Phenotypic and genetic relationship between litter birthweight characteristics, indicators of intrauterine growth restriction and piglet survival

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Risk factor for piglets

- Low birth weight piglets
- Industry-wide push for selection of increased litter size in breeding herds

- More piglets being born with reduced birth weight (Rutherford et al, 2013; Root et al, 2012)

What is a low birth weight piglet?

- Meta-analysis study of risk focusing on piglet outcomes
- Piglets with a birth weight ≤1.25kg are at a significant risk of impaired lifetime growth (Douglas et al, 2013)

![Diagram showing the percentage of piglets born in different weight categories]

Data from Multiplier herd 2016

- >1.80kg (high bwt)
- 1.25-1.80kg (normal bwt)
- <1.25kg (low bwt)

20959 piglets born

Roehe & Kalm, 2000
More than just low birth weight?

- Low birth weight piglets may be:
  - Small for gestational age (SGA)
  - Intrauterine growth restricted/retarded (IUGR)

- Intrauterine growth restricted (IUGR) piglets typically identified by birthweight

- However, birthweight does not indicate whether a piglet has been exposed to IUGR during development
More than just low birth weight?
How to recognise IUGR?

- Chevaux *et al* 2010 developed scoring system for identifying IUGR piglets based on head morphology
- ‘Brain sparing’ effects – prioritised brain development
- Foetal adaptive reaction to placental deficiency
Normal vs IUGR head shape
Data collection

- Data collection over 52 weeks
- Number of piglets – 21,159
  - Birth weight
  - Head shape
  - Cause of death (and date)
- 1,575 farrowings
  - 862 individual sows
  - Parity 1-6+
Birth weight – head shape
What is a low birth weight piglet?

Multiplier herd 2016

20959 piglets born

- >1.80kg (high bwt)
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Genetic selection approach:

- Two approaches:

- Piglet level selection:
  - Select on piglet head shape at birth

<table>
<thead>
<tr>
<th></th>
<th>Head shape 0/1</th>
<th>Birth weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head shape 0/1</td>
<td>0.05 ± 0.016</td>
<td>-0.62 ± 0.008</td>
</tr>
<tr>
<td>Birth weight</td>
<td>-0.72 ± 0.09</td>
<td>0.18 ± 0.040</td>
</tr>
</tbody>
</table>
Genetic selection approach:

- Two approaches:

  - Piglet level selection:
    - Select on piglet head shape at birth

  - Sow level selection:
    - Select on the proportion of piglet head shapes at birth within a litter
      - Proportion of IUGR-head shape piglets – IUGR-PROP
      - Within litter average birth weight – avBWT
      - Within litter standard deviation of birth weight – sdBWT
      - Litter size at birth – Littersize
      - Proportion of litter surviving to processing – SURV-PROP
## Genetic selection approach – 2

### Sow level - selection on IUGR-PROP

<table>
<thead>
<tr>
<th></th>
<th>IUGR-PROP</th>
<th>avBWT</th>
<th>sdBWT</th>
<th>Littersize</th>
<th>SURV-PROP</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUGR-PROP</td>
<td>0.19 ± 0.05</td>
<td>-0.52 ± 0.02</td>
<td>0.10 ± 0.02</td>
<td>0.23 ± 0.02</td>
<td>-0.18 ± 0.02</td>
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<tr>
<td>avBWT</td>
<td>-0.88 ± 0.07</td>
<td>0.38 ± 0.07</td>
<td>-0.06 ± 0.03</td>
<td>-0.59 ± 0.02</td>
<td>0.26 ± 0.02</td>
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<tr>
<td>sdBWT</td>
<td>-0.23 ± 0.22</td>
<td>0.61 ± 0.17</td>
<td>0.13 ± 0.05</td>
<td>0.19 ± 0.03</td>
<td>-0.08 ± 0.03</td>
</tr>
<tr>
<td>Littersize</td>
<td>0.63 ± 0.19</td>
<td>-0.62 ± 0.14</td>
<td>-0.53 ± 0.27</td>
<td>0.11 ± 0.04</td>
<td>-0.11 ± 0.03</td>
</tr>
<tr>
<td>Surv-PROP</td>
<td>-0.64 ± 0.25</td>
<td>0.85 ± 0.20</td>
<td>0.49 ± 0.32</td>
<td>-0.63 ± 0.29</td>
<td>0.06 ± 0.04</td>
</tr>
<tr>
<td>Repeatability</td>
<td>0.19 ± 0.04</td>
<td>0.40 ± 0.03</td>
<td>0.17 ± 0.04</td>
<td>0.25 ± 0.03</td>
<td>0.17 ± 0.04</td>
</tr>
</tbody>
</table>

Asreml model – parity !r ANIMAL ide.(ANIMAL)
Conclusions

- Piglet survival is phenotypically impaired by large litter size and low piglet birth weight (nothing new)

- IUGR has detrimental effects on survival – these are in addition to the influence of birth weight

- IUGR using head shape as a simple phenotypic marker is amenable to genetic selection

- Selection at the sow level against IUGR could be highly effective in improving piglet survival

- Selection for lower proportion of IUGR in a litter has favourable genetic correlations with average birth weight and survival

- However, the genetic correlation with litter size is unfavourable
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