remained constant from d 0 to 101 of gestation. Treatment 3 was identical to Treatment 2 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.

[b]Values represent 185 control sows, 180 sows on Treatment 2, and 194 sows on Treatment 3.

weaned among control sows and those on Treatments 2 and 3 (9.6, 9.7, and 9.8, respectively). The percentage of sows returning to estrus in 7 d postweaning did not differ among treatments. In the subsequent parity, sows on Treatment 3 tended to have a greater ($P < 0.08$) total of pigs born and had a greater number born alive ($P < 0.05$) compared with control sows and those that received Treatment 2. There was no difference in the number of mummies and sows that did not farrow subsequently.

As parity increased (1, 2, 3+) feed intake in lactation increased ($P < 0.05$; 5.2, 6.2, and 6.3 kg, respectively), whereas backfat loss decreased, 4.3 to 2.5 mm (Table 14). Estimated protein mass loss in lactation was not different between parities. Estimated fat mass loss was greater ($P < 0.05$) for Parity 1 compared with Parity 2 and 3 sows ($P < 0.05$; 7.8 vs. 5.3 and 4.4 kg). Total born and born alive decreased ($P < 0.05$) between Parity 1 and 2 sows. The number of mummies was higher ($P < 0.05$) for Parity 1 sows compared with Parity 2 and 3+ sows.

Performance of Thin and Fat Sows in Lactation

Sows with low backfat (<17 mm) at farrowing had lower weight at farrowing and weaning ($P < 0.01$; Table 14) relative to sows in the target backfat range (17 to 21 mm) and fat sows (>21 mm) at farrowing. Also, thin sows tended to lose less weight ($P < 0.08$) in lactation compared with sows in the target backfat range and fat sows (23.7 kg compared with 27.4 and 28.3 kg). As expected, sow backfat loss in lactation was lower ($P < 0.01$; 2.1, 3.2, and 4.8 mm) for the thin sows compared with sows in the target backfat range and fat sows at farrowing. There was no difference in the total number of pigs born, born alive, born dead, mummified, fostered, and weaned between the thin and other sows. Feed intake in lactation was decreased for sows with greater than 21 mm of backfat at farrowing. Sows in the <17 mm backfat category at farrowing had greater ($P < 0.05$) feed intake, and sows in the 17 to 21 mm backfat category tended ($P < 0.07$) to have greater feed intake in lactation compared with sows with greater than 21 mm of backfat at farrowing (Table 14). Fat sows had lower (>21 mm; $P < 0.05$) subsequent total born and born alive than did sows in the target backfat range, and tended ($P < 0.09$) to have lower subsequent total born and born alive than thin sows. Although there was a relationship between weight gain in gestation and lactation feed intake, the relationship was highly variable ($R^2 = 0.15$), with weight gain only explaining 15% of the differences between sows in lactation feed intake.

Discussion

Influence of Treatment on Sow Performance

Feeding sows in gestation based on backfat (Treatments 2 and 3), compared with the standard system of feeding based on body condition (control), resulted in a numerically higher proportion of sows in the target backfat range of 17 to 21 mm at farrowing, with a numerically lower percentage of fat sows (>21 mm), but no difference in the percentage of thin sows (<17 mm). It is desirable to have sows with 17 mm or greater of backfat 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. Research from Australia (Gaughan et al., 1995) showed that sows with low backfat at selection (9 to 13 mm) had lower lifetime performance compared with sows with >14 mm of backfat thickness at selection. Data from several studies have shown that low backfat levels at weaning (<14 mm) compromise subsequent reproductive performance (Young et al., 1991; Hughes, 1993; Tantasuparuk et al., 2001). Yang et al. (1989) observed that sows with a backfat thickness of 20 mm at farrowing reared piglets that had higher growth rates than sows with a backfat thickness of 12 mm when given restricted feed in lactation. Furthermore, recent data suggests that if primiparous sows mobilize more than 12% of their body protein mass during lactation, then subsequent ovarian function and, in turn, reproductive performance, will be negatively affected in addition to decreased litter growth rate (Clowes et al., 2003). Gestation feeding method had no

Table 13. Effect of gestation feeding method on lactation and subsequent performance

	Treatment[a]				
Item	Control	2	3	SE	$P<$
No. of sows[b]	179	175	189	—	0.93
Average parity	3.8	4.2	3.9	—	—
Daily feed intake, kg	6.1	6.0	6.1	0.13	0.70
Sow weight, kg					
Farrowing	262.2	260.0	257.6	3.71	0.43
Weaning	234.9	234.2	231.9	4.12	0.76
Weight loss	27.5	25.3	26.1	1.77	0.48
Estimated postfarrowing[c]	241.5	239.1	236.8	3.71	0.48
Estimated maternal weight loss, kg[d]	6.4	4.4	5.4	1.77	0.54
Estimated protein mass, kg[e]					
Farrowing	38.7	38.5	38.1	0.64	0.69
Weaning	38.6	38.6	38.4	0.62	0.91
Loss	0.1	–0.2	–0.1	0.29	0.76
Estimated fat mass, kg[f]					
Farrowing	53.6	51.7	51.4	1.02	0.12
Weaning	47.9	46.9	45.8	1.43	0.38
Loss	5.6	4.8	5.7	0.66	0.40
Sow backfat, mm					
Farrowing	20.0	19.0	19.1	0.38	0.06
Weaning	16.8	16.3	15.9	0.43	0.17
Loss	3.2	2.8	3.2	0.34	0.40
Total born	11.4	11.2	11.2	0.32	0.79
Born alive	10.6	10.3	10.4	0.32	0.69
Born dead	0.5	0.6	0.5	0.13	0.42
Mummies	0.3	0.3	0.3	0.07	0.84
Fostered[g]	11.1	11.2	11.2	0.11	0.63
Pigs weaned	9.6	9.7	9.8	0.20	0.42
Sows returning to estrus in 7 d, %[b]	95.7	93.8	95.3	—	0.70
Subsequent performance					
No. of sows	141	133	150	—	0.72
Average parity	4.3	4.7	4.5	—	—
Total born	11.4	11.1	12.3	0.47	0.08
Born alive	10.2[h]	10.0[h]	11.3[i]	0.36	0.01
Born dead	0.9	0.7	0.5	0.15	0.14
Mummies	0.4	0.4	0.4	0.09	0.91
No. of sows not pregnant[b]	38	42	39	—	0.72

[a]Control sows were visually assessed and fed according to body condition based on a scale of 1 to 5 (1 = thin, 5 = fat) to achieve a BCS of 3 at farrowing. Treatment 2 used feeding levels based on backfat thickness (measured between d 0 and 5 after breeding) and weight at weaning for sows or service for gilts. Feed allowance was calculated to achieve a target backfat of 19 mm at farrowing, and remained constant from d 0 to 101 of gestation. Treatment 3 was identical to Treatment 2 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.

[b]Tested for differences using the χ^2 analysis.

[c]Farrowing weight – (total born × 1.85).

[d]Postfarrowing weight – weaning weight.

[e]Prediction equation Dourmad et al. (1997): 2.3 + 0.178 × (live weight, kg) – 0.33 × (backfat, mm).

[f]Prediction equation from Dourmad et al. (1997): –26.40 + 0.221 × (live weight, kg) + 1.33 × (backfat, mm).

[g]Values represent average litter size 24 h postfarrowing.

[h,i]Means with different superscript on the same row differ, $P < 0.05$.

effect on sow performance in lactation in our experiment.

Target vs. Actual Backfat and Weight Gains

A high proportion of sows targeted to gain 6 and 9 mm of backfat on all three treatments failed to gain the predicted backfat. The estimated amount of feed needed to achieve target gains of 6 and 9 mm of backfat may not have been enough for the projected backfat gains of these sows. Research by Cooper et al. (2001) suggested that the deviation in predicted (NRC, 1998) and actual BW gains in gestation decreased with increased parity and initial BW at breeding until the fifth parity and a BW range of 210 to 240 kg. For Parity 5 and older sows with a BW range of 210 to 240 kg and greater at breeding, the deviation between predicted (NRC, 1998) and actual BW gains in gestation increased. The composition of the weight gain predicted by the NRC (1998) model may underestimate BW gain

Table 14. 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 to 21	>21	SE	Parity	P2 group
No. 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	—	—	—
Daily feed intake, kg	5.19[b]	6.19[c]	6.34[d]	6.06[x]	5.93[xy]	5.73[y]	0.12	0.01	0.04
Sow weight, kg									
Farrowing	215.7[b]	232.4[c]	282.9[d]	233.7[x]	245.1[y]	252.2[z]	2.70	0.01	0.01
Weaning	187.0[b]	208.0[c]	257.7[d]	210.5[x]	217.5[y]	224.7[z]	2.88	0.01	0.01
Weight loss	29.4	24.6	25.5	23.7	27.4	28.3	1.93	0.07	0.07
Estimated postfarrowing[e]	194.6[b]	211.3[c]	261.8[d]	212.6[x]	224.0[y]	231.0[z]	2.69	0.01	0.01
Estimated maternal weight loss, kg[f]	6.2	2.1	5.5	1.9	5.6	6.3	2.13	0.13	0.08
Estimated protein mass, kg[g]									
Farrowing	30.6[b]	33.7[c]	42.5[d]	35.3	35.9	35.6	0.47	0.01	0.51
Weaning	30.7[b]	34.3[c]	42.6[d]	35.5	35.8	35.1	0.48	0.01	0.48
Loss	0.05	–0.4	–0.05	–0.16	0.06	–0.30	0.32	0.42	0.42
Estimated fat mass, kg[b]									
Farrowing	42.2[b]	45.4[c]	56.9[d]	39.9[x]	48.4[y]	56.1[z]	0.69	0.01	0.01
Weaning	34.5[b]	40.3[c]	52.6[d]	36.5[x]	42.5[y]	48.4[z]	0.91	0.01	0.01
Loss	7.8[b]	5.3[c]	4.4[d]	3.0[x]	5.9[x]	8.1[z]	0.77	0.05	0.01
Sow backfat, mm									
Farrowing	19.2	18.8	19.1	14.5[x]	19.0[y]	23.7[z]	0.20	0.20	0.01
Weaning	14.9[b]	15.5[b]	16.7[c]	12.5[x]	15.8[y]	18.8[z]	0.35	0.01	0.01
Backfat loss	4.3[b]	3.3[b]	2.5[c]	2.1[x]	3.2[y]	4.8[z]	0.33	0.01	0.01
Total born	12.3[b]	10.5[c]	11.2[b]	11.2	11.4	11.4	0.35	0.01	0.83
Born alive	11.5[b]	10.0[c]	10.2[b]	10.4	10.7	10.7	0.34	0.01	0.62
Born dead	0.3	0.3	0.7	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]	11.3	11.2	11.0	11.2	11.2	11.1	0.13	0.45	0.66
Pigs weaned	10.0	9.7	9.6	9.8	9.7	9.8	0.21	0.07	0.75
Sows returning to estrus 7 d, %[a]	95.8	93.8	95.2	91.9	95.7	96.1	—	0.79	0.24
Subsequent performance									
No. 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	—	—	—
Total born	11.8	12.0	11.3	11.8[xy]	12.1[x]	11.1[y]	0.38	0.10	0.02
Born alive	11.1	11.2	9.9	10.9[xy]	11.1[x]	10.2[y]	0.39	0.01	0.02
Born dead	0.3	0.5	0.9	0.6	0.6	0.6	0.15	0.01	0.97
Mummies	0.3	0.2	0.4	0.3	0.4	0.4	0.10	0.08	0.43
Number of sows not pregnant[a]	10	11	98	30	58	31	—	0.01	0.54

[a]Tested for differences using the χ^2 analysis.
[b,c,d]Means with different superscripts on the same row differ, $P < 0.05$.
[x,y,z]Means with different superscripts on the same row differ, $P < 0.05$.
[e]Farrowing weight – (total born × 1.85 kg).
[f]Postfarrowing weight – weaning weight.
[g]Prediction equation from Dourmad et al. (1997): 2.3 + 0.178 × (live weight, kg) – 0.33 × (backfat, mm).
[h]Prediction equation from Dourmad et al. (1997): –26.40 + 0.221 × (live weight, kg) + 1.33 × (backfat, mm).
[i]Values represent average litter size 24 h after farrowing.

in smaller, younger sows because gain is based more on protein and less on lipid and thus is more efficient than predicted by the NRC (1998). Although overestimation of gain in older, larger sows may be explained by less-efficient use of energy for gain than predicted by the NRC (1998) model, suggesting a higher than expected proportion of lipid gain. Because these older sows have very little backfat, they have less insulation and tend to lose more energy in the form of heat than sows with greater backfat thickness. Tissue insulation of thin sows was about 28% less than that of standard sows (Hovell et al., 1977). The average barn temperature for the duration of the experiment was at the lower critical temperature (**LCT**). The LCT of gestating sows housed individually is 20 to 23°C (Noblet et al., 1989). To compensate for the effects of cold, 10 to 18 kJ of ME/(kgBW$^{0.75}$•°C) is required, depending on the temperature and housing conditions (Noblet et al., 1997); this is equivalent to 40 to 70 g of feed/°C below LCT in 200-kg sows.

Thin sows tend to be more active (standing up more often), and thereby expend more energy. Work by Bergeron and Gonyou (1997) demonstrated that sows that had been classified as more active (Category 1) at the beginning of the experiment gained less ($P < 0.05$) weight (32.0 ± 7.75 kg) during gestation compared with less active sows (45.7 ± 8.15, 41.4 ± 11.18, and 45.7 ± 7.98 kg for Categories 2, 3, and 4, respectively). Similarly, Cronin (1985) reported that sows with high activity levels produce more heat and consequently retain less energy than sows with lower activity levels in gestation. Even under confinement, the energy expenditure of swine per "unit" of physical activity represents a considerable proportion of total energy expenditure, despite reduced duration of standing activity and locomotion. This is due to a 4 to 5× higher energy expenditure per "unit" of physical activity in swine than in most other domestic species (Noblet et al., 1993).

Performance of Thin Sows

Sows (targeted to gain 6 and 9 mm) that failed to gain target backfat in gestation are a major concern. We believe that backfat may need to be measured again during midgestation 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. We are currently investigating further strategies to determine whether these thin sows can attain adequate backfat gain.

Kinetics of Energy Supply

Regardless of the kinetics of the energy (feed) supply, high feed levels in early gestation (Treatment 3 sows were <15 mm at service) or a constant feeding level (Treatment 2) throughout gestation had no effect on backfat or weight gain in gestation, total number of pigs born or born alive, or performance in lactation. Several reports indicate that high feed intake similar to that used for flushing during the first month of gestation decreases embryo survival (Jindal et al., 1996, 1997). Although other experiments have shown increasing feed intake during early gestation does not affect the number of pigs born (den Hartog and van Kempen, 1980; Toplis et al., 1983). Elsley et al. (1971) and Cromwell et al. (1980, 1989) demonstrated that the pattern of feed intake during pregnancy was less important in influencing sow performance than the total amount of feed given to sows. The majority of experiments assessing the effects of increased energy intake of gestating sows on piglet birth weight have demonstrated that pig birth weight progressively increases when sow feed or energy intake increases during pregnancy (NRC, 1998). However, a birth weight increase with a maternal feed intake of more than 6.0 Mcal of ME/d is seldom significant (Libal and Wahlstrom, 1977; Henry and Etienne, 1978; Agricultural Research Council, 1981). Contrary to expectation, subsequent total born and born alive were greater for sows on Treatment 3 compared with sows on the control and Treatment 2.

Backfat and Parity Groups

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 (Mullan and Williams, 1989; Dourmad, 1991; Revell et al., 1998). Also, as backfat at farrowing increased backfat loss in lactation increased as a result of the lower feed intake, with sows in the high backfat group (>21 mm) mobilizing 4.8 mm of backfat. Primiparous sows had approximately 20% lower feed intake in lactation than multiparous sows. The difference in feed consumed between primiparous and multiparous sows found in the current experiment is greater than that reported by the NRC (1986) of 15%. From a five-study review, Aherne (1999) concluded that a 20% decrease in feed intake of first litter females (5.5 to 4.5 kg/d) resulted in a decrease of second litter size of approximately one pig. Many other studies have demonstrated that reduced feed intake during lactation resulted in lower ovulation rates in primiparous sows (Foxcroft et al., 1995; Zak et al., 1997; van den Brand et al., 2000).

In conclusion, using backfat and estimated weight at service is an inexpensive method to bring more objectivity to feeding gestating sows. In addition, it has the potential to decrease labor needs or redirect labor away from scoring to individual animal care. Also, it is easier to train staff to use a Lean-Meater backfat probe (Renco Corp.) compared with training them to subjectively score sows for body condition. We believe these data indicate that using backfat measurement to make individual sow feeding recommendations could be a viable alternative to the widely used body condition scoring methods. In the present experiment, feeding sows in gestation based on backfat resulted in sows being fed approximately 27 kg less feed throughout gestation compared with control-fed sows. For a sow producing 2.3 litters per year, and for a gestation feed cost of $0.13/kg, this equates to an approximate saving of $8 per sow yearly for sows fed based on backfat compared with control fed sows.

Implications

Feeding gestating sows based on modeled nutrient requirements from weight at weaning and backfat at service seems 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 with the visual body scoring system. Thin (targeted to gain 6 and 9 mm backfat) sows require greater feeding levels than proposed by current models if sows are to achieve target backfat gains. We propose that backfat be measured again in midgestation of thin sows and the feeding level increased if sows are not achieving the target backfat gains. Alternatively, these larger target amounts of backfat gain (6 to 9 mm) can be achieved over two parities instead of one.

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