Estrus Detection in Dairy Cattle

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The global threat to food security has increased attention towards high-production dairy cows. Nevertheless, because of the inverse relationship between the two, improving farm animals' productivity has a negative influence on their reproductive performance. Estrus detection characterizes those behaviors which represent physiological changes leading to ovulation. Main purpose for estrus detection is to identify an appropriate time for insemination, which further results in achieving higher pregnancy rate. The accuracy of estrus detection is an important concern that also limits artificial insemination use. The cost, labor, and management system associated with estrus detection aid also play an important role in deciding the best approach for heat detection. Following are the estrus detection aids

- **Visual estrus detection**

The most common technique involves skilled professionals identifying animals in estrus through visual observation. Visual observation may be supplemented with other estrus detection aids to increase efficiency. The main indication of estrus is when an animal "stands to be mounted" by other members of the herd. Additional secondary indicators of estrus include restlessness, bellowing, vulva swelling and redness, frequent urination and rise in body temperature. These behavioral shifts in animals are noted to breed the animal at the best possible period to increase the likelihood of conception. It is recommended to inseminate a cow during mid to late estrus and at field level A.M./P.M.-P.M./A.M rule can be followed to idealize the time to inseminate a cow in heat.

- **Tail-chalking and Painting of tail**

Tail painting or tail chalking is commonly used in estrus detection. Close observation of the marking and noting signs of it being rubbed off or smudged are required after covering the tail-head with bright colored tail paint or chalk. The painted animal likely stood in estrus while mounted by herd mates. Reapplication, false readings, wallowing and rubbing interferes with the efficiency of this method.

- **Chin ball marking device**

It is a less expensive heat detection aid but requires an extra effort to be effective. It consists of a halter that holds reservoir of paint and is placed place under the chin of the marker animal's (Gomer or teaser) chin. When an animal in standing estrus is mounted by the marker animal, the chin-ball marker will rub against the animal in standing estrus, leaving marks on her back and rump. As ink needs to be refilled therefore maintenance is necessary.

- **Pressure-sensors / Heat mount patches**

Pressure-sensors are stimulated each time a cow is mounted and are placed on the cow's tail head. False detection of estrus can occur as they can be "triggered" by other activities unrelated to heat which affect estrus detection accuracy. It requires a minimum of twice a day inspection on daily basis to be of value as a heat detection aid. Besides this the considerable investment in labor to apply and maintain them in working conditions is another issue.

- **Electronic mounting sensors/ Radio telemetric devices**

This system is associated with specific heat behavior, and they are on the job 24 hours per day which increases its accuracy and efficiency. It is a pressure sensitive telemetry device that is glued to the cow's tail head. When the cow is mounted it sends a radio telemetry message to a receiver to be recorded by computer. The message contains animal ID, the date and time of mount and duration of each mount.

- **Milk progesterone assay**

Progesterone can be used to determine the functional status of the corpus luteum and ovarian activity (Banu *et al.*, 2012). Performing the progesterone test on animals prior to the onset of estrus allows one to determine the amount of progesterone in the blood or milk and identify animals that should be watched for signs of being in heat. High levels of progesterone indicate the animal is not in heat, and low levels indicate that animal may be in or near estrus.

- **Ultrasonography**

Ultrasonography is more accurate, reliable, simple, and non-invasive imaging technique without secondary effects. This technique is useful for diagnosing various ovarian structures than per rectal palpation

- **Closed circuit television (CCTV)**

Estrus can be detected by using CCTV or video recording (Norman *et al*., 2005). Since the animals are watched 24/7 for their behavioral activity, it is the gold standard in oestrus detection. Even with infra-red cameras it is even more challenging to identify animals in heat during night hours but by using time- lapse and fast playback, the estrous activity of the night can be viewed.

- **Saliva crystallization patterns**

Examining the characteristics of cervical mucus during the oestrous cycle reveals that, in contrast to other phases of the cycle, the degree of the crystallization phenomenon peaks during oestrus. This is mostly because of the increased oestrogen levels at this point, which are affecting the cervical mucosa and altering the characteristics of the mucus as a result. Salivary crystallization pattern can also serve as a non-invasive and cost effective and easy-to-use cow-side tool for estrus detection

- **Electronic nose (eNose) / Chemo-signals**

Electronic nose which are based on detection of sex pheromones that are secreted by the animal, exclusively during estrus can be used to detect estrus.

- **Estrus specific protein expression**

Estrus-specific protein expression can be considered as a better marker for estrus detection. Expression of more proteins during the estrus phase supports a functional significance during the period to make condition for sperm movement comfortable and facilitate fertilization.

- **Electronic estrus detection- Pedometer/activity tags, Activity tags**

A pedometer is a leg band that electronically transmits signal to a receiver which is often mounted in the milking parlor detecting the physical activity of an animal by sensing no. of steps taken. Pedometer could be even more effective in continuous monitoring compared to traditional ones.

- **Heat expectancy chart/ Breeding record analysis**

Individual animal cards, barn charts, or breeding wheels are used to anticipate the date when an animal is expected to come into heat. Most charts are organized on a 21-day cycle so that future heats can be anticipated.

- **Hormonal treatments**

Hormonal treatments do not require the identification of estrus. Estrus synchronization allows the fixed time AI or improves heat detection efficiency. Gonadotropin releasing hormone (GnRH) and prostaglandin (PGF2α.) are mainly used for estrous synchronization.

- **Bull parading**

Acceptance of male is considered as the most reliable estrus indicator. Teaser/Goomer is a bull that is used for detecting animals in heat by monitoring olfactory and gustatory cues, without being able to fertilize them. To prevent intromission various surgical treatments (penectomy, penis/prepuce deviation, epididymectomy and penile blocked bull or androgenized female) have been attempted so that physical mating could not occur.

- **Temperature**

During the estrus cycle there is a change in body temperature. During the heat day, the temperature is high and during ovulation it drops again. Around the LH-surge during the estrus the rise in body temperature can be detected.

- **Infra-red thermography (IRT)**

IRT is a very helpful technique for identifying these variations in surface temperature linked to animal reproductive physiological events. Infrared thermography, particularly computer-assisted automation of IRT systems, could be useful in generating estrus alerts. Cows in heat require a non-contact, non-stressful method of recognizing cows in heat by detecting temperature features in locations with low body hair coverage, such as the eyes, vulva, and rectum.

Conclusion

The importance of estrous detection in animal husbandry cannot be overstated. Accurate detection allows for timely breeding, which can lead to improved conception rates and better overall herd or flock management. Additionally, it can contribute to more efficient use of resources and better reproductive outcomes. Estrous detection is a crucial aspect of animal agriculture that directly impacts productivity and profitability.