

## Non-genetic factors influencing sow longevity

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### Introduction

The way that sows are housed during gestation and lactation has moved towards more intensive systems so that sows can be more easily managed and production maximized. At a minimum, some of these factors have contributed to a decline in the productive life of sows in commercial pork production systems. A sow remaining in the breeding herd for fewer parities is likely to produce fewer pigs in her lifetime, compared to a sow that remains in the breeding herd for a longer period of time. This reduces the opportunity of a sow to be sufficiently productive (pigs weaned and sold per lifetime) to achieve a return on the replacement gilt investment cost.

### Objectives

Discuss factors that influence sow longevity such as:

- Gilt development
- Nutrition
- Lactation length
- Body condition
- Repeat breeding
- Season
- Housing
- Feet and leg soundness
- Management
- Behavior

### Background

Poor longevity requires larger replacement gilt pools, regardless of whether a pork production system raises or purchases these gilts. Table 1 shows the reported common reasons that sows leave the breeding herd while table 2 shows the average parity at which sows are culled from several studies. In addition to the initial purchase or opportunity cost of replacement females, a producer will incur further expenses associated with developing and acclimating replacement gilts. There is a disease risk, whether small or large, when animals are introduced into the breeding herd. Reducing the number of animals and the frequency of animal introductions can reduce the risk of introducing diseases not currently present in swine operations. In some cases, poorer maternal production from younger sows, while not a direct out-of-pocket expense, will reduce the gross income of a swine operation when compared to the production of more mature sows [1].

## Effect of gilt development on sow longevity

Deen and Turner [2] clearly state what may be an important clue for poor longevity and high mortality in intensely managed pork operations. They suggest that it may be more beneficial to breed gilts early so that breeding targets are met and removal of a sow of questionable productivity is facilitated. Breeding gilts at virtually any age so that production flow is not hindered may be a major reason why breeding herd females do not remain productive in intensely managed herds. There are several factors involved with adequate gilt development to enhance sow longevity.

**Nutrition.** Scientific studies have shown that gilt development nutritional trials have had a mixture of positive and negative impacts on sow longevity. Some researchers have suggested that the relationship between body composition at mating and longevity may be “merely reflecting the consequences of subjecting improved pigs to conventional management” and “when modern gilts are subjected to good management that minimizes weight and condition loss during lactation, there is no association between live weight or backfat depth at first successful breeding and subsequent reproductive performance” [3]. However, many commercial pork operations have some challenges that may cause backfat to play a role in sow longevity.

Replacement gilts need to be fed differently starting somewhere between 150 to 180 pounds. The goal of this practice is to start building the body reserves in the gilt that will allow the sow to have long productive herd lives. The building of body reserves includes increasing mineral levels to build bone strength. The key to gilt development is to slow down protein deposition and build fat, mineral, and other nutritional reserves that the gilt can utilize when lactation dietary intake is not sufficient to meet needs. The practice of feeding gilts fed a high energy, high protein diet ad-libitum from 120 d of age until 180 d of age has been shown to adversely affect longevity [4]. Limiting energy intake during rearing may prevent gilts from getting overweight and having additional problems with fat deposits in the udder and lameness in prepubertal gilts [5-8]. Certainly, other studies have shown that gilts reared from 180 lb to 180 d of age on a restricted energy diet had a higher proportion producing four litters when compared to gilts receiving higher energy diets or gilts receiving high protein and energy diets [9].

**Off-test backfat and growth.** The level of backfat needed at offtest is likely a function of the management and environmental conditions found on individual operations. Under ideal management conditions where lactation feed intake is not a problem, backfat plays less of a role with sow longevity when compared to a situation where management and the environmental situation is less than ideal. Several studies have not found an association between longevity and backfat [10-12].

Study <sup>2</sup>	Reprod. Failure	Poor Perf.	Old Age	Feet, Leg & Locomotion Disorders	Death	Farrowing Problems	Injury, Health & Disease	Milking Problems
Pomeroy, 1960	21.4	22.4	17.1	NR <sup>1</sup>	NR	2.0	13.3	6.1
Jones, 1967	8.8	NR	2.2	9.4	10.1	NR	2.4	5.6
Svensen et al., 1975	28.8	10.0	3.9	15.0	NR	NR	NR	NR
Dagorn & Aumaitre, 1979	39.2	8.4	27.2	8.8	6.5	4.0	NR	NR
Pattison et al., 1980	37.5	13.8	24.4	11.8	NR	NR	NR	NR
Joo & Kang, 1981	32.6	15.7	16.7	9.7	NR	NR	NR	NR
Muirhead, 1981	35.4	NR	28.2	10.8	4.6	2.8	NR	5.0
Stone, 1981	12.9	20.6	33.4	11.0	NR	1.6	4.2	8.9
Friendship et al., 1986	23.7	14.5	19.2	11.8	3.0	2.3	2.5	9.0
D'Allaire, 1987	32.4	16.8	14.0	8.9	11.6	7.2	1.6	NR
Dijkhuizen et al., 1989	34.2	20.1	11.0	10.5	NR	NR	NR	NR
Stein et al., 1990	29.6	9.4	17.9	11.0	10.7	5.0	0.8	8.8
Cederberg & Jonsson, 1996	29.0	1.0	8.0	14.0	7.5	NR	NR	13.0
Kangasniemi, 1996	28.2	14.4	16.8	13.5	3.2	2.4	1.4	1.9
Paterson et al., 1996	21.3	2.3	7.2	9.3	5.0	NR	3.5	1.6
Pedersen, 1996	34.5	4.6	18.8	6.1	12.3	NR	NR	NR
Sehested & Schjerve, 1996	28.7	4.8	11.3	10.2	4.2	1.9	4.9	0.9
Boyle et al., 1998	29.8	11.1	31.3	11.3	6.6	NR	7.4	NR
Lucia et al., 2000 <sup>b</sup>	33.6	20.6	8.7	13.2	7.4	NR	3.1	NR

**Table 1. Summary of the percentage of sows culled and reason for culling. Portions of this table have been adapted from D'Allaire and Drolet, 1999. <sup>2</sup> All of the studies reviewed did not report results exactly in the same categories. When this occurred, the authors attempted to summarize the study and place results in the appropriate classification. <sup>3</sup>NR = not reported.**

Some researchers have suggested that there is no minimum level of backfat that a gilt should have at selection if management during lactation and gestation is ideal [3]. However ideal conditions frequently do not exist. When ideal conditions do not exist, some minimum level of backfat is needed on replacement gilts so that they maximize lifetime number of piglets born alive. Numerous studies have shown that gilts should have a minimum of 0.70 to 0.85 in. (18 to 22 mm) of fat at 250 lbs. to maximize longevity and lifetime productivity [13-15]. Breeding herd mortality has been shown to greatly increase when sows have less than 18 mm of backfat when measured at off-test weight [16].

Grow – finish growth rate, independently, does not appear to affect longevity. Age at first mating was not associated with number of piglets born alive in parity one, two, three, or overall, in results reported by Rozeboom et al. [11]. Other studies [10] have not demonstrated a significant effect of daily gain on longevity. Moreover, when gilts were fed to alter daily gain from 80 kg to breeding, Newton and Mahan [17] found no relationship between breeding weights of 120 kg, 135 kg, or 150kg and the ability of gilts to reproduce over three parities.

**Age at puberty and first farrowing.** In general, parity at removal can be maximized in those females that reach puberty at a younger age [18]. The improved longevity likely increases lifetime number of pigs born alive for each sow, hence a greater opportunity for a sow to generate more pigs and income. The total number of piglets produced per sow, herd life, and the parity number at culling can be improved with decreased age at first farrowing [19,20].

### Sow nutritional effects on sow longevity

We know that reproductive failure is the main reason for sows, particularly young sows, to leave the breeding herd. Particular attention needs to focus on lactation feed intake. Management to enhance lactation feed intake will prevent the sow from using her body reserves to meet the needs of her nursing pigs and hence, she will have more reserves to begin the next gestation cycle. Lactation feed intake can be enhanced by keeping the sow as cool as possible in the summer time. This can be accomplished by using drip cool systems and providing adequate ventilation. Producers should continue to monitor sow feeders during lactation in order to reduce the risk of the accumulation of moldy feed. Increased feeding frequency can also stimulate increased feed intake in the lactating sow. If the sow or gilt is not eating well in lactation, the nutrient density of the diet must be increased so that the nutritional requirements for vitamins, minerals, protein, etc., are met in a smaller package. Studies have shown that a sow's mineral status tends to decline from parity one to parity three. High quality ingredients should be utilized to Ensure maximum feed intake and nutrient utilization. Lactation feed consumption should be sufficient so that sows' body condition is somewhere between a 2 and 3 at weaning. This will enhance the chances that she will return to estrus in a timely manner after weaning. For more information concerning the nutritional needs of sows, consult PIH-23 [21], PIH-2 [22], and PIH-52 [23] which discuss swine diets, vitamins needed in swine rations, and mineral needs of swine, respectively.

### Lactation length effects on sow longevity

Modern swine operations have been weaning pigs at younger ages than had been common place up to 15 years ago. While early weaning accomplishes several beneficial goals, it does create some new challenges. Sows that are weaned early have greater odds of being removed from the breeding herd [24]. It should be clear from these data that weaning at early ages, particularly less than 16 days of lactation

Study	Avg. Parity at Culling	Culling Rate
Joubert, 1960	3.2	NR <sup>1</sup>
Pomeroy, 1960	3.75	NR
Jones, 1967	3.7	NR
Straw, 1984	5.8	NR
Friendship et al., 1986	NR	44%
Zivkovic et al., 1986	4.4 purebreds, 5.3 crossbreds	NR
D'Allaire, 1987	3.77	50%
Stein et al., 1990	NR	50%
Cederberg & Johnsson, 1996	4.7	NR
Paterson et al., 1996	3.7	NR
Pedersen, 1996	4.6	50%
Sehested & Schjerve, 1996	3.01 purebreds, 3.61 crossbreds	NR
Boyle et al., 1998	4.58	43%
Koketsu et al., 1999	5.6	NR
Lucia et al., 2000 <sup>b</sup>	3.3	NR

**Table 2. Summary of reported culling parity and rate.**  
<sup>1</sup>NR=not reported.

(Figure 1), could adversely impact sow longevity through increased culling due to reproductive failure, the number one reason sows are culled from commercial swine breeding herds. Lactation lengths longer than 28 days may also create longevity problems as the nursing pigs place increased stress on the sow's nutritional status.

### Effect of body condition on sow longevity

Thin sows at weaning have been problematic since intensive management of the breeding sow herd has become common place in the pork industry, though the problem is not necessarily new. It is well known that the thin sow problem or degree of body composition adversely contribute to poor reproductive performance and sow longevity [25,26]. Changes in backfat or condition are related to both backfat level and body weight [27]. Backfat alone, without assessing body weight change, can be misleading when evaluating sows after lactation or during gestation. Certainly, body condition score is intertwined with both lactation length and nutritional status.

Common symptoms associated with thin sows include apathy, hindquarter weakness, swaying gait, and difficulty rising, in addition to a thin or even gaunt appearance. Sow fat and weight losses can far exceed their gain from mating after parity one to the next farrowing [28]. Studies have shown that sows with 0.25 in. (6.3 mm) of fat depth or less at weaning is indicative of an eventual thin sow problem, prolonged weaning to estrus intervals, reproductive failure, and early exit from the breeding herd.

Body condition score may become an animal welfare concern. It has been shown that body condition score and shoulder lesions were significantly associated [29]. This study also pointed out those animals with no shoulder lesions had higher odds of having a body condition score of 4 or 5. Clearly, reproductive failure and body condition appear to be associated. Improving body condition at weaning likely has potential benefits that include decreased sow mortality, decreased replacement rates, lower wean-to-oestrus intervals, improved animal welfare, and better reproductive performance in the next litter. Additionally, sows with improved body condition would have greater economic value at culling.

### Repeat breeding effects on sow longevity

We have established that the majority of culling occurs in commercial swine herds because of reproductive failure. An important aspect of reproductive failure is determining if initial reproductive performance has any lingering effect on reproductive performance in later parities. Studies indicate that 8.5% to 16.9% of females return to oestrus after initially being mated after weaning [30-32]. Sows should not be culled just because they do not conceive at their first oestrus after weaning. Litter size from sows will not be adversely affected if they do not conceive until their second oestrus after weaning and some studies have shown as much as a 0.5 pig increase in litter size when sows conceive at the second estrus after weaning. As will be discussed later, some repeat breeding problems can be the result of worker related issues, boar problems, and other issues that are not related to the sow. However, the sow ends up being culled because she is not with pig after one or two estrus cycles. Sows should not be culled for being open when the boar, management, or some other factor is a problem.

### Seasonal effects on sow longevity

Many pork producers experience seasonal variation in reproductive performance of their sow herd. This seasonal variation can lead to longevity issues or increased culling during certain times of the year. The variation in reproductive performance due to season may be the result of increased temperature, changes in light duration, or other factors [33]. Modern swine facilities, which house sows indoors and in individual crates, can provide artificial lighting, and attempt to control temperature to alleviate some reproductive performance variation due to season [34].

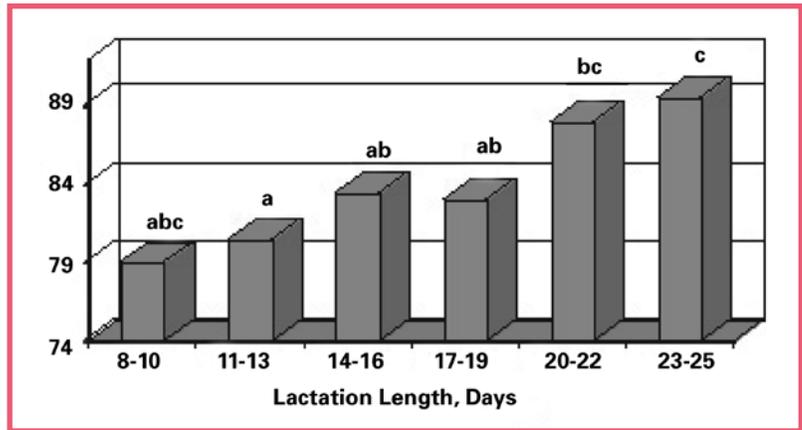
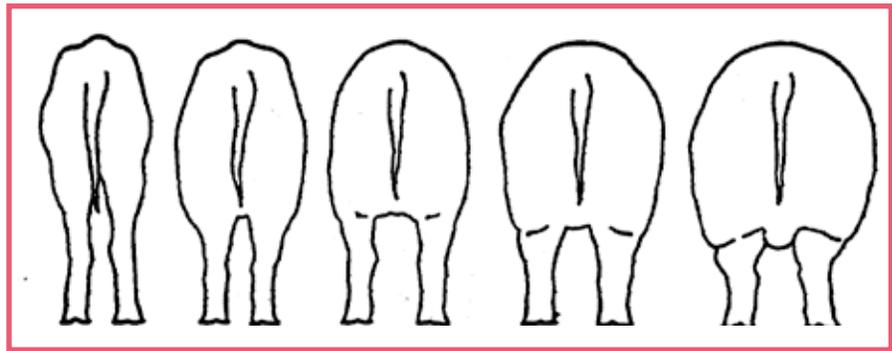


Figure 1. Influence of lactation length on farrowing rate [60].

Thacker [35] described typical attributes of seasonal infertility as 1) delayed onset of puberty, 2) prolonged wean-to-oestrus intervals, 3) reduced farrowing rate, and 4) increased abortions. Seasonal effects on farrowing rate tend to not be as large of a problem when sows are individually stalled [36]. However, sows housed in pens tend to have a much larger problem with seasonal infertility when compared to sows that are individually stalled [35].



Body Score	1	2	3	4	5
Backfat, in.	<0.6	0.60 - 0.70	0.70 - 0.80	0.80 - 0.90	>0.90
Backfat, mm	<15	15 - 18	18 - 20	20 - 23	>23

Score	Condition	Body Shape
1	Emaciated hip	Backbone prominent to the eye
2	Thin hips	Backbone easily felt without applying palm pressure
3	Ideal hips	Backbone felt only with firm palm pressure
4	Fat hips	Backbone cannot be felt
5	Over fat hips	Backbone heavily covered

Figure 2. Diagram of sow body condition scoring with corresponding backfat estimates.

Record keeping agencies have noted that sow mortality during the summer months is substantially higher when compared to the other seasons of the year [37,38]. Increased sow death is generally seen when temperatures rise from 75° F and higher [39]. High temperatures contribute to an increased risk of cardiac failure in sows [40]. Sows farrowing in the summer have lighter litter weights at weaning and longer weaning-to-first service intervals when compared to sows farrowing in the fall, winter, and spring [41]. High ambient temperatures result in reduced appetite, milk production, and body reserve mobilization in lactating sows [42]. All of these factors likely play a role in delayed return-to-oestrus and increased sow culling for reproductive failure that typically occurs after weaning in the high temperature conditions. Similarly, producers should not overlook the effect that people or workers have on sow longevity [35]. The summer months are times when workers take vacations and substitutes or inexperienced personnel handle more tasks on a sow farm. This in turn could explain a portion of the problems associated with these months.

### Housing effects on sow longevity

Sow housing systems and their effects on sow productivity and longevity are difficult to determine because of the number of different systems that exist. Feet and leg injuries can be problematic if cement flooring has been poorly cast, improperly cleaned or managed, or has extensive wear and tear [43]. Figure 3 shows an example of cement flooring that has excessive wear and should be repaired. For more information regarding flooring used in swine facilities you may review PIH-53, Flooring For Swine.

Culling differences between systems housing gestating sows in individual stalls and those housing them in groups appear to be highly related to the management of the system. Improved sow longevity does not appear to be necessarily associated with sows housed in either individual stalls or grouped in pens during gestation [44,45]. Some small group housing systems have been shown to be quite successful. Sows housed in the Hurnik-Morris system, in which sows are housed in small groups during gestation, had higher parity at culling and lifetime production when compared to sows in conventional gestation crates [46]. Others have reported that sows gestated in stalls took fewer days to return to oestrus after weaning than sows that were group housed with electronic feeders [47]. There is no clear advantage for group or stall gestational systems for sows as they relate major contributions to sow culling or improved longevity, reproductive failure, and sow performance.

As size of our mature sow increases, there is an increased injury risk that may be related to individual gestation stall size [48]. Back injuries were related to gestation stall width, and the amount of time required for the sow to get up and lie down increases as sow size increases in relation to sow stall length. Additionally, sows in outdoor production systems have been shown to have higher mortality rates when

compared to indoor production systems [49].

### **Influence of feet and leg soundness on sow longevity**

Feet and leg soundness, locomotion problems, and claw disorders can be major contributors to poor sow longevity. Figure 4 shows proper toe size and placement as well as an example of cracked toes that can result from a variety of reasons. For a more detailed discussion of feet and leg structural soundness you should review the Pork Industry Handbook factsheet PIH-101 [50].

Leg weakness accounts for a high percentage loss in first litter sows [51]. Soundness or leg weakness has been shown to be under at least some genetic control. Heritability estimates for various leg soundness scores range from 0.01 to 0.47, with many values above 0.15. This indicates that structural soundness can be improved through proper genetic selection.

When selecting females for the breeding herd, producers may have to choose females with less than perfect structural soundness. If producers must choose gilts with various degrees of structural problems, they should focus on finding gilts with weak pasterns as it has been shown they have a positive influence on longevity [52]. However, gilts that have buck-kneed front legs, swaying hindquarters, or upright pasterns on rear feet should be avoided as all of these conditions have been unfavorably associated with longevity [53].

It has been demonstrated that leg weakness problems are antagonistically correlated with backfat [54]. This seems to indicate some selection for feet and leg soundness is necessary to maintain adequate structure, especially if there is a strong selection against backfat. Selection against backfat has been employed by most seedstock suppliers for a number of years and may help explain some of the feet and leg problems that many commercial producers see in the females in the breeding herd.

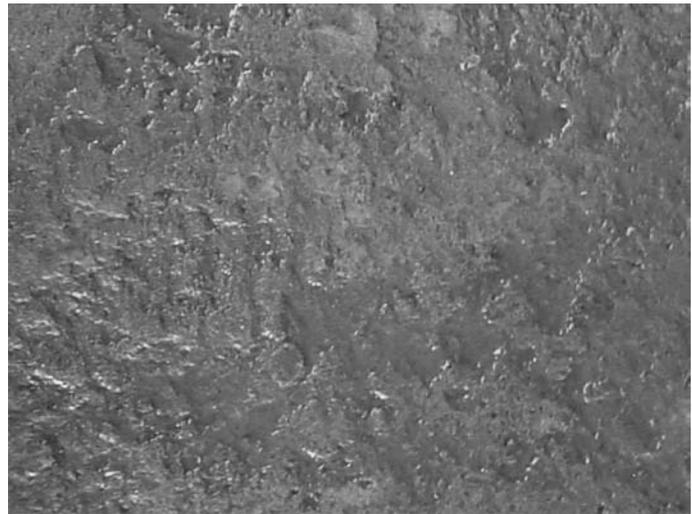
### **People/management factors influencing sow longevity**

Many common management practices and the stockmanship of persons employed on pork operations do influence factors known to contribute to culling and / or mortality of sows from the breeding herd. An inexperienced labor force, having very little training and little background with livestock, can contribute to high mortality [55,56]. Sow observation is an important key to reducing sow culling and mortality. Employees without at least some livestock experience are likely to require training to develop the keen observation skills that are required on a successful pork operation. Most pork producers would consider many of the skills necessary for maintaining successful pork operations just good husbandry knowledge. This seems to indicate that appropriate employee training programs are essential, particularly for those workers without previous livestock experience.

Herd size may be related to rate of culling and mortality as well as associated practices. Numerous studies have reported that sow mortality rate was significantly associated with average female inventory [38,57]. There have been reports that some intermediate herd size (400 to 600 sows) may be more ideal [58], when compared to herds with fewer than 200 or more than 800 sows. This could be related to the large number of hired employees on large farms. Someone with ownership in the operation may have more incentive to be more detail oriented in management of the sow herd on a daily basis. This may indicate that workers without ownership in the operation may respond to some sort of incentive program for reducing sow mortality or improving sow longevity.

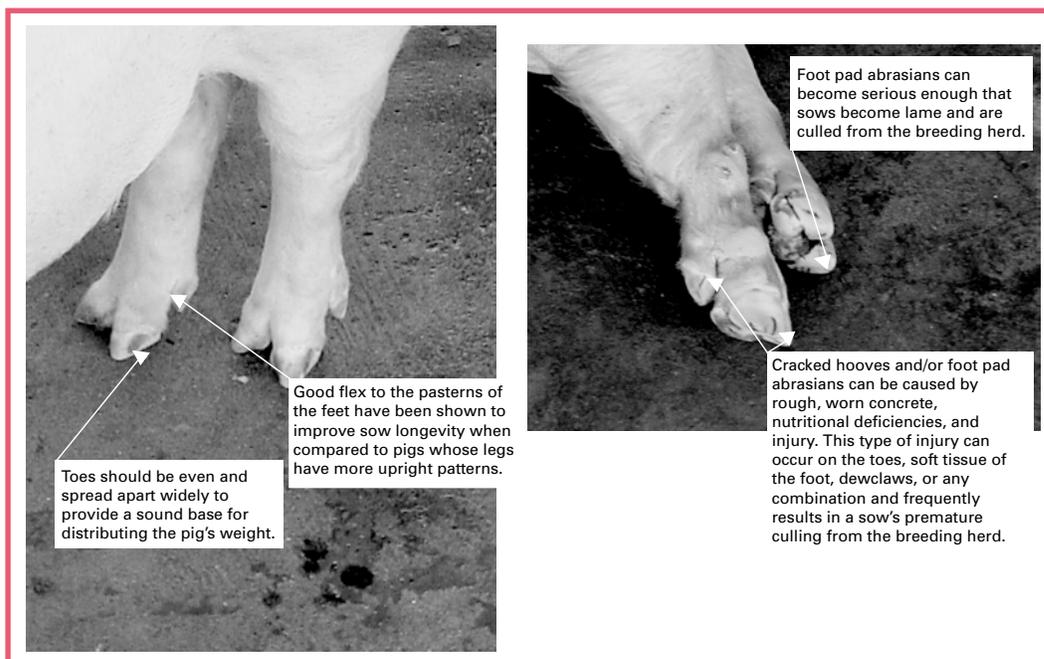
### **Behavioral effects on sow longevity**

Like the health section, few studies have evaluated the influence of behavior on sow longevity. There are



**Figure 3. Cement flooring showing signs of excessive wear and in need of repair.**

a few reports that indicate certain housing conditions create a continuous stressful situation for gestating sows [59]. If one assumes that stress has a negative impact on sow longevity, then the behavior patterns associated with crated housing conditions could reduce sow longevity. However, Lay [59] goes on to say that sows in outdoor systems, grouped in pens indoors, or individually housed present behavior issues like fighting in lots, fighting in pens where sows cannot escape the aggressor sow, fighting between bars of gestation crates, and unsettled aggression. It is clear that there is no magic housing system where no aggression among sows takes place, and certainly no information regarding which system will allow sows, particularly when genetic type is considered, to have the longest productive herd life.



**Figure 4. Proper toe size and placement (left) and an example of cracked toes (right) that can result from a variety of reasons**

## Summary

Poor sow longevity in commercial pork production systems can lead to economic inefficiency and animal well being concerns. The economic concerns of poor sow longevity arise from the fact that the sow will remain in the breeding herd for fewer parities. A sow with poor longevity is likely to produce fewer pigs in her lifetime, compared to a sow that remains in the breeding herd for a longer period of time. This reduces the opportunity of a sow to be sufficiently productive (pigs weaned and sold per lifetime) to achieve a return on the replacement gilt investment cost. Sow longevity is a complex trait with many factors that can contribute to a sow having a long and productive life in a commercial breeding herd. The factors that have a negative influence on the length of time a sow remains productive in a commercial swine breeding operation can do so singly or in conjunction with one or more factors. Many of these factors have non-genetic origins. This can make solving sow longevity challenges a long and difficult process. If a pork producer is having challenges with their sows having long productive herd lives, then focusing on one or more of these factors should help improve longevity.

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