Technology Guideline

AUTOMATED HEAT DETECTION

This guideline is designed to provide you with an overview of automated heat detection systems including how they work and factors to consider when choosing a system.

Key messages

- There are two main types of automated heat detection systems, monitoring individual cow activity or camera inspection of heat patches
- Well performing technology can achieve an accuracy similar to an experienced farm manager, but performance varies between and within systems
- Camera systems require few changes to current manual procedures
- Activity systems are data-rich, requiring some data input, but may also offer other measurements of value (e.g. rumination, grazing time).
- Tail paint, or other backup, should be used in case of technology system failure

What are automated mastitis detection systems?

Automated heat detection uses technology to help with the manual task of identifying cycling cows. It can be used for identifying pre-mating heats, cows that need to be submitted for artificial insemination in the mating period, and those that aborted and resumed cycling later. Results from a 2013 survey indicate that around 350 New Zealand dairy farms (3%) use automated heat detection systems.

Why use automated heat detection technologies?

Heat detection is a key driver of reproductive performance in the dairy herd. Achieving good performance manually requires a high degree of skill, effort and organisation. Farmer fatigue and limited skills among staff are the most common challenges to getting a good result.

An accurate automated heat detection technology offers the potential to apply an acceptable, consistent level of performance, irrespective of staff skills. Potential benefits include:

- Reduced dependence on the skills of staff
- Greater consistency of detection
- Less staff time spent on heat detection

Many factors can cause poor reproductive performance, such as a high proportion of non-cycling cows leading in to mating, poor heat detection, and a low conception rate. Reasons for reproductive failure can be identified using the In-Calf Fertility Focus report which sets out the key performance indicators of good reproductive performance and calculates your farm performance against industry targets (**InCalf**).

Tip: Use the Fertility focus report to determine whether heat detection is an area for improvement, and consider procedures to improve manual detection performance first to be sure that investing in an automated system is the right option for your farm.

How does heat detection technology work?

In New Zealand, the two main methods of automated heat detection are activity-based detection or camera-based monitoring of a heat patch (e.g. a KAMAR). Recently, electronic heat patches have been released, where a flashing light on the device indicates potential oestrus.

These technologies only provide an indication of potential oestrous activity, visual confirmation will still be required.

Activity-based detection

Activity monitoring uses accelerometer technology (an advanced version of pedometers) inside a device mounted on a neck collar, leg bracelet or ear tag of each cow. The cow's current level of activity is compared with her 'activity baseline' or reference period, e.g. the last seven days. If activity changes above a pre-determined threshold, an alert is generated.

The threshold set for activity-based alerts is critical to the performance of this technology:

- If the activity threshold is set too high, a lower proportion of the cows will be identified by alert and many of the cows in heat will be missed.
- If the activity threshold is set too low, a high proportion of the herd will be identified by alert, but many of these cows may not be in heat (i.e. more false alerts).

A heat detection back-up system, such as tail painting, should be used as well to mitigate the risk of the activity system failing (e.g. due to a computer malfunction).

Some activity sensors can also measure rumination or eating time, which may be used to improve the heat detection ability or indicate health events.

Camera-based detection

Camera systems automate the manual task of inspecting mounting indicators such as heat patches (e.g. KAMARs). The accuracy of the system first relies on the performance of the heat patch. Systems typically use a digital or infra-red camera mounted in the dairy (rotary) or exit race (rotary or herringbone) to take an image of the heat patch as cows pass. If the image analysis classifies a heat patch as either 'activated' or missing, an alert is generated, and the cow drafted if auto drafting is in use.

The camera systems require fewer changes to the way heat detection is performed on farm compared with activity systems and, in the event of a camera system failure, the heat patches can be visually inspected as normal. The systems can be used independently of the current herd management systems in most cases.

Tip: When selecting a type of heat detection system, consider the changes that you would need to make to your routines and the capability of those operating the system. Discuss this with the suppliers and other farmers who have experience with these systems.

How well do these technologies perform?

The performance of all systems rely on the quality and frequency of the data recorded, the sophistication of software algorithms (calculations) that generate alerts, and regular maintenance of the associated devices and databases (i.e. keeping cow records up to date). Auto-drafting is a useful option to automate the separation of alerted cows, further reducing manual effort.

An effective automated system will have a high detection rate and minimise the number of cows a farmer needs to assess for visual confirmation of heat (few false alerts). DairyNZ research on commercial farms, between 2008 and 2010, highlighted a wide range of heat detection system performance (Table 1). Important

performance criteria are detection rate (the % true heats detected) and false alert rate (% alerts that were incorrect). Detection rate ranged from 70% to 91%, and false alert rate ranged from 17% to 67%. In comparison, an experienced farmer achieved a detection rate of 91% and false alert rate of 5%. For more information, see Issue 7, December 2011, of the DairyNZ Technical Series (here).

Table 1. Detection rate and false alert rate for different oestrus detection approaches

Detection method	Detection rate (% true heats detected)	False alert rate (% alerts that were incorrect)
Experienced farmer	91%	5%
Camera-based system	91%	23%
Best activity-based system	89%	17%
Worst activity-based system	70%	67%

Achieving and maintaining best performance from the system will require:

- Good installation (e.g. well positioned EID readers or camera location)
- Regular maintenance checks (e.g. identifying and replacing defective activity devices or keeping the camera operational)
- Up-to-date record keeping where the system relies on daily data (e.g. cows changing herds that may affect walking distances).

Tips: Allow time for training and ensure more than one person can understand the software. Be diligent with data quality (e.g. prompt and correct input of cow ID), and with regular data back-ups.

Have a manual heat detection backup in place (e.g. tail paint) in case of system failure.

What are the investment costs?

The investment costs for heat detection include a cost per cow, fixed costs for electronic identification (EID) readers and computer systems, and ongoing maintenance and replacement. Payback on investment is highly dependent on initial costs, and the difference between current manual detection and performance of the new system. There will be a negative return if a currently good manual performance drops due to a poor performing technology.

Table 2. Investment costs and considerations

	Activity-based	Camera
Per cow costs for 400 cow herd:	Activity devices: $100-S160 /cow $40,000-$64,000	Heat patch: $2/cow per cycle/year $1,500/yr
Data receivers/ software/hardware: **Fees:**	EID /data receivers: $5,000-10,000	EID /data receivers: $5,000-10,000 Camera system: $20,000 Licence fee: + $300 pa
Installation	*Cost available from supplier*	*Cost available from supplier*
Auto-drafting (optional)	$25,000 - $45,000	$25,000 - $45,000
Note: Costs are indicative only Activity device battery life is generally 2-10 years (some have replaceable batteries) Labour not included for attaching/adjusting collars or attaching heat patches		

What are the key considerations before purchase?

Consider your reasons for investing in an automated system and evaluate the technologies to understand the trade-offs for you, your team, and your business.

If your motivation is to improve reproductive performance through improved heat detection, you first need to be sure that heat detection performance is your key problem;

- Use information from the Fertility Focus Report to review all areas of reproductive performance
- Know your current heat detection performance and the potential for improvement
- Review whether you can achieve your target through better procedures and/or more motivated staff, as this is the lowest-cost solution.
- Seek reliable information on whether the automated systems can help you achieve your target.

Identify what type of automated system fits best with the way you prefer to manage the interface between animals and data. You may prefer a simple system that requires minimal new skills and computer input, or a data-rich system that allows more analysis or detail. Some heat detection systems can operate independently of any herd management software you might currently have installed. If you wish to integrate heat detection data into existing herd management software, then your options may be more limited.

If your goal is to maintain a high heat detection performance, but with reduced dependence on key skilled people, be mindful that technologies do not replace the need for skilled staff;

- Training will be needed to use the heat detection system; for entering data, setting alert thresholds and confirming heats, and performing maintenance. Discuss with your technology supplier what training and support will be provided and whether the software is 'user-friendly' (simple).
- Skilled handlers will still need to make the final decision on cows selected for artificial insemination

Prepare a budget using realistic costs and returns so that you know the projected annual costs, the number of years until break-even is reached and the longer term return on investment.

Tips: Ask farmers who currently use an automated system about their experiences. For instance, how they measure the system's performance objectively and separate from any other changes made in farm management.

What changes have they had to make to their daily routines and how much time and skill is required to use the system?

Examples of heat detection systems available in New Zealand

Most milking technology companies in New Zealand offer a heat detection system. They can differ in terms of their technological approach, and the post-installation service and support. The following list of suppliers and products was compiled in 2016; it may not reflect the current market.

Supplier	Brand name	Website
Activity systems		
DairyMaster	MooMonitor™	www.dairymaster.co.nz
GEA/MilFos	Rescounter 3™, CowScout™, Heatime HR™	www.gea-farmtechnologies.com
Lely	Qwes-H™	www.lely.co.nz
Samen NZ Ltd	Sensoor CowManager™	www.samen.co.nz
Waikato Milking Systems	Afi-Act™	www.waikatomilking.com
Camera systems		
LIC Automation	EZ Heat™	www.licautomation.com

Tru-Test	Milkhub Heat Scanner™	www.livestock.tru-test.com

Further information

Burke CR, Blackwell MB, Little S. The InCalf Book for New Zealand Dairy Farmers. DairyNZ, Hamilton, New Zealand, 2007

DairyNZ Technical Series 7 - December 2011, Automation of oestrus detection

DairyNZ Inside Dairy article – September 2015, Getting Repro Right, Reproduction Champs Share Their Secret

Dela Rue, B. T., Kamphuis, C., Burke, C. R., & Jago, J. G (2014). Using activity-based monitoring systems to detect dairy cows in oestrus: a field evaluation. New Zealand Veterinary Journal 62(2): 57-62.

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