Technology driven by science

The Grange Reproductive Management Model is a decision support tool developed by TEAGASC to aid in reproductive management of suckler herds.

Sustainability within pasture-based beef cow systems is underpinned by the annual production of a live calf per breeding female and the achievement of a mean herd calving date close to the point of turnout to pasture each year. In addition to this, achieving a compact calving pattern will accrue additional benefits from the production of more uniform calf crops, such as savings in labour during routine husbandry procedures and the availability of more marketable groups of animals. However, due to the complex interaction between farm environment and animal biological cycles, farm managers often find it difficult to achieve such reproductive performance. Management decisions to achieve such targets are further complicated by the inability to robustly predict the impact a particular management strategy will have on farm performance and profitability as a whole. Given the nature of this issue, a study was commissioned to investigate the impacts of alternative reproductive management strategies on the technical and economic performance of a suckler beef herd, through the framework of a dynamic simulation model.

Impacts of reproductive management

On review of the literature, the period that occurs between calving and conception, otherwise known as the postpartum interval (PPI), was identified as a region within a suckler beef cow's reproductive cycle that was highly affected by herd management. A meta-analysis was therefore undertaken to quantify the impact of the most prominent management-related factors on the duration of this interval, focusing on body condition score of the cow at calving (BCSc), level of postpartum nutrition (PPN), level of access to the suckling calf (CA), parity of the cow post calving (primiparous or multiparous), and impact of exposure to a male stimuli pre breeding (Bexp). Results from this analysis indicated that cows managed to a correct level of nutrition pre and post calving had the potential to achieve a PPI of 52 days in duration ($P < 0.001$). However, as BCSc reduced from 2.5 to ≤ 2.25 (0-5 scale), an extension to the PPI occurred by 14 days ($P < 0.001$). This could be alleviated somewhat by increasing the level of nutrition post calving, or through the introduction of a form of biostimulation of the cow pre breeding (teaser or fence-line restricted bull). Analysis also showed that potential exists in herds that calve in an adequate BCSc (2.75), to condense their calving pattern further by implementing a temporary restriction to the suckling calf (≥ 23.5 hrs/d for six consecutive days). This strategy was indicated to be most effective at inducing oestrus activity when the calf was penned outside of both visual and olfactory range of the dam.

Dynamic model

Using the co-efficients developed from this meta-analysis, a *de novo* dynamic simulation model, known as the Grange Reproductive Management Model (GReMM), was developed to help quantify the impact of reproductive management on overall farm system performance (**Figure 1**). To construct the framework of the model, a novel system dynamics software package, 'Stella architect', was utilised. The model was sub-sectioned to allow a detailed simulation of both the gestational and PPI periods of the reproductive cycle of a herd of beef cows and ran over a period of six years. Reproductive outputs included the calving distribution of the herd, three-, six- and nine-week calving rates, calves per cow per year, and herd culling rates due to barrenness. These outputs

FIGURE 1: User interface for the Grange Reproductive Management Model (GReMM) decision support tool.

were then integrated within a whole-farm bio-economic model to assess the potential economic and environmental viability of specific reproductive management strategies.

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Decision support tool

Following on from the development of the GReMM simulation model, a more industry-applicable decision support tool has been developed in order to allow wider dissemination of the study findings. A user interface allows the input of current herd size, breeding season length, calving profile, replacement rate and pre-weaning mortality rate for a particular farm. Energy availability around calving is predicated on the level of concentrates fed, the silage quality, and date of turnout to pasture as indicated by the user. A number of management options can then be selected prior to the next breeding season for farmers who wish to improve upon the existing reproductive performance of their herds. These include alternative sire selection, increasing the energy density of the diet post calving, biostimulation of the cow through the use of a vasectomised bull, and temporarily restricting the suckling time of the calf from the cow.

Future editions of the GReMM decision support tool will also incorporate recent study findings on the genetic and nutritional control of puberty in beef heifers, in addition to results from trials conducted on the use of oestrus synchronisation in beef herds. A prototype GReMM decision support tool is currently being tested with advisors and farmers to ensure its adequacy in the field, with the intention for release in the coming months.

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