Summary: The evaluation of an artificial intelligence system for estrus detection in sows

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Main Points:

- Three Belgian sow farms (A, B, and C) where an artificial intelligence (AI) system was installed were used to investigate whether such an AI system could help to optimize the moment of insemination.
- In farm A, all assessed parameters significantly improved, (farrowing rate + 4.3%, percentage of repeat-breeders − 3.75%, farrowing rate after first insemination + 6.2%, and number of total born per litter + 1.06 piglets), after the AI system implementation.
- In farm B, the only statistically significant difference before and after the implementation of the AI system was the number of total born per litter (−0.48 piglets), while in farm C, this parameter significantly increased by 0.45 piglets.

Introduction

Estrus detection in sows is essential to predict the best moment of insemination. In commercial breeding farms, estrus detection is often done visually by the farmer, based on sow behavioral signs. However, these signs are highly variable between sows and estrus duration is hardly predictable in advance. Therefore, multiple inseminations per estrus to optimize fertility results has been an approach. This strategy is time-consuming and incurs extra costs. Nowadays, technological innovations using connected sensors and cameras that continuously monitor behavioral data have been developed for estrus detection in the sow. The collected behavioral data are subsequently analyzed by an artificial intelligence (AI) system. This study investigated whether such an AI system could help the producer to optimize the moment of insemination and reproductive performance.

Materials and Methods

Three commercial Belgian sow farms (A, B, and C) where the AI system (SmaRt Sow Breeding (SSB)) was installed participated in the study. The SSB system continuously collects behavioral data of each sow in the breeding unit via a camera that is attached to the crate above the sow. The algorithm uses the collected sow's activity patterns to predict the best moment of insemination for each sow and an insemination request is displayed on the user's interface. Farmers using the system are recommended to: 1) perform estrus detection with a teaser boar once per day and to indicate the time when they perform estrus detection; 2) feed the sows maximum twice per day and at fixed times, allowing the system to discriminate between behavior related to feeding and behavior related to estrus; 3) keep the insemination unit as quiet as possible to minimize the risk of sows showing any irregular behavior that is not related to estrus, and make it easier for the system to detect signals of estrus. The system has been designed to be used in weaned sows, not in gilts as their behavior is too variable and difficult to assess reliably. Thus, the performance of gilts was not included in this study.

In the three farms involved in this study, the reproductive cycles (n = 6717) of 1.5 years before and 1.5 years after the implementation of the system were included. Parameters included: (1) farrowing rate (FR), (2) percentage of repeat-breeders (RB), (3) farrowing rate after first insemination (FRFI), and (4) number of total born per litter (NTBP). Also, data collected by the system was analyzed to describe the weaning-to-estrus interval (WEI), estrus duration (ED), and the number of inseminations per estrus. This dataset included 2261 cycles, collected on farms B and C.

Results and Discussion

In farm A, all parameters significantly improved namely FR + 4.3%, RB − 3.75%, FRFI + 6.2%, and NTBP + 1.06 piglets. In farm B, the NTBP significantly decreased with 0.48 piglets, but in this farm, the insemination dose was low (0.8×10^9 spermatozoa per dose). In farm C, only the NTBP significantly increased with 0.45 piglets after the implementation of the system. The WEI, as determined by the system, varied between 78 and 90 hours (h), being 10–20 h shorter in comparison with the WEI as determined by the farmer. The ED, determined by the system ranged from 48 to 60 h, and was less variable as compared to the ED as assessed by the farmer. In farm B, only the difference in NTBP was statistically significant, i.e. − 0.48 piglets. FR and FRFI improved, whereas the RB increased ($p > 0.05$). The mean number of inseminations per estrus remained similar over time in farm B whereas it decreased over time from approximately 1.6–1.2 in farm C.

This study showed that a real-time artificial intelligence system for estrus detection in sows can assist farmers in determining the best moment of insemination and if used properly, improve the reproductive performance of the farm. The overall results on reproductive performance were positive, but the results vary per farm due to differences in farm management. Besides proper estrus detection, other factors such as management, genetics, feed, health status, and sperm quality are of major importance to increase the chance of successful conception. These factors may have influenced in some way the results, for example, increasing litter sizes as a result of genetic improvement.

Conclusions

The AI system can help farmers to improve the reproductive performance, assess estrus characteristics and reduce the number of inseminations per estrus. Results may vary between farms as many other variables such as farm management, genetics, and insemination dose also influence reproductive performance.

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