

Factors Influencing Sow Culling

M. T. Knauer¹, K. J. Stalder², L. Karriker², C. Johnson², and L. Layman²

¹North Carolina State University

²Iowa State University

Introduction

Poor sow longevity in commercial pork production systems can lead to economic inefficiency and animal welfare concerns (Stalder et al., 2004). The reported average parity of cull sows in the U.S. is 3.8 (PigCHAMP, 2001, 2002, 2003). Optimum average herd life to maximize herd productivity has been estimated between 5 and 10 parities (Wiseman et al., 2000). This requires a high percentage of females to remain in the herd for 6 to 8 parities (Wiseman et al., 2000). A younger sow herd can result in lower weaning weights, increased mortality, slower growth, and increased treatment costs associated with offspring from gilt litters (Moore, 2001).

Traditional culling studies are based on retrospective farm data as they are easy and economical to obtain. Producers typically report one reason for culling each sow without reporting co-morbid conditions. Additionally, these reasons are typically based on external signs or indications and do not incorporate evidence of internal lesions or results from diagnostic testing. Sow harvest plants offer researchers an opportunity to confirm farm data and to characterize factors which may cause culling. However, studies investigating the presence of gross lesions in harvest plants are few. Post-mortem examinations of female pig reproductive organs are a potential source of information concerning sow reproductive failure. Foot lesions, body condition, disease status, and other problems may also contribute to sow culling decisions. The objective of this study was to characterize the physical condition of cull sows from U.S. Midwestern sow harvest plants.

Data Collection (3,158 sows)

Harvest populations were chosen to represent the range of sows culled from U.S. pork operations. Because the type of sows harvested by individual facilities is driven by varied purchasing criteria based on anticipated output from those facilities, we chose two different Midwestern plants for data collection. Plant 1 (n= 1,321 sows) harvested a “leaner” type of sow and Plant 2 (n= 1,837 sows) harvested a “fleshier”, meatier type of sow. Twelve trips, six to each harvest plant, were made between April 7 and September 29, 2005. Body condition, feet, shoulders, teeth, lungs, and reproductive tracts were visually evaluated for gross lesions on harvested sows.

The following body composition traits were measured and recorded: backfat, loin eye area, loin depth, and body condition score (BCS). A National Swine Improvement Federation certified real-time ultrasound technician measured backfat, loin eye area, and loin eye depth from a cross sectional 10th rib image using an Aloka 500V SSD ultrasound machine (Corometrics Medical Systems, Inc., Wallingford, CT). At both plants, ultrasound evaluations were performed ante mortem while sows were restrained in a chute immediately prior to harvest. Body condition score was evaluated using a scale of 1 (thin) to 5 (fat), similar to the methods used to evaluate body condition of sows just after farrowing and during gestation (Patience and Thacker, 1989). Body

condition scores 4 and 5 were combined because only 28 sows (0.9%) evaluated were classified as a BCS of 5.

Front and rear foot lesions were evaluated and recorded by a trained technician. Like the individuals evaluating BCS, technicians conducting the feet evaluation had extensive sow and livestock evaluation experience. The presence of toe and toe wall cracks (cracked toes) included side wall lesions, cracks in the white line, and toes (Gjein and Larssen, 1995a). The presence of pad lesions included heel lesions as described by Gjein and Larssen, (1995a). Feet were examined for the presence or absence of abscesses on any surface of the foot. Both toes and dew claws were evaluated for normal and abnormal overgrown conditions (digital overgrowth). Missing dew claws were recorded where observed.

Shoulder lesions were evaluated and assigned into one of the following categories none, abscess, abrasion, or open lesions. Lesion score was classified as none if the skin appeared normal over the point of the shoulder, an abscess lesion score was assigned upon the presence of an open or closed abscess, an abrasion lesion score was designated if nodules of fibrous tissue were evident at the point of the shoulder (Ritter et al., 1999), and an open lesion score was used for open, draining sores/healing sores apparent at the point of the shoulder (Ritter et al., 1999). In the analysis, sows with an abrasion and open lesion they were placed in the open lesion category.

Teeth were evaluated and recorded by a trained technician. Top and bottom teeth were counted and scored for severity of wear. The following three definitions were used to categorize teeth wear: minimum, sharp points present on molars and incisors; moderate, points on molars and incisors worn but grooves between points still evident; and severe, no points or grooves present on molars and incisors.

Reproductive tracts were removed from the carcass by harvest plant personnel and immediately visually inspected by the research veterinarian. From the macroscopic appearance of the ovaries, sows were classified as normal (corpora lutea, corpora hemorrhagica, or mature follicles were present), cystic (multiple follicular cysts, > 1.5 cm in diameter without corpora lutea or corpora hemorrhagica), or acyclic (no corpora lutea, corpora hemorrhagica, small follicles, < 50% of ovary). Ovaries representing each macroscopic appearance category were submitted to the Iowa State Veterinary Diagnostic Lab for histopathologic characterization of status and confirmation of criteria. Pregnancy status was determined and fetal tissues (if present) were classified as normal, decomposed, or mummified.

The thoracic and abdominal cavities and organs were visually evaluated for lesions by the research veterinarian. The presence or absence of peritonitis, pleural adhesions, and pneumonia was recorded. If pneumonia was visually diagnosed, an estimate of the percentage lung involvement was made. Lesions other than those previously mentioned were noted when visual evidence was present.

Data Collection (923 sows with farm data)

Of the 3,158 sows collected, 923 sows were from 8 farms in one large integrated U.S. pork production system. These sows had been housed in gestation stalls on concrete floors with slats in the rear half of the stall. Farrowing stalls were 8.5 feet long with either cast iron or wire metal slatted flooring.

Farm records collected included sow identification, genetic line, parity, first conception date, first farrowing date, lifetime pigs born alive, pigs born alive in last litter, last farrowing/weaning date, culling date, and culling code. Farm records constructed included

pigs/litter (lifetime pigs born alive \div parity), non-productive days/parity ((culling date - first litter conception date – (parity \times 114)) \div parity), weaning to culling (culling date – last weaning date), and pigs born alive/day/herd life (lifetime pigs born alive \div (culling date – first litter conception date)).

Farm culling codes were categorized into poor body condition (poor body condition, unthrifty), old age (grandma, old age, parity), lameness (downer, injury, lameness), other (cesarean section, not found, other illness, prolapse, sudden death, unknown), poor litter performance (farrowing complications, low number born alive/number weaned, mastitis, poor milking ability, retained pigs), and reproductive failure (abortion, did not conceive, no heat, not in pig).

Results

Body composition

A variety of body types were observed. Backfat and loin eye area ranged from 0.17 to 2.46 in and 2.79 to 11.45 in², respectively. Average sow backfat was 0.98 in. All five body condition scores were observed. Most sows were assigned a BCS of 3 (49.2%), 9.7% had a BCS of 1, 28.8% had a BCS of 2, and 12.3% had a BCS of 4 or 5. All correlation coefficients among BCS, backfat, loin eye area, and loin depth were different ($P < 0.01$) from zero. Pearson correlation coefficients between BCS and backfat, loin eye area, and loin depth were 0.74, 0.51, and 0.47, respectively. Correlations between backfat and loin eye area and loin depth were 0.30 and 0.26, respectively. Among body composition traits evaluated, the correlation between loin eye area and loin depth (0.92) was greatest in magnitude. Backfat and BCS were not different ($P > 0.05$) between parities.

Feet evaluation

The most common foot lesions observed among harvested cull sows were on the rear (67.5%) and front (32.9%) pads. Traits measured on cull sows by BCS (3,158 sows), parity (923 sows with farm data), and farm (923 sows with farm data) are presented in Tables 1, 2, and 3, respectively. Rear pad lesions were associated with heavier conditioned, higher parity sows and were different ($P < 0.05$) between farms.

Cracked toes were found on of the front and rear feet of 22.6% and 18.1% of sows, respectively. Front cracked toes were more common on poorer conditioned, lower parity sows and differed ($P < 0.05$) between farms. Solution estimates for lifetime pigs born alive, pigs born alive in last litter, and pigs born alive/day/herd life by trait (923 sows with farm data) are shown in Table 4. Sows with front cracked toes compared to sows without tended ($P < 0.10$) to have fewer pigs born alive/day/herd life (0.0703 vs. 0.0725). Rear cracked toes were more prevalent on poorer conditioned sows and were different ($P < 0.01$) between farms.

Digital overgrowth was present on the rear feet of 21.1% of sows. This disorder was associated with poorer conditioned, higher parity sows and differed ($P < 0.01$) between farms. Sows with rear digital overgrowth in comparison to sows without had fewer ($P < 0.05$) pigs born alive in last litter (9.68 vs. 10.22) and a trend ($P < 0.10$) for decreased pigs born alive/day/herd life (0.0702 vs. 0.0724).

Reproductive tract evaluation

The most common reproductive lesion observed among harvested cull sows was acyclic ovaries (9.0%). Acyclic ovaries were more commonplace in poorer conditioned, lower parity sows and tended ($P < 0.10$) to be different between farms. However, there were no differences ($P = 0.65$) in acyclic ovaries between farms when farm 3 was excluded from the analysis.

Pregnancy was detected in 5.9% of sows. By farm, the likelihood of sows being pregnant ranged from 1.8% in farm 3 to 9.3% in farm 4. Pregnant sows in comparison to non-pregnant sows tended ($P < 0.10$) to have fewer pigs born alive in last litter (9.34 vs. 10.14). These results indicate farm managers may have attempted to cull the least productive sows when exceeding breeding targets. However, there was no difference in lifetime pigs born alive between pregnant (59.75) and non-pregnant sows (59.62).

Systemic lesions

Pneumonia was present in 9.7% of sows. Of the sows with pneumonia, 51% had less than or equal to 10% lung involvement from this disease. Pneumonia was associated with poorer conditioned sows. A higher percentage of lung involvement from pneumonia tended ($P < 0.10$) to be associated with higher producing sows (lifetime pigs born alive, pigs born/day/herd life) (results not shown).

Following signs of pneumonia, the next most common systemic lesion among harvested cull sows was pleural adhesions (5.6%). Plural adhesions were more common in poorer conditioned sows. By farm, the probability of pleural adhesions ranged from 0.7% on farm 7 to 10.4% on farm 2. Other than the previously described lesions, any additional gross abnormalities were noted in the present study when observed; however they were rare (less than 1%).

Shoulder lesions

Shoulder lesions were more commonplace in poorer conditioned, higher parity sows. By farm, shoulder lesions varied from 6.1% in farm 6 to 20.8% in farm 7. Sows with shoulder lesions compared to sows without had fewer ($P < 0.05$) lifetime pigs born alive (57.96 vs. 59.97). Shoulder abrasions and open wounds as scored in the present study are thought to be different traits.

Teeth evaluation

Teeth appeared to have no influence on BCS. Minimum, moderate, and severe teeth wear were not different ($P > 0.05$) between body condition scores. The number of top and bottom teeth, although different ($P < 0.05$) between body condition scores, were not different ($P > 0.05$) between BCS 1 and BCS 4.

Sows with moderate teeth compared to sows without tended to have more ($P < 0.10$) pigs born alive/day/herd life (0.0731 vs. 0.0713). Sows with severe teeth wear in comparison to sows without tended to have fewer ($P < 0.10$) lifetime pigs born alive (58.94 vs. 60.30), pigs born alive in last litter (9.87 vs. 10.31) and had less ($P < 0.01$) pigs born alive/day/herd life (0.0704 vs. 0.0734).

Production traits

Lifetime pigs born alive, pigs/litter, pigs born alive in last litter, non-productive days/parity, wean to cull, and pigs born alive/day/herd life differed ($P < 0.05$) between parities and farms (Tables 2 and 3, respectively). Parity 9+ sows in comparison to parity 1,2 sows had 87.9 more lifetime pigs born alive, 21.5 fewer non-productive days/parity, and produced 0.0103 more pigs born alive/day/herd life. Pigs/litter was not different ($P > 0.05$) between parity 1,2 sows (10.9) and parity 7,8 sows (10.7).

Culling codes

Frequencies of culling codes by parity are shown in Table 5. Reproductive failure was the most common culling code in parities 1 to 5 (66.1, 58.1, 52.7, 39.4, and 37.7%, respectively). No heat was the most frequent farm culling code in parity 1 (41.1%) and did not conceive most common in parities 2 to 5 (39.2, 36.5, 25.4, and 27.4%, respectively). Of the sows culled for reproductive failure, 86.2% were classified as having normal ovaries. Body condition was the second most frequent culling code in parities 1 to 3 (11.3, 12.2, and 16.2%, respectively). In parities 6 to 10+ old age was the most common culling code (30.1, 60.4, 71.0, 81.7, and 86.6%, respectively).

Summary

Body condition was associated with multiple abnormal conditions of sows. Whether the lesions caused BCS to change, BCS caused the lesions, or the lesions and BCS changed simultaneously is unknown.

Foot lesions were scored as present or absent. Several foot lesions reduced sow efficiency measures. However, the severity of foot lesions in relation to sow performance parameters and locomotion disorders is unknown.

Improving the retention rate of lower parity sows may offer the best opportunity to increase sow herd efficiency. In the current study, the majority of low parity sows were culled for reproductive failure, but had normal appearing ovaries. Improvements in culling decisions, gilt development, feeding/breeding management, heat detection, and/or genetics may be possible approaches to increase sow herd efficiency and lower sow culling rates.

References

Gjein, H., and R. B. Larssen. 1995a. Housing of pregnant sows in loose and confined systems - a field study. 2. Claw lesions: morphology, prevalence, location and relation to age. *Acta Vet. Scand.* 36:433-442.

Moore, C. 2001. Segregated Production: How far could we go ? *Proc. A.D. Leman Swine Conf.*, Univ. Minnesota, pp. 203-206.

Patience, J. F., and P. A. Thacker. 1989. *Swine nutrition guide*. Prairie Swine Centre, University of Saskatchewan, Saskatoon. pp: 149-171.

PigCHAMP. 2001. PigCHAMP 2001 Datashare. PigCHAMP Inc. Ames, Iowa, USA Available: www.pigchamp.com/2001Datashare.htm. Accessed Dec. 1, 2006.

PigCHAMP. 2002. PigCHAMP 2002 Datashare. PigCHAMP Inc. Ames, Iowa, USA Available: www.pigchamp.com/2002Datashare.htm. Accessed Dec. 1, 2006.

PigCHAMP. 2003. PigCHAMP 2003 Datashare. PigCHAMP Inc. Ames, Iowa, USA Available: www.pigchamp.com/2003AnnualDatashare.htm. Accessed Dec. 1, 2006.

Ritter, L. A., J. L. Xue, G. D. Dial, R. B. Morrison, and W. E. Marsh. 1999. Prevalence of lesions and body condition scores among female swine at slaughter. *J. Am. Vet. Med. Assoc.* 214:525-528.

Stalder, K. J., M. Knauer, T. J. Baas, M. F. Rothschild, and J. W. Mabry. 2004. Sow longevity. *Pig News Info.* 25:53-74.

Wiseman, J., M. A. Varley, and B. Kemp. 2003. *Perspectives in pig science*. Nottingham University Press, Thrumpton, Nottingham, UK. pp. 334.

Table 1. Traits by BCS^a measured on 3,158 cull sows evaluated at two U.S. Midwestern harvest facilities in 2005

Trait	BCS				P- value ^b
	1	2	3	4	
Front feet					
Pad lesions, %	26.3	35.4	32.6	33.1	.41
Cracked toes, %	32.9	24.9	20.4	17.6	.01
Digital overgrowth, %	6.3	5.3	2.7	0.5	.01
Abscesses, %	2.3	0.3	0.6	0.3	.02
Missing dew claws, %	0.7	0.1	0.1	0.0	.03
Rear feet					
Pad lesions, %	55.1	68.5	68.6	70.8	.01
Digital overgrowth, %	26.5	22.2	21.3	12.6	.01
Cracked toes, %	19.1	20.7	17.7	12.6	.01
Missing dew claws, %	3.7	6.5	4.7	3.0	.16
Abscesses, %	6.1	7.8	2.9	1.1	.01
Ovaries					
Normal, %	76.6	85.2	85.1	87.7	.01
Acyclic, %	20.6	9.9	7.6	4.2	.01
Cystic, %	2.8	4.8	7.3	8.1	.01
Pregnancy					
Pregnant, %	6.7	4.8	6.2	6.3	.56
Normal, %	3.9	4.0	5.8	6.0	.04
Mummified, %	2.8	0.1	0.3	0.3	.01
Decomposed, %	0.0	0.7	0.1	0.0	.16
Systemic lesions					
Pneumonia 1- 10% ^c	6.2	6.9	4.2	2.6	.01
Pneumonia > 10% ^d	13.2	6.4	2.6	3.1	.01
Pleural adhesion, %	11.0	7.4	4.1	3.7	.01
Peritonitis, %	8.2	2.2	0.6	0.5	.01
Shoulder lesions					
None, %	60.8	69.8	90.4	96.1	.01
Abrasions, %	21.6	20.4	8.3	3.9	.01
Open, %	16.9	8.9	1.2	0.0	.01
Abscesses, %	0.7	0.9	0.1	0.0	.01
Teeth wear					
Minimum, %	16.0	10.3	8.3	16.1	.85
Moderate, %	53.5	42.6	46.7	52.8	.24
Severe, %	30.6	47.1	45.2	31.1	.3
Teeth no.					
Top teeth, no.	21.3 ^{ef}	21.4 ^f	21.3 ^{ef}	21.2 ^e	
Bottom teeth, no.	21.5 ^e	21.8 ^f	21.8 ^f	21.7 ^{ef}	

^aBCS = Body condition score (possible range 1 to 5, Patience and Thacker, 1989).

^bP- value= tests the linear association between trait and BCS.

^c% of sows with pneumonia and 1- 10% lung involvement.

^d% of sows with pneumonia and > 10% lung involvement.

^{ef}Row means with different subscripts differ (P < 0.05).

Table 2. Binary trait frequencies and continuous trait LS MEANS by parity category on 923 cull sows from 8 farms evaluated at two U.S. Midwestern harvest facilities in 2005

<i>Binary trait</i>	Parity					P-value ^a
	1,2 n= 198	3,4 n= 145	5,6 n= 219	7,8 n= 201	9+ n= 160	
<i>Front feet</i>						
Heel lesions, %	19.4	20.8	40.9	42.7	47.5	0.0001
Cracked hooves, %	24.5	29.9	16.0	15.1	15.8	0.001
Digital overgrowth, %	0.0	2.1	1.4	4.0	8.2	0.0001
<i>Rear feet</i>						
Heel lesions, %	50.8	67.6	71.4	71.6	67.1	0.0003
Digital overgrowth, %	8.8	20.1	29.1	33.0	45.2	0.0001
Cracked hooves, %	13.5	15.8	17.6	11.2	14.2	0.43
Missing dewclaws, %	2.1	6.5	6.7	4.6	10.3	0.01
Abscesses, %	0.5	7.2	1.9	2.5	1.9	0.94
<i>Ovaries</i>						
Normal, %	87.2	83.2	81.3	87.4	87.8	0.60
Acyclic, %	9.7	10.5	7.5	5.0	5.8	0.04
Cystic, %	3.1	6.3	11.2	7.5	6.4	0.15
<i>Pregnancy</i>						
Pregnant, %	4.6	4.9	5.6	12.1	2.6	0.40
<i>Systemic lesions</i>						
Pneumonia 1-10% ^b	1.0	9.0	4.1	8.0	8.8	0.004
Pneumonia > 10% ^c	4.6	2.8	5.9	6.5	1.9	0.81
Pleural adhesions, %	5.6	5.6	4.7	4.5	7.1	0.81
<i>Shoulder lesions</i>						
None, %	92.9	83.5	83.6	84.6	80.6	0.003
Abrasions, %	5.1	13.1	11.9	11.0	14.4	0.02
Open, %	2.0	3.5	4.1	4.5	3.8	0.27
<i>Teeth wear</i>						
Minimum, %	47.4	5.2	1.0	1.1	0	0.0001
Moderate, %	43.8	64.0	52.3	41.4	30.9	0.0007
Severe, %	8.9	30.9	47.2	57.6	69.1	0.0001
<i>Continuous trait</i>						P-value ^{efghi}
<i>Teeth no.</i>						
Top teeth, no.	21.0 ^e	21.7 ^f	21.9 ^f	21.8 ^f	21.8 ^f	0.0001
Bottom teeth, no.	21.3 ^e	22.1 ^f	22.0 ^f	22.0 ^f	22.1 ^f	0.0001
<i>Production trait</i>						
Lifetime pigs born alive	13.9 ^e	39.2 ^f	60.2 ^g	80.7 ^h	101.8 ⁱ	0.0001
Pigs/litter	10.9 ^{fg}	11.2 ^g	10.9 ^{fg}	10.7 ^{ef}	10.5 ^a	0.02
Pigs born alive in last litter	10.8 ^g	11.4 ^g	10.0 ^f	9.5 ^f	8.8 ^e	0.0001
Non-productive days/parity	49.0 ⁱ	41.7 ^h	36.2 ^g	30.7 ^f	27.5 ^e	0.0001
Wean to cull, days	42.2 ^h	45.4 ^h	33.0 ^g	22.3 ^f	10.4 ^e	0.0001
Pigs born alive/day/herd life	.0638 ^e	.0727 ^f	.0730 ^f	.742 ^f	.0741 ^f	0.0001

^aP- value= tests the linear association between trait and parity.

^b% of sows with pneumonia and 1- 10% lung involvement.

^c% of sows with pneumonia and > 10% lung involvement.

^{efghi}Row means with different subscripts differ (P < 0.05).

Table 3. Binary trait probabilities and continuous trait LS MEANS by farm on 923 cull sows from 8 farms evaluated at two U.S. Midwestern harvest facilities in 2005

<i>Binary trait</i>	Farm								P- value ^a
	1 n= 93	2 n= 291	3 n= 41	4 n= 136	5 n= 69	6 n= 60	7 n= 109	8 n= 124	
<i>Front feet</i>									
Pad lesions, %	36.4	31.5	23.6	38.0	23.2	24.0	41.8	36.1	0.13
Cracked toes, %	21.4 ^{abc}	13.6 ^a	37.0 ^c	27.7 ^{bc}	17.4 ^{ab}	17.1 ^{ab}	23.9 ^{abc}	19.3 ^{ab}	0.04
Digital overgrowth, %	2.2	1.2	0.0	7.4	0.0	5.2	2.8	4.2	0.21
<i>Rear feet</i>									
Pad lesions, %	77.8 ^c	59.1 ^a	61.2 ^{abc}	74.7 ^c	58.3 ^{ab}	67.6 ^{abc}	65.7 ^{abc}	72.4 ^{bc}	0.02
Digital overgrowth, %	8.7 ^a	38.4 ^d	21.0 ^{abcd}	23.6 ^{bc}	16.1 ^{abc}	31.9 ^{cd}	16.0 ^{ab}	21.6 ^{bc}	0.0001
Cracked toes, %	16.9 ^{ab}	8.9 ^a	16.1 ^{ab}	29.1 ^b	16.5 ^{ab}	9.0 ^a	21.8 ^b	9.5 ^a	0.0006
Missing dewclaws, %	2.8	5.1	9.6	9.1	6.1	5.7	1.7	4.2	0.26
Abscesses, %	1.1	1.6	5.0	5.2	0.0	1.8	2.9	3.4	0.60
<i>Ovaries</i>									
Normal, %	94.3 ^c	84.8 ^{ab}	70.8 ^a	86.2 ^{bc}	86.1 ^{abc}	91.3 ^{bc}	85.0 ^{ab}	81.6 ^{ab}	0.06
Acyclic, %	2.4 ^a	6.1 ^a	22.5 ^b	7.2 ^a	9.1 ^{ab}	4.9 ^a	9.5 ^{ab}	6.8 ^a	0.05
Cystic, %	2.7	7.9	4.9	5.5	4.4	3.0	4.5	9.4	0.36
<i>Pregnancy</i>									
Pregnant, %	2.0 ^a	7.4 ^{bc}	1.8 ^{abc}	9.3 ^c	3.5 ^{ab}	6.8 ^{abc}	1.9 ^a	3.0 ^{ab}	0.04
<i>Systemic lesions</i>									
Pneumonia 1-10% ^e	2.9	8.4	3.6	7.9	5.3	1.8	4.7	2.6	0.26
Pneumonia > 10% ^f	4.2	3.7	5.9	4.1	3.1	3.3	1.5	4.3	0.84
Pleural adhesions, %	8.4 ^{bc}	10.4 ^c	6.3 ^{abc}	6.6 ^{bc}	6.8 ^{bc}	1.2 ^{ab}	0.7 ^a	2.4 ^{ab}	0.06
<i>Shoulder lesions</i>									
None, %	92.2 ^b	80.4 ^a	89.6 ^{ab}	92.2 ^b	88.8 ^{ab}	93.9 ^b	79.2 ^a	90.6 ^b	0.003
Abrasions, %	7.5 ^a	11.7 ^{ab}	17.1 ^{ab}	7.4 ^a	7.2 ^{ab}	8.3 ^{ab}	17.4 ^b	8.9 ^{ab}	0.14
Open, %	5.4 ^{ab}	3.6 ^a	0.0 ^{ab}	1.5 ^a	1.4 ^a	1.7 ^{ab}	10.1 ^b	2.4 ^a	0.05
<i>Teeth wear</i>									
Minimum, %	3.5 ^a	19.0 ^b	20.0 ^b	5.4 ^a	15.2 ^b	7.4 ^{ab}	15.2 ^b	7.6 ^{ab}	0.0007
Moderate, %	51.2	42.9	47.8	50.7	65.9	40.8	46.5	54.7	0.11
Severe, %	37.9 ^b	41.6 ^b	29.7 ^{ab}	36.6 ^b	17.5 ^a	47.5 ^b	33.7 ^b	30.6 ^{ab}	0.07
<i>Continuous trait</i>									
<i>Teeth no.</i>									
Top teeth, no.	21.7	21.4	21.3	21.5	21.4	21.5	21.5	21.5	0.12
Bottom teeth, no.	21.9 ^{bc}	21.7 ^{ab}	21.5 ^a	21.7 ^{ab}	21.8 ^{abc}	21.6 ^{ab}	21.9 ^{abc}	22.1 ^c	0.05
<i>Production trait</i>									
Parity	6.5 ^c	5.1 ^a	5.0 ^a	6.1 ^{bc}	4.9 ^a	5.4 ^{ab}	5.3 ^a	5.3 ^a	0.0004
BCS	2.8 ^d	2.7 ^{cd}	2.4 ^{ab}	2.6 ^{bc}	2.7 ^{cd}	2.3 ^a	2.3 ^a	2.7 ^{cd}	0.0001
Lifetime pigs born alive	64.2 ^{de}	61.8 ^{cd}	57.3 ^{ab}	65.1 ^e	60.0 ^{bc}	56.9 ^{ab}	56.1 ^a	56.0 ^a	0.0001
Pigs/litter	11.5 ^{bc}	11.4 ^b	10.4 ^a	11.8 ^c	10.6 ^a	10.4 ^a	10.2 ^a	10.2 ^a	0.0001
Pigs born alive in last litter	11.4 ^d	10.8 ^{cd}	9.6 ^{ab}	11.0 ^{cd}	10.3 ^{bc}	9.0 ^a	9.6 ^{ab}	9.1 ^a	0.0001
Non-productive days/parity	33.9 ^{ab}	38.0 ^{cd}	38.8 ^{bcd}	39.2 ^d	40.0 ^d	32.7 ^a	38.5 ^{cd}	35.7 ^{abc}	0.005
Weaning to culling, days	20.5 ^a	32.4 ^c	20.1 ^{ab}	45.4 ^d	32.8 ^c	31.1 ^{bc}	28.9 ^{abc}	36.2 ^c	0.0001
Pigs born alive/day/herd life	0.0785 ^c	0.0748 ^b	0.0691 ^a	0.0774 ^{bc}	0.0698 ^a	0.0703 ^a	0.0676 ^a	0.0683 ^a	0.0001

^{abcd}Row means with different subscripts differ (P < 0.05).

^eSows with 1- 10% lung involvement from pneumonia.

^fSows with > 10% lung involvement from pneumonia.

Table 4. Lifetime pigs born alive, pigs born alive in last litter, and pigs born alive/day/herd life for the absence and presence of binary traits measured on 923 cull sows from 8 farms evaluated at two U.S. Midwestern harvest facilities in 2005

<i>Binary trait</i>	Lifetime pigs born live			Pigs born alive in last litter			Pigs born alive/day/herd life		
	Absence	Presence	P- value	Absence	Presence	P- value	Absence	Presence	P- value
Front feet									
Pad lesions	59.49	59.94	0.55	10.17	9.99	0.42	0.0715	0.0729	0.19
Cracked toes	59.76	59.26	0.57	10.11	10.11	0.98	0.0725	0.0703	0.07
Digital overgrowth	59.65	59.43	0.92	10.12	9.77	0.55	0.0720	0.0722	0.94
Rear feet									
Pad lesions	59.20	59.86	0.39	9.91	10.17	0.23	0.0722	0.0716	0.55
Digital overgrowth	59.88	58.94	0.27	10.22	9.68	0.03	0.0724	0.0702	0.06
Cracked toes	59.68	59.42	0.79	10.06	10.20	0.65	0.0716	0.0731	0.29
Missing dewclaws	59.78	57.63	0.16	10.08	10.10	0.97	0.0719	0.0708	0.60
Abscesses	59.59	61.59	0.37	10.08	10.16	0.91	0.0718	0.0727	0.76
Ovaries									
Normal	60.20	59.52	0.50	9.87	10.14	0.36	0.0722	0.0719	0.82
Acyclic	59.58	59.99	0.76	10.12	9.88	0.53	0.0718	0.0732	0.45
Cystic	59.56	60.45	0.53	10.11	9.87	0.54	0.0720	0.0711	0.63
Pregnancy									
Pregnant	59.62	59.75	0.93	10.14	9.34	0.06	0.0721	0.0691	0.14
Systemic lesions									
Pneumonia 1-10% ^a	59.41	61.34	0.19	10.02	10.46	0.31	0.0716	0.0742	0.20
Pneumonia > 10% ^b	59.47	61.96	0.13	10.01	10.46	0.36	0.0717	0.0750	0.14
Pleural adhesions	59.55	61.13	0.30	10.11	9.98	0.77	0.0720	0.0713	0.74
Shoulder lesions									
None	57.96	59.97	0.04	9.98	10.12	0.64	0.0721	0.0722	0.93
Abrasions	59.90	57.81	0.07	10.14	9.78	0.27	0.0723	0.0715	0.65
Open	59.71	58.65	0.57	10.09	10.41	0.55	0.0721	0.0745	0.41
Teeth wear									
Minimum, %	59.64	60.64	0.50	10.10	10.34	0.58	0.0719	0.0749	0.15
Moderate, %	59.30	60.22	0.22	9.97	10.29	0.14	0.0713	0.0731	0.08
Severe, %	60.30	58.94	0.10	10.31	9.86	0.06	0.0734	0.0704	0.007

^aSows with 1- 10% lung involvement from pneumonia.

^bSows with > 10% lung involvement from pneumonia.

Table 5. Frequency of culling code by parity category on 923 cull sows from 8 farms evaluated at two U.S. Midwestern harvest facilities in 2005

Farm culling code	Parity				
	1,2 n= 198	3,4 n= 145	5,6 n= 219	7,8 n= 201	9+ n= 160
Body condition, %	11.6 (2) ^a	15.2 (3)	9.6 (5)	7.5 (3)	5.6 (3)
Old age, %	1.5 (6)	4.1 (6)	21.5 (2)	65.7 (1)	83.8 (1)
Lameness, %	10.6 (3)	17.9 (2)	11 (4)	5.5 (4)	0.6 (6)
Other, %	7.1 (4)	10.3 (4)	8.2 (6)	5.5 (4)	1.3 (5)
Poor litter performance, %	6.1 (5)	6.2 (5)	19.6 (3)	2.5 (6)	2.5 (4)
Reproduction, %	63.1 (1)	46.2 (1)	30.1 (1)	13.4 (2)	6.3 (2)

^aRank of culling code within parity group.

