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Clinical Field Trial for Remote Radio Telemetry Heat Mount Detection System

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Abstract

Accurate and efficient estrus detection is required to maintain reproductive performance in an artificially inseminated herd. Even with a substantial labor commitment, visual estrus detection is not practical in a large, multi-unit herd given the diurnal pattern of estrous behavior. Large dairies increasingly elect to reduce labor costs by relying on less accurate detection methods, eg. tail chalk, or by eliminating genetic improvement of youngstock from the operation mission.

A commercial heat mount detection system (HMDS) was evaluated for accuracy of estrus detection. The system was used to monitor behavioral estrus in 130 cows. HMDS was compared with visual observation and biweekly radioimmunoassay of milk progesterone.

The study was conducted on Holstein cows at a commercial dairy in Colorado from December 1991 to September 1992. Cows were confined in groups of 200 to an uncovered free-stall area and allowed onto an open dirt lot if weather conditions permitted. Expermental animals were mature cows producing greater than 85 lbs of milk per day on three times a day milking. Cows were eligible for enrollment into a study group based on a normal post-partum rectal palpation and more than 29 days in milk. HMDS patches were fitted to the tailhead of all cows at enrollment. Visual heat detection took place twice daily for half an hour at varying times of day depending on season and weather condition. Tail chalk was applied daily and HMDS patches were evaluated for attachment and replaced as needed on a daily basis. Visual data collected included standing, bulling, loss of tail chalk, mucoid and bloody discharges, and restlessness or bellowing. Milk samples were collected twice weekly from the time of enrollment until the cow was confirmed pregnant or removed from the pen due to decreased production. Progesterone (P4) analysis by radioimmunoassay (Niswinder, 1973) was performed by the Animal Reproduction Laboratory at Colorado State University.

Physiological estrus was defined as P4 less than 1 ng/ml or decreased by five-fold in magnitude from the previous diestrual peak. HMDS criteria for estrus were greater than or equal to 4 recorded mounts in 24 hours. Visually detected estrus was defined as standing to be mounted.

Sensitivity and specificity of the device, data recording capabilities and other details of the trial will be presented.

Summary

A commercial heat mount detection system (HMDS) was evaluated for accuracy of estrus detection. The system was used to monitor behavioral estrus in 130 cows. HMDS was compared with visual observation and biweekly radioimmunoassay of milk progesterone. Sensitivity (74%), specificity (99%) and predictive values for HMDS were calculated using progesterone RIA as the gold standard.

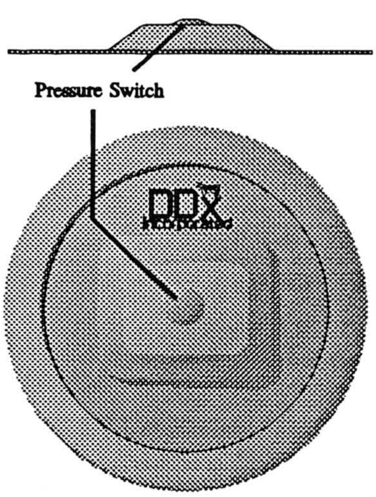
Introduction

Accurate and efficient estrus detection is required to maintain reproductive performance in an artificially inseminated herd. Even with a substantial labor commitment, visual estrus detection is not practical in a large, multi-unit herd given the diurnal pattern of estrous behavior. Large dairies increasingly elect to reduce labor costs by relying on less accurate detection methods, eg. tail chalk, or by eliminating genetic improvement of youngstock from the operation mission.

The sensitivity of heat detection describes the probability that an animal in physiological estrus is classified correctly by the test method. This value, also termed efficiency, is economically important because each missed heat potentially adds 21 days open at an estimated value of $2.00 per day (Kirk, 1985). Specificity of heat detection describes the probability that an anestrous or diestrous state is correctly classified by the test method (Gaines, 1989). Specificity or accuracy is also one minus the incidence of a false positive test result. A method with high accuracy would reduce insemination costs for non-fertile, misclassified animals.

Materials and Methods

A newly designed, commercial heat mount detection system, Heat Watch™ under development by DDx Inc. of Boulder Colorado, was used to collect computerized data on physiological estrus (Figure 1).



The HMDS system includes a pressure sensitive switch mounted on a radio-transmitter. Once triggered, the signal identifying the cow, the time of onset and duration of mount is relayed from the transmitter to a receiver. Data then are stored in the memory of the on-farm personal computer until the proprietary program is activated. The software application allows for detailed analysis and management of the heat activity information. Reports of heat activity for the day, non-returns to activity, or inappropriate intervals of activity can be generated. (See Figure 3 screen display)

The study was conducted on Holstein cows at a commercial dairy in Colorado from December 1991 to September 1992. Cows were confined in groups of 200 to an uncovered free-stall area and allowed onto an open dirt lot if weather conditions permitted. Experimental animals were mature cows producing greater than 85 lbs of milk per day on three times a day milking. Cows were eligible for enrollment into a study group based on a normal post-partum rectal palpation and more than 29 days in milk. HMDS patches were fitted to the tailhead of all cows at enrollment. Visual heat detection took place twice daily for half an hour at varying times of day depending on season and weather conditions. Tail chalk was applied daily and HMDS patches were evaluated for attachment and replaced as needed on a daily basis. Visual data collected included standing, bulling, loss of tail chalk, mucoid and bloody discharges, and restlessness or bellowing. Milk samples were collected twice weekly from the time of enrollment until the cow was confirmed pregnant or removed from the pen due to decreased production. Progesterone (P4) analysis by radioimmunoassay (Niswinder, 1973) was performed by the Animal Reproduction Laboratory at Colorado State University.

Physiological estrus was defined as P4 less than 1 ng/ml or decreased by five-fold in magnitude from the previous diestrual peak (Figure 2). HMDS criteria for estrus were greater than or equal to 4 recorded mounts in 24 hours. Visually detected estrus was defined as standing to be mounted. Each biweekly sample frame was included only if data for all three tests were available, ie. milk sample was collected and tested by RIA, cow was not removed from observation group for health reasons, and the HMDS patch was in place.

Results

The accuracy of estrus detection was estimated by the sensitivities, specificities and predictive values of each mount detection test relative to RIA results. Of 176 bi-weekly estrus samples, 130 were detected by HMDS for a sensitivity of 74%. Specificity of the test is calculated as 99% or 1456 out of 1474 anestrous or diestrous samples.

Discussion

HMDS technology increases surveillance time from the standard twice daily observation. This allows for detection of "silent heats" of short duration or inconvenient hours in an unlimited number of animals. Other current indicators of estrus such as core body temperature spikes, increased ambulation and electrical conductivity have varying degrees of accuracy and efficiency. The digital format of HMDS and other electronically collected data allows for integration of mounting behavior with herd reproductive management records and allows for internal validation of activity patterns within the HMDS data set.

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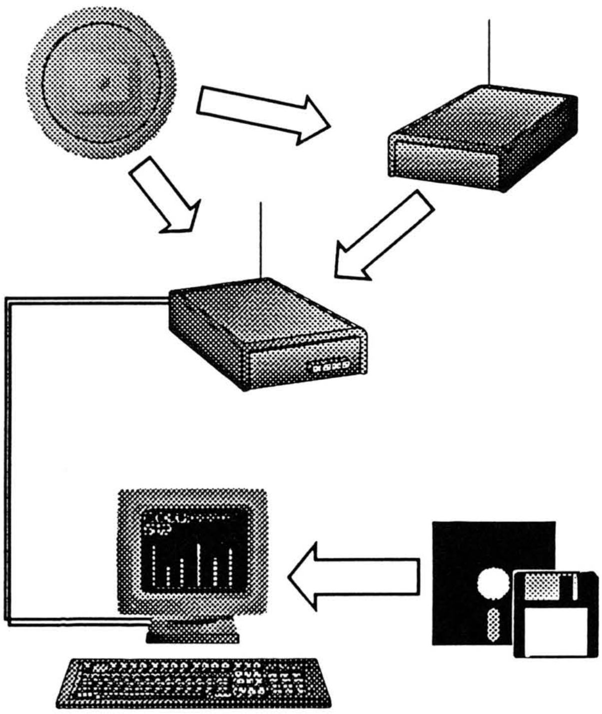

figure 1- ***system configuration***

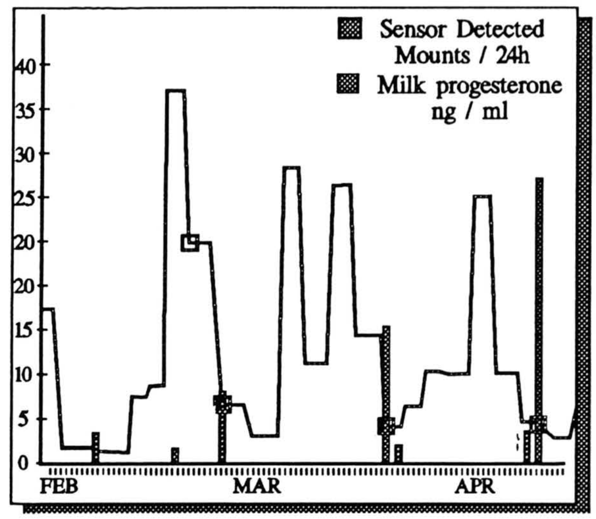

figure 2- ***Estrus Activity and Milk Progesterone Levels***

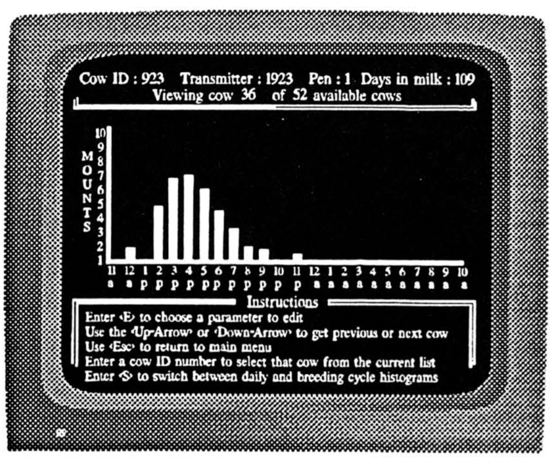

figure 3- ***screen display***