Trends in genetic merit for dairy cow fertility

An acceleration in dairy cow genetic merit for fertility will change the type of reproductive interventions required on Irish dairy farms, writes George Ramsbottom, Teagasc Oak Park

Achieving a high level of dairy cow fertility is underpinned by four key factors: providing adequate nutrition throughout the year; a high level of disease control; careful management of the breeding season and breeding for greater genetic merit for fertility. It is the trends in genetic merit for fertility in the context of an expanding national dairy herd and their likely implications for the veterinary profession that is the focus of this article. The introduction of the Economic Breeding Index (EBI) in 2000 was primarily prompted by a decline in the genetic merit for fertility in the Irish dairy herd (Evans et al, 2006). Initially confined to milk and fertility sub-indices, the current EBI has been expanded to include seven traits of economic importance. The milk and fertility sub-indices, however, remain the most important accounting for approximately one third each of the weighting within the EBI. In this article, however, I'm focusing on the trends, outcomes and likely impacts of the rapid improvement in genetic merit for fertility. The rate of genetic improvement in dairy cow fertility is accelerating in an expanding national dairy herd and the combination of the two will change the nature of veterinary interventions required on Irish dairy farms in the coming years.

TRENDS IN GENETIC MERIT FOR FERTILITY

The trend observed nationally in genetic merit for fertility sub-index by year of calving in dairy heifers entering the national herd since 2000 is presented in Figure 1.

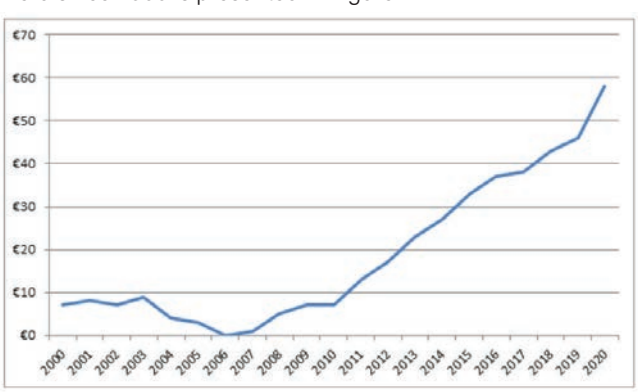

Figure 1: Fertility sub-index by year of first calving for dairy females (2000-2020).

The data in Figure 1 show three distinct phases. Between 2000 and 2006, there was a decline in fertility sub-index of heifers entering the national herd. This was an artefact of the national breeding programme prior to the EBI. Those bulls were selected based on their milk-production potential alone and the negative genetic correlation between milk and fertility was underestimated. This trend was, however, reversed as artificial insemination (AI) companies began to select AI sires on the EBI and dairy farmers adopted the index. The second phase occurred between 2006 and 2010 where the bulls used to breed the heifers entering the national herd were predominantly 'daughter proven' showing improved genetic merit for fertility.

The third and current phase commenced in 2011. It shows an accelerated rate of gain in the fertility sub-index of dairy cows entering the national herd with their fertility sub-index increasing by an average of €5 per annum. This increase has been underpinned by the introduction of genomic analysis. Its development has facilitated greater selection intensity from within the pool of potential young dairy AI sires. The widespread use of genomically selected bulls by Irish dairy farmers resulted in dairy heifers entering the herd in 2020 having an average fertility sub-index of €58. There is still potential for further increase, however. Teagasc advisers promote a target for herd fertility sub-index of €85 for pasture-based spring calving dairy cows.

HORMONAL AND BEHAVIOURAL DIFFERENCES

Genetic merit for reproductive traits is having a pronounced effect on circulating concentrations of reproductive hormones, reproductive behaviour and body condition score (BCS). Research conducted at Moorepark by Moore et al (2014) has found that cows of higher fertility sub-index (Fert+) had a more rapid rise in circulating oestradiol pre-ovulation (see Figure 2) compared to cows of lower fertility sub-index (Fert-). The rise was associated with 41% greater heat activity (Cummins et al, 2012). Progesterone concentrations in Fert+ cows rose more rapidly post-ovulation (Figure 2) underpinned by greater luteal size (Moore et al, 2014).

The Fert+ cows also maintained greater BCS during mid- and late-lactation compared to the Fert- cows (Cummins et al, 2012 [see Figure 3]). More recent research by O'Sullivan et al (2020) compared divergent strains of Holstein Friesian cows with average fertility sub-indexes of €103 and €28 respectively. While he observed little difference in the concentrations of the various reproductive hormones, he observed greater BCS throughout lactation in the high fertility group.

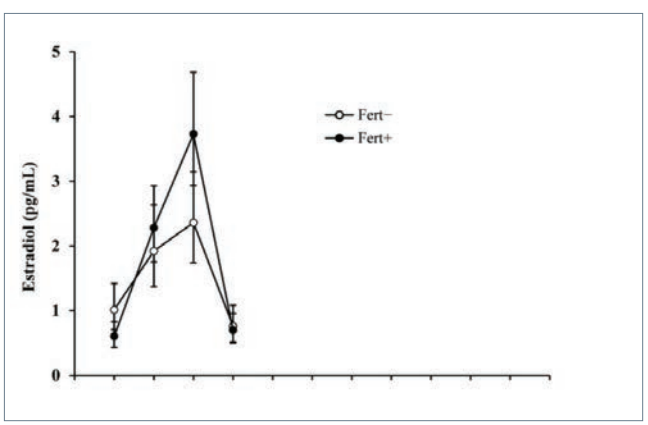

Figure 2: Circulating oestradiol and progesterone concentrations in Fert+ and Fert- cows prior to and after oestrus (Moore et al., 2014).

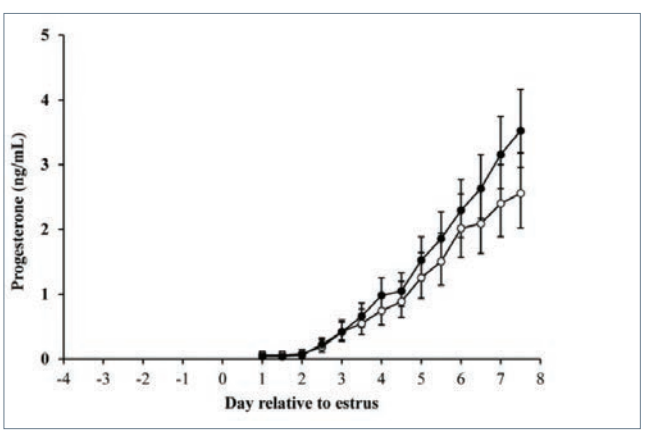

Figure 3: Body condition score relative to parturition in Fert+ and Fert- dairy cows (adapted from Cummins et al, 2012).

GREATER REPRODUCTIVE PERFORMANCE AND SURVIVAL RATES

The research of O'Sullivan et al (2020) showed greater conception rates to first service (60.4% versus 45.5%), and lower empty rates after 12 weeks of breeding (7.3% versus 16.9%) for the high fertility sub-index group. In addition, the high fertility group were 43% less likely to be culled by the start of the fifth lactation than the low fertility group. The fertility sub-index is having a profound impact on cow longevity (and production) at commercial farm level as well. Ranked in quartiles for fertility sub-index (highest to lowest), the highest fertility quartile had the highest survival rates to fifth calving (see Figure 4) and were 61% more likely than cows in the lowest fertility quartile. In addition, despite having the lowest mean milk production sub-index, they also had the greatest milk production (measured as the cumulative quantity of milk solids produced between first and fifth lactation) because of their greater maturity.

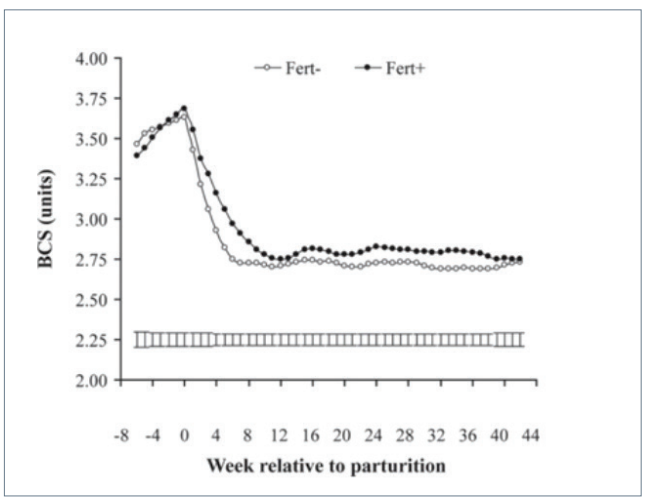

Figure 4: Survival to the start of the fifth lactation of 9,520 dairy cows on spring calving Irish dairy farms ranked by fertility sub-index (highest to lowest).

CALVING OF THE NATIONAL DAIRY HERD – MORE COMPACT

The number of calvings in the month of February on Irish dairy farms increased by almost 90% from 270,000 in 2010 to 510,000 in 2020. Two factors are contributing to this change. Firstly, a 50% increase in the size of the national dairy herd. Secondly, increased compactness of calving from approximately 25% of all calves born on Irish dairy farms in 2010 to an estimated 33% in 2020. Undoubtedly, the improvement observed nationally in genetic merit for fertility is contributing substantially to the increased compactness of calving observed in the national dairy herd.

IMPLICATIONS OF INCREASED COMPACTNESS OF CALVING

The trend outlined above is creating workload challenges for farmers and vets with periods of intense calving occurring in early spring. This is then being followed by a similarly intense period of calf rearing. Diseases such as coccidiosis or pneumonia can be especially challenging in such situations if they occur. Problems associated with older cows such as lameness and incidence of milk fever may increase in the years ahead as cows remain in the herd for longer. Cows with higher fertility sub-index tend to calve earlier in the calving season and this facilitates a longer interval between calving and breeding. The need for veterinary intervention to induce cyclicity will be reduced.

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READER QUESTIONS AND ANSWERS

1. WHAT WEIGHTING DOES THE FERTILITY SUB-INDEX HAVE WITHIN THE EBI?

- **A.** 20%
- **B.** 33%
- **C.** 60%

2. FOR THE HIGH FERTILITY SUB-INDEX, WHAT CONCEPTION RATES TO FIRST SERVICE ARE EXPECTED?

- **A.** 50%
- **B.** 40%
- **C.** 60%

3. COMPACT CALVING COULD LEAD TO

- **A.** Intensive calving during the spring
- **B.** Intense disease challenges during calf rearing
- **C.** Reduced veterinary intervention to induce cyclicity
- **D.** All of the above

ANSWERS: 1A; 2C; 3D.