Automated detection of oestrus

Emily Sitko, Stephen Moore and Stephen Butler
Teagasc, Animal & Grassland Research & Innovation Centre, Moorepark, Fermoy, Co. Cork

Summary

- Automated activity monitoring systems can improve herd reproductive performance and decrease labour costs.
- Evaluating the cost-benefit of an automated activity monitoring system requires knowledge of current herd performance, technology cost and capabilities, and overall farm goals.

Introduction

In recent years, there has been an increased emphasis on maximizing the efficiency of dairy farms due to multiple challenges linked to labour constraints, market volatility, and sustainability. Therefore, developing strategies to optimise reproductive efficiency and management is critical for modern dairy farms. One potential approach is through the implementation of precision technologies on-farm. Depending on various factors such as herd size, labour cost, technology cost and accuracy, automated activity monitoring (AAM) technologies can improve the success of oestrus detection and decrease associated labour costs. The objective of this paper is to describe available data on the performance of AAM systems for oestrus detection of pasture-based dairy cows, discuss how AAM system data may be utilized on the farm to optimise reproductive performance, and summarize the key considerations to reflect on when considering investment.

Accuracy of AAM systems for oestrus detection

Oestrus detection efficiency is a key driver of submission rate, and thus critical for fertility performance and seasonal calving patterns. During oestrus, dairy cows display behaviours such as mounting and increased activity. Therefore, AAM systems are able to indirectly determine oestrus by monitoring individual cow activity and generating alerts when activity levels surpass a threshold indicative of oestrus. Automated technologies are commonly evaluated for their sensitivity (Se), Specificity (Sp), and positive predictive value (PPV). Sensitivity is proportion of the cows in oestrus correctly 'alerted' by the system, whereas Sp is the proportion of cows not in oestrus and correctly not 'alerted' by the system. Positive predictive value reflects the proportion of cows with an oestrus alert that truly are in oestrus. Based on data collected in a New Zealand pasture-based dairy system, AAM technology achieved 77%, 99%, and 82% for Se, Sp and PPV, respectively. In confinement TMR systems, AAM systems have been reported to have similar performance metrics. Overall, this is an acceptable performance given that data has shown skilled farm personnel conducting visual observations at 4-5 hour intervals fail to detect up to 10% of cows in oestrus. More research on accuracy of these technologies within a pasture-based system is necessary to gain a better understanding of the return on investment.

Utilizing AAM systems to optimize fertility

Reproductive efficiency is dependent on achieving high submission and conception rates. To achieve this, cows must resume ovarian activity, undergo normal uterine involution, and be detected in oestrus and inseminated at an optimum time. Several studies have demonstrated that oestrus expression and oestrus features are correlated with phenotypic fertility outcomes. Additionally, genetic merit for fertility traits (EBI Fertility sub-index) has been associated with many aspects of dairy cow reproductive physiology, including oestrus expression and overall reproductive performance. Cows that have a prompt resumption of oestrous cycles after calving and have multiple normal oestrous cycles before the farm mating start date have better fertility performance during the breeding season. Automatic

identification of cows that have or have not cycled before the farm mating start date is valuable information that can be utilized in decision-making. For example, non-cyclic cows may benefit from hormonal synchronization to assure timely insemination. On the other hand, cows with at least one oestrus event before breeding are likely to have better fertility, and are therefore potential candidates for AI with sexed semen. Knowing the time when an oestrus alert was generated also informs decision making around timing of AI, which is also important for inseminations with sexed semen.

In 2022, the Teagasc dairy herd at Ballyhaise exclusively relied on an AAM system for detection of oestrus. The herd achieved a 21-day submission rate of 87%, a six week pregnancy rate of 72% and an empty rate of 12%. The farm also utilizes the system before mating start date to automatically identify non-cyclic cows for ultrasonography and, if required, hormonal intervention to aid cyclicity.

Considerations before investment

Investment in AAM technologies by Irish farmers has been increasing in recent years, driven by increased herd size and inadequate labour availability. The decision to invest in an AAM system is primarily influenced by the expected accuracy and reliability of the system, initial and on-going costs, and the need for new technology skills to effectively engage with the data generated. In order to determine if an AAM system is a good farm investment, careful consideration of costs and benefits is required. It is important to consider the following factors; 1) Farm financial position, 2) Farm current fertility performance and future fertility goals, 3) Labour availability, 4) Technology costs, capabilities and limitations. It is vital to know your herd's strengths, weaknesses and goals because the value of the investment is impacted by success of oestrus detection by the system relative to current management. It is also important to consider other areas of herd management that could be improved by investment. For example, many of the AAM systems also monitor rumination and eating, which can potentially improve health management through early detection of health events. Additionally, individual goals and values are important since smaller improvements in reproductive performance may be acceptable to the farmer if other benefits such as reduced labour requirements or improved work-life balance are achieved.

Conclusions

Depending on various factors such as herd size, labour cost, technology cost and capabilities, AAM systems can improve the success of oestrus detection and decrease associated labour costs. It is important, however, to consider factors such as current farm finances, herd performance, technology cost and capabilities, and overall farm goals before investment. Future studies will be aimed at evaluating the accuracy of AAM systems within an Irish pasture-based system, as well as the impact of incorporating AAM system into reproductive management on fertility and profitability.