Improving piglet survival – Implications of selection strategies

Susanne Hermesch

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Why is piglet survival important?

1. Survival of animals is a prime welfare criterion

2. Loss of piglets reduces economic returns

3. Focus on productivity alone will lead to higher mortalities

Piglet survival can only be improved in the context of the selection and production system

Selection emphasis continues to change

- Breeding companies started using BLUP technologies in early 1990s in Australia
- Initial emphasis was on growth, backfat and feed efficiency
- Litter size was the main selection criterion for dam lines from the mid 90s to mid 00s
- Survival of piglets has been considered in various AU breeding programs since early to mid 00s

Annual genetic gains from 2000 to 2005*

Trait	Average of 28 populations	Top 25% ($Index)	Top 25% (trait)
Growth rate (g/day)	5.00	7.52	9.59
Backfat (mm)	-0.15	-0.26	-0.28
Feed conversion ratio	-0.01	-0.027	-0.028
Muscle depth (mm)	0.05	0.014	0.20
Litter size (piglets/litter)	0.07	0.12	0.18

* Hermesch (2006); available at: http://agbu.une.edu.au/pig_genetics/pdf/2006/Paper%2010_SH_Trends.pdf

Cumulative genetic gains over 10 years

Trait	Cumulative genetic gains
Growth rate (g/day)	50 to 100
Backfat (mm)	-1.5 to -2.80
Feed conversion ratio	-0.10 to -0.28
Muscle depth (mm)	0.50 to 2.0
Litter size (piglets/litter)	0.7 to 1.8

Breeding herd performance 2000 versus 2010

	2000	2010	Difference
Total Born per litter	11.1	12.0*	
Number born alive per litter (NBA)	10.3	10.9	**0.59**
No weaned per litter (NW)	9.2	9.5	**0.34**
Survival at birth (%)	93.4		?
Pre-weaning survival (%) - given	86.7	88.2	1.5
Pre-weaning survival (%) - derived (NW/NBA)	89.3	87.6	-1.7

* Sows only

Industry needs better information about piglet survival

References: Pig Stats 2000 and 2001; Australian Pig Manual, 2010-2011

AUSTRALIAN Pork

AGBU
ANIMAL GENETICS AND BREEDING UNIT
A joint unit of NSW DPI and UNE

Selection for productivity affects litter mortalities*

Selection for:	Effect on litter mortality	Coefficients**
Higher lifetime growth rate	Reduction	-0.003 piglets/gram.day
Lower backfat	Increase	-0.052 piglets/mm
Higher number born alive	Increase	+0.39 piglets/piglet
Heavier piglet birth weight	Reduction	-0.68 piglets/kg (farrowing) -2.67 piglets/kg (pre-weaning)

** Coefficients from the regression of litter mortality on trait EBVs

* Hermesch, 2010; available at: http://agbu.une.edu.au/pig_genetics/pdf/2010/P08-Susanne-Consequences%20of%20selection.pdf

Strategies to improve piglet survival

1. **Increase piglet birth weight**
2.
3.

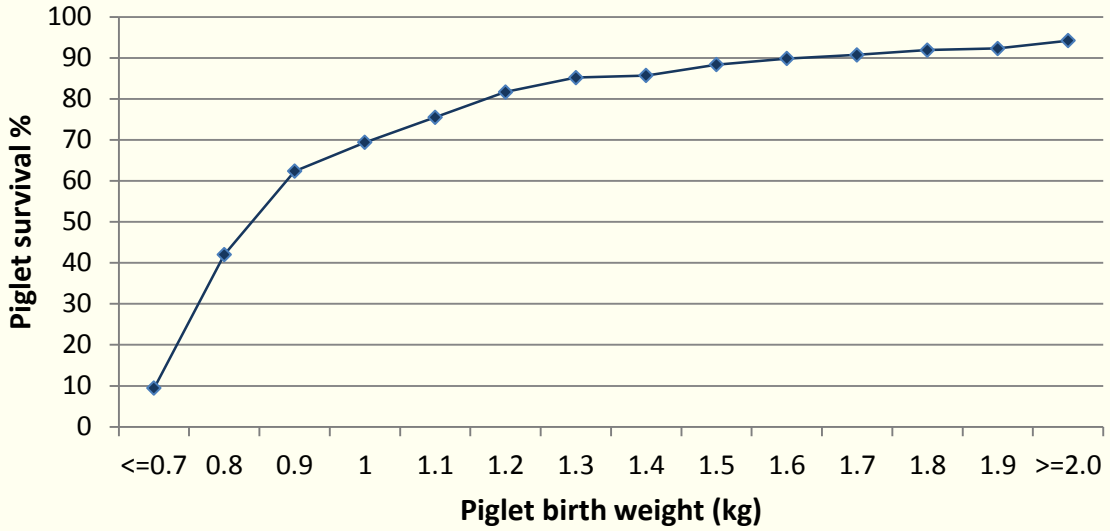
Outline of selection strategies for litter survival in 2001*

Selection on:	Response in:		Predicted
	No. Born Alive	No. Died	No. Weaned
Number born alive (NBA) only	0.14	0.07	+0.07
NBA and number died	0.13	0.06	+0.07
NBA and average piglet birth weight	**0.09**	**-0.03**	**+0.12**

Recommended strategy has been implemented by various Australian pig breeding companies

* Hermesch, 2001; available at:
http://agbu.une.edu.au/pig_genetics/pdf/2001/Paper_6_Avenues_for_genetic_improvement_Hermesch_2001.pdf

Birth weight and survival



Points to note:

- Diminishing benefits of higher birth weight
- Survival rates of very light piglets more important

- Adapted from Hermesch (2000);
  available at: http://agbu.une.edu.au/pig_genetics/pdf/2000/Paper%207_A%20first%20analysis_Hermesch_2000.pdf

High birth weight due to high lean meat growth is less beneficial for piglet survival*

Selection for efficient lean meat growth is associated with

- Heavier piglets at birth
- Physiologically less mature piglets with lower energy reserves at birth

High birth weights in progeny of terminal sire lines may be less beneficial than high birth weights in progeny from dam lines

*For more details see the review by Bunter (2009); Manipulating pig production XII, pp. 149-156.

High birth weight is less beneficial for piglet survival in better environments

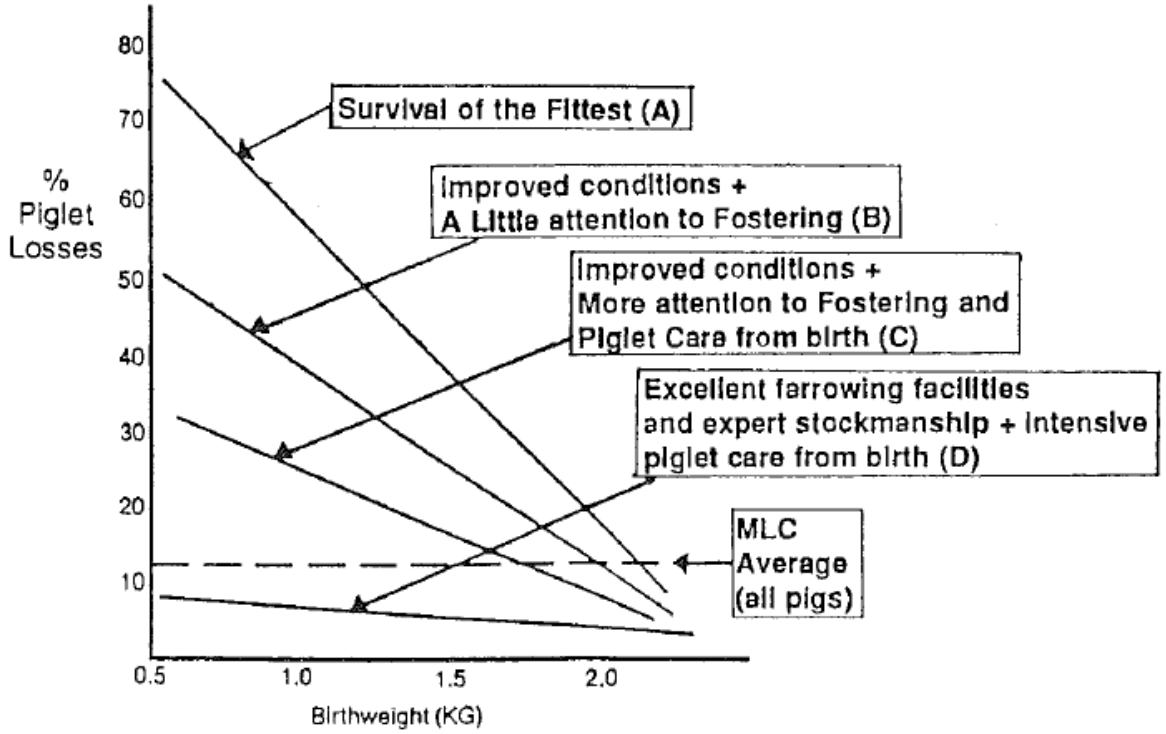


Fig. 6.5. The changing relationship between piglet birthweight and survival (English, 1985).

Strategies to improve piglet survival

1. Increase piglet birth weight
2. **Improve piglet vitality and viability**
3.

Strategies to improve survival curves

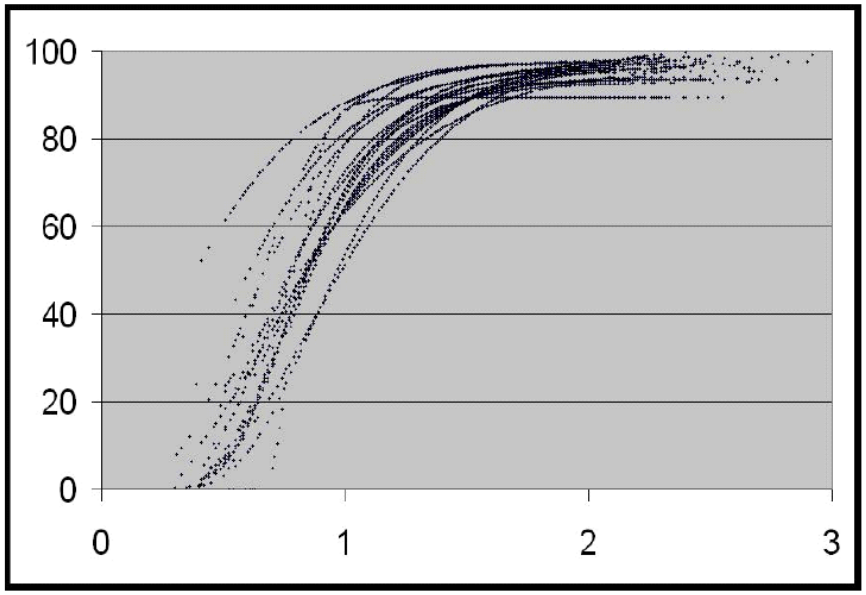


Figure 1. Survival curves for piglets for different sires. Birth weight (kg) on the X-axis by pre-weaning survival (%) on the Y-axis.

- Choice of genotypes
  - Breed, sires
- Improve environment
  - e.g. Danish approach (Thorup, 2009; APSA)
- Measure maturity & viability of piglets
  - Tooth eruption
  - Thermal images
  - Haemoglobin

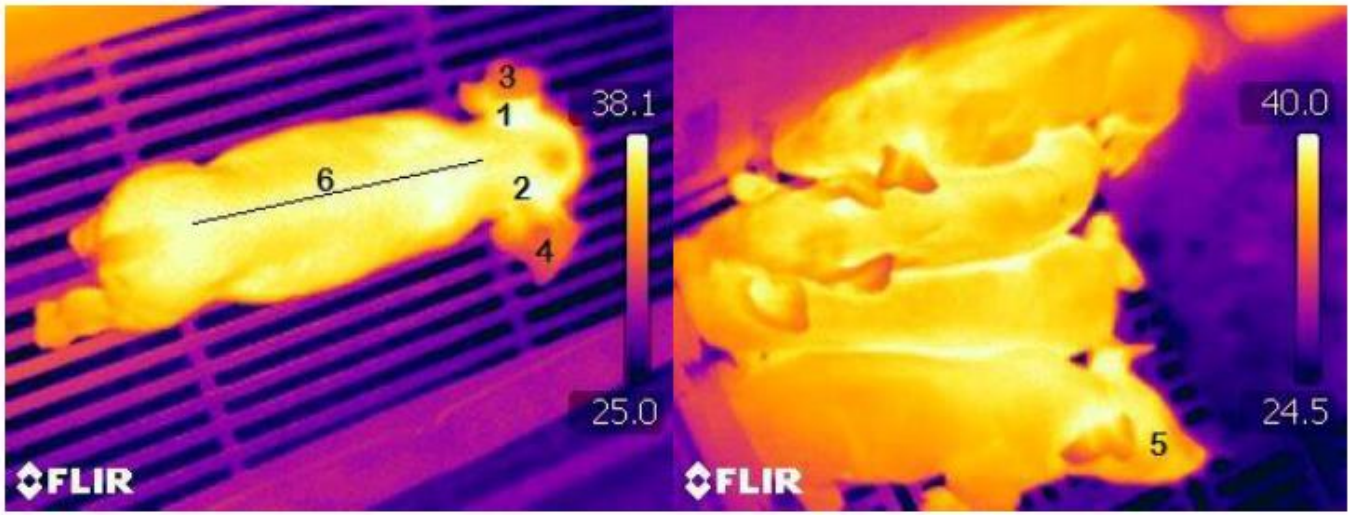
Knol (2004); available at: http://agbu.une.edu.au/pig_genetics/pdf/2004/Paper_9_EK_survival_2004.pdf

Presence of lower incisor tooth (I_1) – a measures of piglet maturity at birth*

- 30% of piglets observed with erupted tooth
  - Considerably higher than observation in other populations
  - Population size and structure; selection/management system
- More teeth erupted in winter (0.40±0.02) compared to summer (0.24±0.02)
  - Eruption can be delayed by maternal stress
- Higher piglet mortality also reported in summer
  - Despite higher birth weight in summer
  - Piglet development affected by ambient temperature?

*Tabuaciri et al. (2010); available at: http://agbu.une.edu.au/pig_genetics/pdf/2010/P09-Poasa-Piglet%20survival.pdf

Thermal imaging as a tool to identify piglets at risk*



Infrared thermography is an effective tool for identifying hypothermic piglets and a viable alternative to measuring the actual core body temperature of newborn piglets.

*Tabuaciri et al. (2012); available at: http://agbu.une.edu.au/pig_genetics/pdf/2012/P5-Poasa_Thermal%20imaging.pdf

Haemoglobin and piglet survival

	Live at weaning	Dead at weaning
Haemoglobin at birth (g/L)	105	99
Haemoglobin at day 1 (g/L)	82	73

Haemoglobin was the only blood parameter among 20 blood measures that was significant at both days

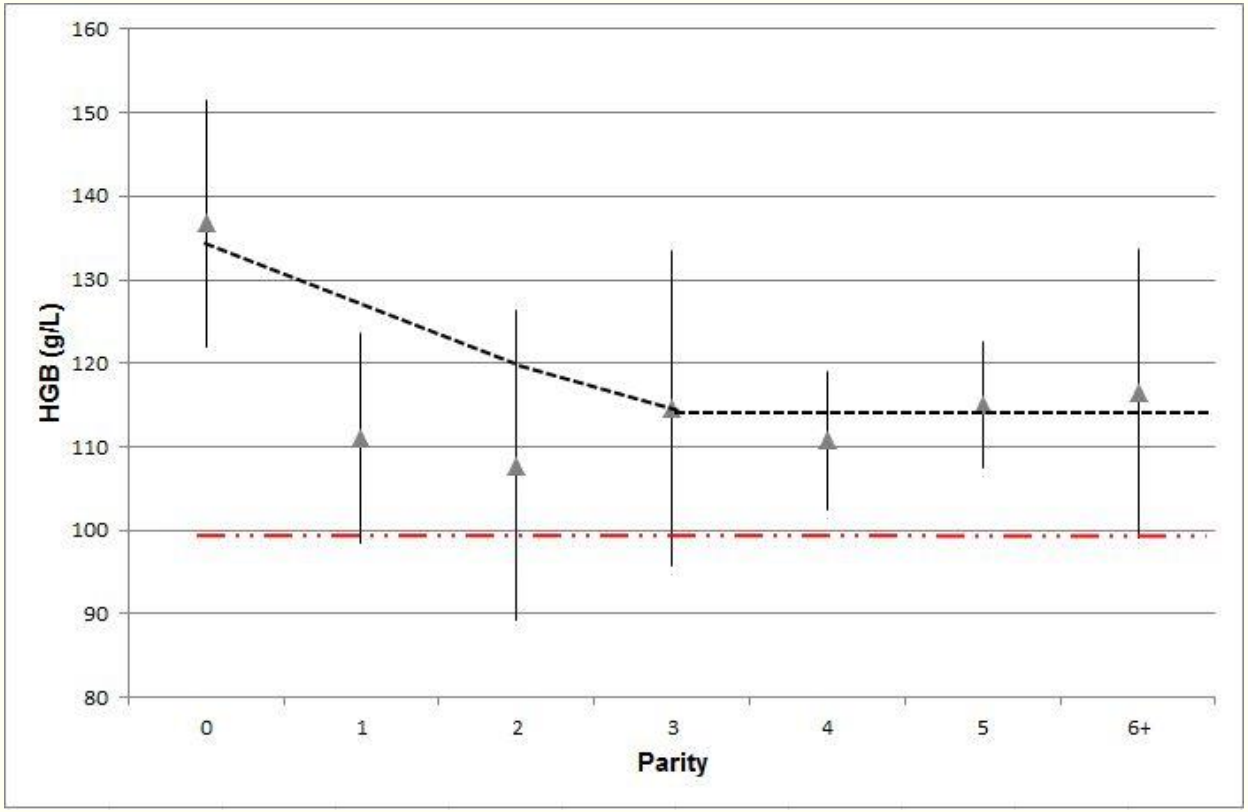
(Rootwelt et al., 2012)

Limited information from selection experiments

- Pigs
  - Started in 1962 with 8 Yorkshire sows (Fahmy and Bernard, 1978)
  - Differences in haemoglobin levels between selected line and control line
  - Abrupt termination due to ‘reproductive problem’
  - ‘Problem is worthy of further investigations’

- Minks (Geddes-Dahl and Helebostad, 1971)
  - “Fecundity and haemoglobin (Hg) were interdependent trait”
  - The breed with lower Hg had lower fecundity
  - Genetic associations between Hg and fecundity or viability were observed within breed

Haemoglobin levels in Australian sows



(Gannon et al., 2011)

Measure haemoglobin in sows and piglets on farm

- Only a droplet of blood is required
- Instant measurement in the shed
- Recording procedures have been established for sows and piglets*

*Hermesch and Tickle (2012); available at: http://agbu.une.edu.au/pig_genetics/pdf/2012/P6-Hermesch-Tickle-Haemoglobin.pdf

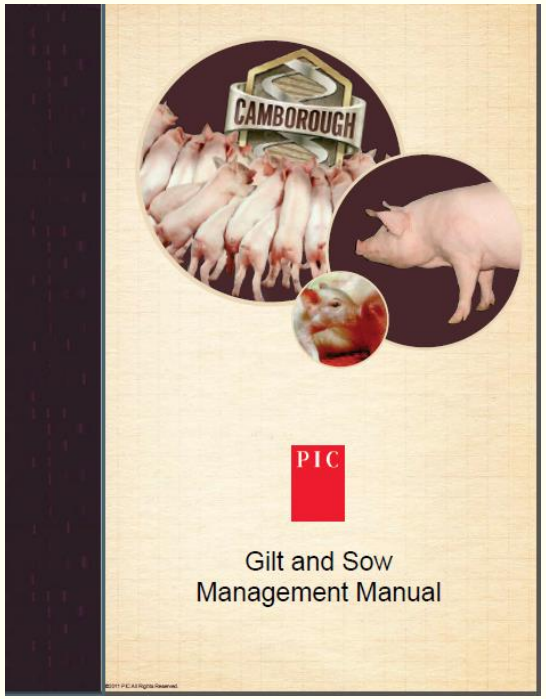
Strategies to improve piglet survival

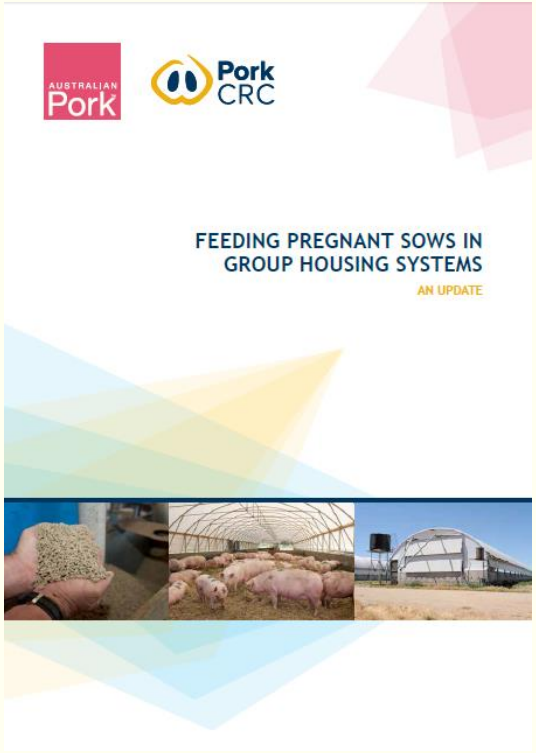
1. Increase piglet birth weight

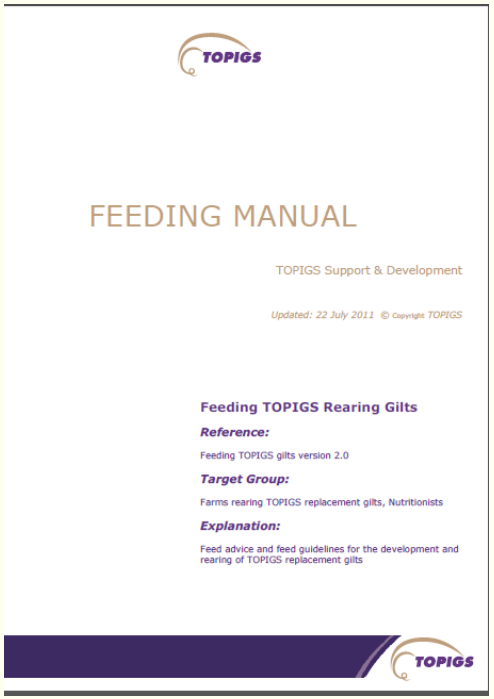
2. Improve piglet vitality and viability

3. **Look after the sow**

Numerous sow manuals are available







Sow characteristics continue to change due to selection for productivity

Selection for:	Effect on sow weight	Effect on sow fatness
Lifetime growth rate	30 kg / 100 gr.day	2 mm / 100 gr.day
Backfat	-0.12 kg / 1 mm	1.56 mm / 1 mm
Number born alive	3.28 kg / piglet	-0.29 mm / piglet
Piglet birth weight	3.51 kg / 100 gr	0.66 mm / 100 gr

Management strategies need to accommodate the changing requirements of sows

* Hermesch, 2010; available at: http://agbu.une.edu.au/pig_genetics/pdf/2010/P08-Susanne-Consequences%20of%20selection.pdf

Selection strategies should consider more traits in maternal lines

- Breeding objectives for dam lines should include
  - Number born alive
  - Farrowing survival
  - Pre-weaning survival
  - Sow longevity
  - Sow mature weight
  - Age at puberty and weaning to conception interval
  - Post-weaning survival
  - Maternal genetic effects on growth of finishers

Economic models are available to industry to quantify economic values for these traits*

* Hermesch, 2012; available at: http://agbu.une.edu.au/pig_genetics/pdf/2012/P8-Hermesch-Ludemann-Amer-PigEV-model.pdf

Piglet survival rate of 100% is not possible

- Evolution has led the pig to produce a large number of relatively undeveloped offspring
  - Inherent variation in neonatal competitiveness is an advantage
  - Perinatal mortality of the weakest piglet is promoted

- A level of piglet mortality of 10-20% can be considered normal given
  - Reproductive biology of pig
  - Evolutionary strategy of pig

(Edwards, 2002)

Industry needs to continue its efforts to improve piglet survival rates

Continued focus on productivity will put further pressures on piglet survival

Only optimal production systems that balance selection, physiology and environment of the sow and her piglets will improve both – productivity and piglet survival