Genetics Factors Impacting Sow Longevity

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Reported Averages - PigCHAMP

Year	Culling Rate,%	Repl. Rate,%	Avg. Parity of Farrowed Sows	Death Loss, %	Lifetime Pigs Wnd.
2003	41.7	79.5	3.8	7.8	32.8
2002	39.5	58.7	4.7	6.5	42.4
2001	39.0	57.0	3.4	6.8	30.6
2000	28.6	47.6	3.0	5.3	30.8
1999	44.6	56.9	3.1	6.9	25.1
1998	45.5	58.5	3.5	5.9	30.7

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When does a sow pay for herself?

No. Born Alive /Litter	1	2	3	4	5	6
8.95	($131.11)	($130.55)	($103.87)	($71.19)	($39.90)	($16.51)
9.20	($120.92)	($110.60)	($74.58)	($32.96)	$6.88	$38.46
9.45	($110.72)	($90.65)	($45.29)	$5.27	$53.66	$93.43
9.70	($100.53)	($70.70)	($16.00)	$43.50	$100.45	$148.40
9.95	($90.33)	($50.74)	$13.29	$81.73	$147.23	$203.37
10.20	***($80.14)***	***($30.79)***	***$42.58***	***$119.96***	***$194.01***	***$258.34***
10.45	($69.94)	($10.84)	$71.87	$158.19	$240.80	$313.31
10.70	($59.75)	$9.11	$101.17	$196.42	$287.58	$368.28
10.95	($49.55)	$29.07	$130.46	$234.65	$334.36	$423.25
11.20	($39.36)	$49.02	$159.75	$272.87	$381.15	$478.22
11.45	($29.16)	$68.97	$189.04	$311.10	$427.93	$533.19

When does a sow pay for herself?

$/CWT for Hogs	1	2	3	4	5	6
$ 36.00	(231.00)	(330.75)	($410.58)	($482.72)	($551.75)	($621.74)
$ 38.00	(193.28)	(255.76)	($297.29)	($332.05)	($365.31)	($401.72)
$ 40.00	(155.57)	(180.77)	($184.00)	($181.38)	($178.87)	($181.70)
$ 42.00	(117.85)	(105.78)	($70.71)	($30.71)	$7.57	$38.32
$ 44.00	***(80.14)***	***(30.79)***	***$42.58***	***$119.96***	***$194.01***	***$258.34***
$ 46.00	(42.42)	44.20	$155.87	$270.63	$380.46	$478.36
$ 48.00	(4.71)	119.19	$269.17	$421.30	$566.90	$698.38
$ 50.00	33.01	194.17	$382.46	$571.96	$753.34	$918.40

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Attainable Goals

- 2003 PigCHAMP data Upper 10 Percentile
  - Replacement rate 31.1%
  - Culling rate 22%
  - Death Loss 3.2%
  - Average parity at culling 5.8
  - Lifetime pigs weaned 48
- Koketsu et al. (1999)
  - A cohort of females born in 1990
  - Average lifetime pig production 67.2 pigs
  - Average parity at removal was 5.6 parities

Challenges Related to High Replacement Rates

- Performance differences
  - Number born alive
  - Litter weaning weight
  - Grow – Finish Performance
  - Better protection from disease??
- Introduction of more gilts
- Associated costs
- Welfare issue
- Down stream production costs

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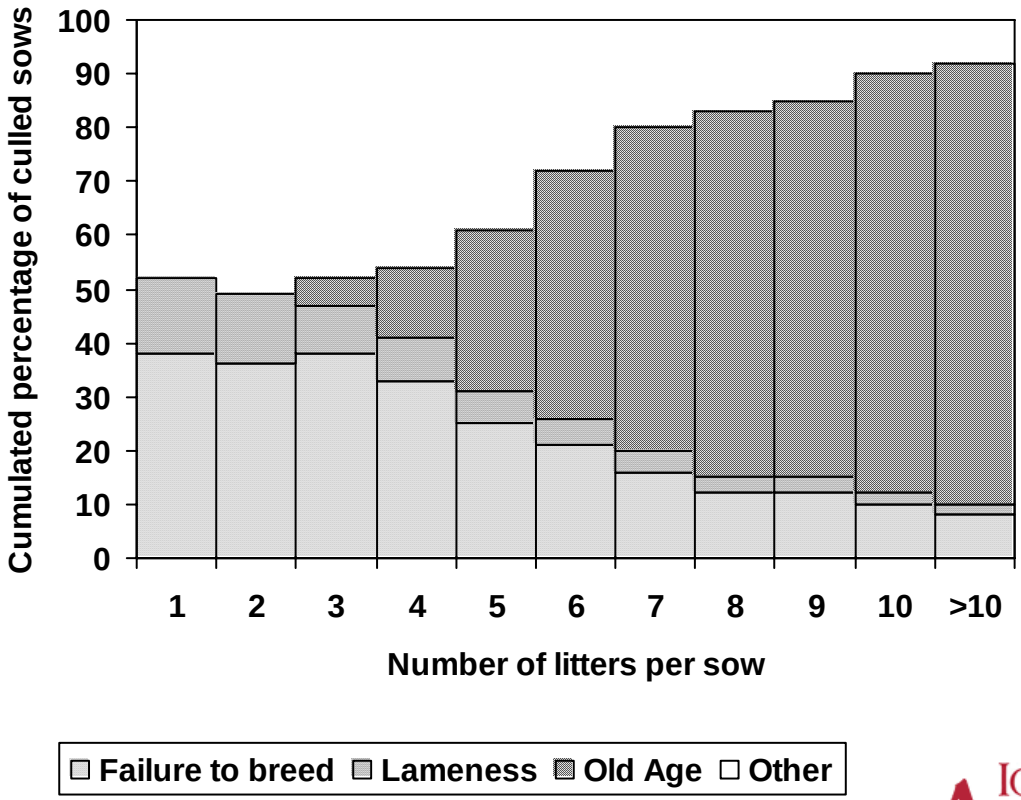
Measures of Longevity

- Number and / or weight of pigs produced per some unit of time
- Stayability
- Removal rate
- Culling rate
- Replacement rate
- Percent gilts in herd
- Mean parity of females in inventory
- Mean parity at removal
- Length of life (true life, or productive life)
- Age at removal
- Removal rate
  - old, less productive sows can be retained just to improve parity or age structure of the herd.
- Proportion of the herd removed in early parities
- Pigs weaned per day of life
- Appropriate measures of longevity are dependent upon the objectives of the evaluation.

Reasons Females Leave the Breeding Herd

• Reproductive failure	30 - 35
• Old age	15 - 20
• Performance	15 - 20
• Feet and leg problems	10 - 15
• Death	5 - 10
• Post-farrowing problems	3 - 5
• Other	5 - 10

Incidence of failure to breed, lameness and culling for old age, in the sows according to litter parity *Dagorn & Aumaitre, 1978*



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Heritability of Sow Longevity

- Tholen *et al.* 1996 –
  - stayability from parity one to two, one to three, and one to four
  - 0.05, 0.06 and 0.09
- Yazdi *et al.* 2000 –
  - longevity ranging from 0.11 to 0.27.
- Serenius and Stalder 2004 –
  - range of heritability from 0.05 to 0.19
  - depending on the model used to analyze the data.

Heritability of Sow Longevity

- Lopez-Serrano *et al.* 2000 –
  - heritability estimates for stayabiltiy ranged from 0.07 to 0.11 in Landrace sows.
- Crump 2001-
  - estimates ranging from 0.11 to 0.21,
  - depending on whether survival analysis, linear model, or generalized linear model methods were used.
- Fortin and Cue 2002 –
  - reported genetic parameters for length of productive life, defined as number of days from first service until culling.
  - heritability estimates 0.16 and 0.13, respectively.

Selection for Sow Longevity

- Generally not been a large focus directly at the nucleus level
- Trait is measured at the end of productive life
- Trait in direct conflict with making rapid genetic change
- Selection pressure, if any is placed, is directed at indicator traits affecting sow longevity
  - Feet and leg soundness
  - Backfat
  - Other conformation traits

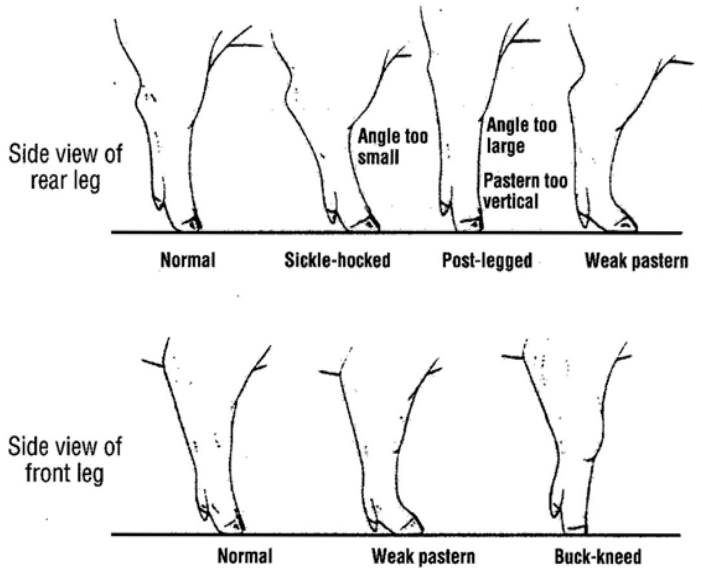
Indirect Selection for Longevity

- Researchers have shown that genetics does influence traits thought to impact longevity.
  - Age, weight, and backfat at puberty (Rydhamer et al, 1994; Bidanel et al., 1996)
- Leg conformation has been shown to be genetically correlated to length of productive life (Serenius and Stalder, 2004)
- Buck kneed fore legs were shown to be negatively associated with:
  - Age at first farrowing,
  - Farrowing interval,
  - Total number born, and
  - Piglet mortality from birth to weaning

  Serenius et al. 2004.

Indirect Selection for Longevity

- Still other reports evaluated leg conformation at six months of age (Jorgensen, 1996)
- Unfavorable effects on sows ability to produce through 3 parities
  - Buck kneed front legs,
  - Swaying hind quarters, and
  - Upright pasterns on the rear legs
- Favorable effects on sows ability to produce through 3 parities
  - Weak pasterns on front legs



Crossbreeding Effects on Sow Longevity

- Crossbred females superior to their purebred or line parents
  - Crossbred sows averaged 5.3 litters and purebred sows averaged 4.4 litters at culling (Živković *et al.*, 1986)
  - 55% of culling of purebred sows occurred before the 3rd parity
  - 40% of culling of crossbred occurred during the same period

Crossbreeding Effects on Sow Longevity

- Mean age and number of litters produced were lower in purebred Yorkshire sows when compared to crossbred sows (Jorgensen, 2000)
  - Purebred sows had higher culling for locomotion and reproductive failure
- Crossbreds averaged 3.61 parities at culling while the purebreds averaged only 3.01 (Sehested and Schjerve, 1996)

Breed or Line Makeup of Crossbred Females Impact on Sow Longevity

Sow Breed Makeup	Productive Life, d	Diff.	Pigs Born Alive	Diff.
1/4 Meishan	778		55.0	
1/4 Duroc	674	104	42.7	12.3
1/8 Duroc	639	139	42.3	12.7

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Breed or Line Makeup of Crossbred Females Impact on Sow Longevity

- Similar percentages of culling by parity was reported in a study comparing purebred Large White and crossbred Large White x Landrace sows (Dagorn and Aumaitre, 1979)

Line Choice can Impact Sow Longevity

- Longevity or productive lifetime differences approached 1 parity Rodriguez – Zas et al., 2003
- National Pork Board Genetic Evaluation
  - Comprehensive study of maternal performance including evaluation of sow longevity measures

Production of 130 cohorts through six parities from the National Pork Board's Maternal Line Genetic Evaluation (Goodwin, 2002).

Genetic Line	Total Sow Days	Avg. Sow Life, d	Total Pigs Born	Pigs Born Alive	Live Pigs / Sow Day	Total Litters Born
Amer. Dmnd. Gen	14138^{b}	566^{b}	835^{c}	758^{c}	0.054^{d}	79.7^{b}
Danbred USA	13632^{b}	545^{b}	860^{bc}	767^{bc}	0.056^{cd}	76.9^{b}
Mons. DK44	14009^{b}	560^{b}	944^{b}	843^{b}	0.060^{b}	80.5^{b}
Mons. GPK347	17197^{a}	688^{a}	1312^{a}	1172^{a}	0.068^{a}	109.0^{a}
Ntnl. Swine Reg.	14033^{b}	561^{b}	871^{bc}	790^{bc}	0.056^{c}	80.6^{b}
Newsham Hbrd. USA	14230^{b}	569^{b}	870^{bc}	790^{bc}	0.055^{cd}	81.4^{b}

Percent of 3283 entered females and (parity to parity loss) that produced litters by line and parity from the National Pork Board's Maternal Line Genetic Evaluation (Goodwin, 2002).

Genetic Line	P1, %	P2, %	P3, %	P4, %	P5, %	P6, %
Amer. Dmnd. Gen	77 (23)	64 (13)	57 (7)	50 (7)	40 (10)	30 (10)
Danbred USA	77 (23)	63 (14)	56 (7)	48 (8)	39 (9)	26 (13)
Mons. DK44	75 (25)	65 (10)	57 (8)	50 (7)	39 (11)	32 (7)
Mons. GPK347	92 (8)	83 (9)	77 (6)	70 (7)	63 (7)	51 (12)
Ntnl. Swine Reg.	76 (24)	63 (13)	57 (6)	52 (5)	43 (9)	32 (11)
Newsham Hbrd. USA	78 (22)	65 (13)	59 (6)	52 (7)	43 (9)	30 (13)
Total	2602	2206	1984	1750	1459	1104

Molecular Genetic Opportunities to Improve Sow Longevity

- Work being conducted at ISU by Dr. Max Rothschild and graduate student Benny Mote
  - Have identified three promising genes having a significant affect on longevity
  - Size and direction of effects vary among lines and herds
  - More work needs to be done in different and larger population to clarify effects

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Other Sow Longevity Work Underway at ISU

- Study examining longevity traits among F1 Yorkshire x Landrace females that have known parentage.
  - Focus on determining genetic parameters for longevity and prolificacy traits from the crossbred population including the dominance effects.
- A large study is just getting underway that will evaluate a representative sample of cull sows at harvest
  - Condition,
  - Feet and leg injuries,
  - Shoulder lesions,
  - Functioning ovaries,
  - Pneumonia lesion,
  - Teeth problems, and
  - a variety of other issues
- Attempt to determine the causes for culling sows.
- An educational program is being undertaken
  - Develop tools that will assist producers in evaluating replacement gilt candidates for feet and leg as well as reproductive soundness.

Summary

- Sow longevity is a complex trait
  - Involves genetics, nutrition, herd health and breeding herd management.