Female Fertility - Are we at the limit or can we further improve using genetics?

Francis Kearney
Genetic Improvement

Is the trait economically important? Yes

Is there data/can it be collected (easily)? Yes

Is Heritability > 0 Yes

Calculate a breeding value (PTA) & reliability Yes

Combine into overall & sub index
Genetic Improvement

The three chickens you see above were raised on the exact same diet, for the same length of time, and under the same conditions. The left-hand chicken is a breed from 1957. The middle chicken is a breed from 1978. The right-hand one is a breed from 2005.

1957
905 g

1978
1,808 g

2005
4,202 g

AgTech – it’s in our DNA
Genetic Improvement

U.S. dairy population and milk yield

Embrapa Gado de Leite, Juiz de Fora, MG, Brasil 10 September 2014 (2)
Female Fertility

• Causes of poor fertility are complex and multi-factorial
  • Genetics
  • Health
  • Management
  • Nutrition

• Infertility is still a large cost of dairy farms

• Intense selection for milk production led to a reduction in fertility => genetic impact

• Heritability > 0 & large genetic variability across sires
Distribution of AI sire CI PTA

Calving Interval

31 Days

370 days

470 days
### Teagasc Next Gen 2013 - 2016

<table>
<thead>
<tr>
<th></th>
<th>Elite</th>
<th>NatAv</th>
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<tbody>
<tr>
<td>Submission rate (%)</td>
<td>92</td>
<td>86</td>
</tr>
<tr>
<td>Pregnancy rate first service (%)</td>
<td>60</td>
<td>46</td>
</tr>
<tr>
<td>6 week in-calf rate (%)</td>
<td>73</td>
<td>58</td>
</tr>
<tr>
<td>Final pregnancy rate - 12 wks (%)</td>
<td>92</td>
<td>81</td>
</tr>
<tr>
<td>Calving to conception interval (days)</td>
<td>93</td>
<td>97</td>
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<tr>
<td>No. of services</td>
<td>1.57</td>
<td>1.77</td>
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</table>
Current Evaluation

• Multi-trait model with 23 genetically correlated traits
  • Calving interval (parity 1 to 5)
  • Survival (parity 1 to 5)
  • Milk (parity 1 to 5)
  • Number of Inseminations (parity 1 to 3)
  • Calving to first service (parity 1 to 3)
  • Age at first calving
  • Lifespan
Genetic Trends

Genetic Trends for CI and SURV for females by birth year
Phenotypic Trends

Calving Interval For Parity 1 animals

AgTech – it’s in our DNA
Trends in Fertility in USA

Source: CDCB 2018

AgTech – it’s in our DNA
Current Evaluation

• Current model has done a very good job in reversing the negative genetic trend in fertility

• Genetic trends for production still increasing!

• Complex model based on calving interval but not accounting for compactness of calving
Current evaluation

Challenges
- Calving interval does not account for the voluntary waiting period (VWP)
- Most fertile cows not rewarded for fertility performance
Trait definitions

- **CSD** – calving season day
  The difference in days between planned start of calving for a contemporary group and actual calving

- **TCD** – time of conception day
  The difference in days between planned start of mating for a contemporary group and the last mating that resulted in pregnancy

- **GL** – Look at the impact of gestation length on fertility independently
Seasonal or non-seasonal herd?

Are there records in 2 previous years?

- YES: Are both years at least 90% seasonal?
  - YES: Was last year SS and were last 3 years all >80% and at least 1>90%?
    - YES: Seasonal
    - NO: Non-seasonal
  - NO: Seasonal
- NO: Non-seasonal

Are both years missing?

- YES: Non-seasonal
- NO: Are there 2 records in last 3 years?
  - YES: Is at least one below 90%?
    - YES: Non-seasonal
    - NO: Seasonal
  - NO: Non-seasonal
## Fertility evaluation

<table>
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<tr>
<th></th>
<th>Cow</th>
<th>AFC Age at first calving</th>
<th>CSD Calving season day</th>
<th>TCD Conception day</th>
<th>CINT Calving interval</th>
<th>NS Number of services</th>
<th>SURV Survival</th>
<th>MILK 305d yield</th>
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<td>101</td>
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Future Work

• Continue research on better trait definitions for compactness of calving

• New predictors/traits/genetics markers will become available in time

• Improving genomic predictions for animals
  • Increasing the reference population
  • Single step methodology
Conclusions

• Clearly not at the limits but genetic selection a key tool to help improve fertility at farm level

• Significant improvements have been made in a relatively short period of time

• Production trends still on an upward trajectory

• Methods to predict EBV will evolve but good quality data essential to maintain favourable genetic trends