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Techniques for Reproductive Efficiency with Reference to Oestrus Detection and Timing of Insemination in Cattle

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Abstract: Recent studies on the improvement and development of oestrus detection and timing of insemination are reviewed with emphasis on: i. Characteristics of oestrus circle, ii. Factors affecting the intensity and duration of heat, iii. Method of improving efficiency of oestrus detection program, iv. Recognition of oestrus signs such as primary and secondary signs of oestrus, v. oestrus detection aids, vi. Insemination time and vii. Evaluation of heat detection efficiency. In our opinion these procedures help in developing awareness of the physiological changes occurring in the cow and how to control a cow's reproductive cycle to obtain maximum efficiency are described.

Key words: Reproductive efficiency, oestrus detection, insemination, cattle

INTRODUCTION

Many-Techniques for improving reproductive efficiency has been stated by many scientist, semenology and Artificial insemination, Genetic engineering, Ovulation manipulation, *in vitro* fertilization and embryo transfer including preservation and cryopreservation of Gametes and embryos, fertility evaluation and computerized record keeping are effective in practice (David, 1989; Hafez, 1993). For achieving the maximum reproductive efficiency, efficient heat detection management and correct insemination timing are vital and plays a pavital role in reproduction.

Poor fertility performance is a serious, unrecognised cause of reduced efficiency in dairy herds, Many dairy farmers are satisfied with their herds reproductive performance provided the cows have reasonable conception rates and do not show obvious signs of reproductive disease. They fail to realise the delecterious effects that delays to service have on calving intervals and thus on profitability (Peter, 1987). Oestrus is described as the period of increased sexual activity and receptivity in animals (Shearer, 1992). During primary behavioral sign the cow stands still and allows others to mount. The cow is in standing heat (oestrus) due to an increased concentration of oestrogen. As oestrogen in the blood reach to a certain threshold level. Surges of Luteinizing Hormone (LH) are released by the anterior pituitary near the end of standing heat, the matured graaffian follicle ovulates in response to this LH surge (Parker and Mathis, 2002).

Undetected and falsely detected oestrus (standing heat) in cattle result in missed or untimely insemination with consequent losses of income due to:

- Unexploited potential of milk and of calf production caused by prolonged calving intervals.
- Expenditure on excessive replacement of heifers and on infertile insemination.
- Reduced rate of genetic progress (Lehrer, 1992).

The overall objective of this article is to offer the farmer an opportunity to (1) Gain adequate basic and practical knowledge in reproductive management of cattle (2) to achieve optimum reproductive efficiency (3) maximize profitability of dairy operation. Having successfully acquired this, knowledge and awareness, the farmer will be able to define and explain all the terms and vocabulary that pertain to reproductive management, efficiency and performance. This paper will discuss factors affecting efficiency of reproduction in dairy herd and identify reproductive problems in the herd based on production management records. It will also discuss management policy's and practices, how to establish such management practices by which improvement in reproductive performance of a herd may be achieved efficiently, oestrus detection methods, opportunities for insemination and accuracy are discussed.

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For a successful breeding programme accurate heat detection and timing of insemination are the most important component in Artificial Insemination.

CHARACTERISTICS OF THE OESTRUS CYCLE

It is important for livestock managers to understand the morphology, endocrine and secretary changes (Biological rhythms) that occur in the ovaries and the tubular genitalia of the cow during oestrus cycle. The knowledge of these changes is useful in oestrus detection, synchronization, super ovulation and artificial insemination. Earlier, it was thought that several thousands of follicles are present in each ovary of the cow, but only one follicle ovulates per oestrus cycle. The other follicles were said to degenerate and a corpus luteum to develop at the site of ovulation (Jainudeen and Hafez, 1993).

Today using real-time ultrasound technology to monitor ovarian structures on a daily basis, reveals that cows or heifers may have two, three or four groups of follicles that develop during each oestrus cycle (Ribadu and Nakao, 1999). Usually, a single follicle within each group becomes dominant, suppressing the continued growth of the other follicle within that group. Such group of developing follicles are called "waves" of follicular growth. Thus various populations of small, medium and large follicles are present in the ovary each period of the cycle (O' Connor, 1993).

In this studies three waves of growth were demonstrated, with first wave beginning on the third and sixth day, the second starting on the ninth to twelfth and the third wave starting on the fifteenth to eighteenth days of the cycle.

The oestrus cycle is hormonally controlled and for the purposes of understanding may be divided into four phases, oestrus, metoestrus, dioestrus and proestrus. The proestrus and oestrus (follicular phase) periods are primarily under the influence of oestrogen and are associated with growth of the follicle. Metoestrus and dioestrus (luteal phase) are associated with growth of the corpus luteum and are primarily under the influence of progesterone (Parker and Mathis, 2002).

Oestrus-(day-0): The cow is in oestrus (standing heat) due to an increased concentration of oestrogen. As oestrogen levels reach a certain threshold level, the pituitary releases a surge of LH Near the end of standing heat, the matured gra affian follicle ovulates in response to this LH surge.

Metoestrus-(day 1-5): The cells that formerly lined the follicle change and become the luteal cells of the corpus luteum. This change in cell form is caused by hormonal action; primarily the action of LH The corpus, luteum grows rapidly in both size and function. At this stage, numerous follicles may be seen on the ovary (first wave). But by day five, they have began to regress.

Dioestrus-(day 5-19): The corpus luteum continue to develop and typically reaches its maximum growth and function by day 15 or 16. It secrets the hormone progesterone, which inhibits LH releases by the pituitary gland. During this period, the ovaries are relatively inactive except for the functional corpus luteum and no follicle reaches maturity (second wave) and/or ovulate because of high concentrations of progesterone.

In days 16-18: There is increased follicular growth (third wave) and accompanying-oestrogen secretion by the ovary which stimulates prostaglandin secretion by the uterus, causing rapid regression of the corpus luteum. In days 18-19 the corpus luteum is almost non-functional and progesterone release is suppressed, removing the blocking action of the progesterone on LH and Follicular Stimulating Hormone (FSH) of the several follicles that are initially recruited, one becomes dominant by a sarge in rapid growth and activity. As this gra'affian follicle grow, it secrets increasing amounts of oestrogen and the smaller follicles regresses.

Proestrus-(day 19-21): With the increase in oestrogen release by the gra'afian follicle and a corresponding decrease in progesterone by the regressing corpus luteum, oestrus or heat will occur (cycle has now return to day 0).

The timing given for the preceding events is only approximate and differs for different cycle lengths. Also the discussion of events that occur during the oestrus cycle is based on a full cycle in which pregnancy does not occur. If the egg is fertilized and begins developing in the uterus, the corpus luteum does not regress but continues to function and secrete progesterone. During pregnancy, no follicles develop to maturity and heat does not normally occur, increase and concentration of the progesterone promote uterine quiescence, providing the most favourable condition for the developing foetus (Parker and Mathias, 2002).

APPOINT SOMEONE RESPONSIBLE

Maintaining a twelve months calving interval depends on good heat detection and correct timing of insemination. Oestrus detection should be made a higher priority item in a herd. Someone should be assigned, responsible for heat detection, be it yourself, a family member or an employee and backup person should be named who should be aware of the responsibilities to take up in that person's absence. This person should be educated on the important benefits of heat detection programme.

IMPROVING HEAT DETECTION METHOD

Cow identification: All cows and heifers should be clearly identified. Ear-tags, neck chains, branding or ankle bands are among the most commonly used methods. Be sure such identification can be read at a distance.

Frequency of observation: Since the average time in standing heat is about 15-18 h long (O' Connor, 1993). 25% of the cows stand to be ridden for less than 8 h. Others may stand 24 to 30 h. Therefore, if cows are observed once a day you may only expect to catch 50% of your cows in heat. Twice a day observation at 11 to 13 h interval will allow you to catch about 80% of the heat, while three or four times intense 30 min to one hour period will result in observing better than 95% of the animals in standing oestrus.

Factors that affect intensity and duration of heat: There are so many variables including diseases, weather, fear, extremely warm to humid or extremely cold days, slick or smooth surface, poor body condition, lost of considerable weight during calving, poor footing, feet and leg problems cow density, accidental rubbing of mount detectors, confinement in pen and cows in heat mounting other cows. Others are observations of oestrus sign during feeding, milking or clearing of the barn. During this active time, cows are busy eating, waiting for relief or dodging the manure scraper impairing intensity and duration of heat.

The best time of oestrus observation therefore are:

- First thing in the morning between 5-6 am before milking and feeding.
- Afternoon before milking
- Late in the evening after milking when animals finished eating

FACILITIES FOR OESTRUS DETECTION

Adequate facilities for heat detection are varied across the country. A small two to three-acre lost near the barn may be adequate. Basically the area should be large enough for the animals to mingle freely, but small enough so that all animals can be watched at once. Provide good footing so that animals won't slip on rainy days. Perhaps a sheltered area for the person doing the watching will be an incentive to cheek for heat during bad weather. A groove of trees or some sort of shade will keep mid afternoon temperatures a bit lower than direct sunlight. Cows express oestrus better under cooler conditions (O' Connor, 1993).

MANAGEMENT PRACTICES THAT MAY AID IN IMPROVING THE EFFICIENCY OF OESTROUS DETECTION

- Allow cows to ineract, especially during the evening and early morning hours, when most of the mounting activities occur. Even though loose housing systems provide more time for cow interaction, be sure to observe the cattle frequently. Move pastured cattle to an area where they can easily be observed. In conventional housing systems, turn cows out twice daily for 20 to 30 min.
- Be sure to turn cows out when time can be spent observing them. Avoid scheduling observation period at feeding time or during the warmest hours in dry season.
- Slippery and muddy conditions severely inhibit mounting activity. Provide an area with a good footing surface where cattle are free to interact and where few obstacles hinder movement. Moving cattle to a separate area for heat detection may stimulate oestrus behaviour.
- When cows have sore feet and legs, heat detection is more difficult. Minimize this problem by trimming hoofs periodically and treat infected feet as soon as a problem is apparent.
- When several people are working with the herd, assign one person to be responsible for heat detection and allow time for employees to do the job properly. Train employees to recognize signs of heat and promptly report this information to the responsible person. Consider having a financial incentive program to increase heat detection efficiency.
- Studies have shown that up to 15% of the cattle presented for insemination are really not in heat (Kiddy, 1979; Lehrer, 1992). Poor cow identification can be one cause of this problem. Legible neck chain numbers, large ear tags and freeze brands can aid accurate identification and can reduce mistakes.
- Record all heats, whether the animal is to be inseminated or not. Heat detection will improve if future heats can be anticipated. Use a pocket notebook to record heats and other information. Transfer information to a heat expectancy chart and to the permanent individual cow record, this permit monitoring of abnormally long cycles and long oestrus intervals from freshening to first service.

- Consider using heat detection aids to help increase the number of oestrus detected. Detection devices and detector animals should be supplemented with routine visual observation.
- In large herds the use of androgenised heifer will stimulate more mounting and probably will be cost effective.
- Using prostaglandin to induce oestrus in one or two cows will increase the overall oestrus behaviour in the herd.
- Oestrus synchronization programs for the lactating herd will results in programmed breeding.
- Isolate the cows suspected to be in oestrus as oestrus may not be detected in some cows if in a large group but when isolated a cow possibly in oestrus may exhibit standing behaviour to an androgenised cow or teaser bull.
- Watch for sexually active groups of cattle. Cows in proestrus or oestrus tend to congregate and stay together.
- Adjust the feeding program so that cows calve in proper body condition and weight loss is minimized during lactation.

RECOGNIZE HEAT SIGNS

Primary heat sign: There are great variations amongst individual cattle in the intensity of heat signs, the manifestation tends to be more marked in heifer' than in cows. However, it is generally agreed that the most reliable criterion that a cow or heifer is in oestrus is that she will stand to be mounted by another (Foote, 1975). This sign determines time of insemination since ovulation occurs 25 to 30 h after an animals first stands to be ridden. This period last for an average of 18 h (O' Connor, 1993; Walker *et al*., 1996).

Secondary heat sign: Secondary signs of heat may be an indication that:

- The animal is in standing heat
- The animal may soon display standing heat
- Has already gone out of heat

Since the degree of these secondary signs varies in length and intensity, they are unreliable as keys to when the animals should be inseminated. O' Onnor (1993); Noaks *et al*. (1996) detailed the above as follows:

(I) Advanced signs that an animal may display as much as 48 h before standing heat include (proestrus period):

- Attempting to mount animals not in heat
- Chin resting and back rubbing
- The animal will begin walking fences (restlessness)
- Start bellowing and become nervous
- This cow lick other cows vulva
- Little clear mucos discharge and red swollen vulva
- Sniffing the genitalia and licking the vulva of other cows
- Head raising and lip curling (Flehmann lip curling)
- Frequent urination

(II) Signs that the animals is in standing heat (oestrus period)

- The hair on here tail head becomes ruffled
- Her flanks will become dirty form other cows hooves
- Saliva from their mouths will be on her back
- Large amount of mucous discharge may stream from here vulva
- She spend less time eating
- There is an increase in body temperature

(III) Signs that the animal is out of oestrus (metoesturs period). As an animals goes out of heat.

- She may stand to be ridden for a few seconds and then scoot out from beneath the riding individual
- She may butt heads with other animals as she goes out of heat
- Her vulva returns to light pink colour and become dry and wrinkled
- A bloody discharge may be seen coming out from here vulva one to three days after standing heat

OESTRUS DETECTION AIDS THAT HELP IN DIFFICULT CASES

By allowing adequate time for heat detection, most cows and heifers will be seen when they show signs of heat. However, certain individuals will not or cannot stand to be mounted while in heat. Others stand for such a short time that you miss them. Visual observation therefore is not a prefect method for selecting cows in oestrus that are in this condition.

Several aids have been developed to maintain 24 h surveillance (Foote, 1975), so as to circumvent some of these constraints and improve on the efficiency of detecting oestrus (Ball *et al*., 1983). Efforts have been made for such aids to be simple, reliable, accurate, consistent, inexpensive and easy to interpret. Now following are practiced.

Tail paint: Tail pain has been shown to be an effective oestrus detection aid and for practical breeding management (Ducker, 1983). It increases oestrus efficiency (Senger, 1994). Tail paint was originally developed as an oestrus detection aid for use in dairy herds managed using grazing based systems (Macmillan and Curnow, 1977). Tail paint is applied in a strip 5 cm wide be 20 cm long over the coccygeal vertebrae of the tail head. Once dried, the paint hardens and, according to the manufacturer, remains intact for up to six weeks unless removed by mounting activity of a heard mate during standing oestrus. Removal of tail paint alerts the herd manger of the occurrence of mounting activity associated with oestrus.

Fricke (2003) described the details of oestrus activity. Tail Paint is available in four colours: red, green, blue and yellow. These four colors have been incorporated into the Detail Management System (FIL Industries Ltd.) for use in managing reproduction in grazing based diary system. Briefly, all cows receive red paint at calving. Removal of red paint before the breeding period is used as an indication that the cow has resumed cyclicity, whereas retention of tail paint during this period is an indication of anoestrus. At the onset of the breeding period, all cows relieve green tail paint. Removal of green paint is an indication that a cow is in oestrus and should receive an AI service. At the first AI service of the breeding period, blue paint is applied. Cows that fail to conceive to first AI are identified by removal of blue paint. All cows requiring a second or greater AI service receive yellow paint.

Heat mount detectors: Senger (1994) strongly recommended the use of pressure activated heat mount detectors for increasing oestrus detection efficiency. These devices are affixed to the tail head of individual cows and are activated by direct pressure from a herd mate during mounting events. Commercially available devices include Kamar heat detection patches and Bovine Beacon. These devices are also supported by Macmillan *et al.* (1979). Gwanxdauskas *et al.* (1990). Lehrer (1992) and Mai *et al.* (2002). Although false positives can occur, these devices are generally useful as oestrus detection aids. Although primary and secondary indicators of behavioral oestrus are the best methods for determining timing of AI, breeding to an activated kamar device can yield acceptable results (Nebel *et al.*, 1993).

Teaser bull or androgenised marker animals: Teaser bull (vasectomies bull, pen-o-blocked bull, penis diverticula's) or and rogenized marker cow (Kiddy, 1979; Elmor *et al.*, 1986; Mortimer *et al.*, 1990; Lehrer *et al.*, 1992; Mar, 2002; Fricke, 2004) with a Chin-ball mating device are also have been shown to improve both oestrus detection efficiency as well as the accuracy of oestrus. Fricke (2004) stated that the use of synovex-H (Sybtex laboratories, Inc., Palo Alto, CA) is a convenient method for androgenizing marker animals.

Heat watch or video recording: Surface applied or implantable pressure sensors also have shown promise for providing accurate daily oestrus detection (Senger, 1994). For example, the Heat Watch O system (DDx Technology) provides continuous information on mounting activity when Heat Watch O was compared with visual oestrus detection (Nebel *et al.*, 1997) efficiency of oestrus detection was greater with Heat Watch O (91% vs. 51%) with similar accuracy (96% vs. 94%). Because these type of mounting detectors require physical interaction among cows, the best results are achieved when cows are house in groups, such as in free stalls, pastures, or lots, compared with cows housed in stanchions or tie-stalls or in poor environmental conditions.

Pedometers: Oestrus behaviour in dairy cattle is accompanied by an increase in physical activity. Kiddy (1977) was the first to use leg mounted pedometers to determine if physical activity related to oestrus varied enough compared with nonoestrual activity to be useful method for oestrus detection in dairy cattle and concluded that pedometers may be a useful method for oestrus detection in dairy operations. Pedometer computer technology improvements coupled with increases in computer software analysis programs have resulted in greatly improved pedometry system (Koelsch *et al.*, 1994; Senger, 1994). Comparison among various statistical comparison procedures that use pedometery data in lactating dairy cows indicate that 70% of oestrus period and 99% of non-oestrual periods can be accurately predicted using currently available pedometry systems.

Vaginal Mucus Electrical Resistance Measurement (Vmer): The use of Vaginal Muscus Electrical Resistance (VMER) measurement in the genital tissues of animals has previously been reported (Mshelia and Amin, 2000; Kitwood *et al.*, 1993; Smith *et al.*, 1989; Feldman *et al.*, 1978). Alzinbudus and Doviljtis in 1993 were the first to report that the electrical resistance in the vagina of cow measured with electrodes inserted in to the vagina lumen, changes in a pattern corresponding to the estrus cycle, with the highest values occurring during diestrus and the lowest value during estrus (Feldman *et al.*, 1978). Othere workers as cited by Feldman *et al.* (1978), later confirmed this finding, Carnfield and Butler, 1988 reported that monitoring changes in the vaginal electrical resistance in association with follicular development during proestrurs provide an alternative for visual detection of estrus in cattle. Subsequent workers (Smith *et al.*, 1989; Kitwood *et al.*, 1993) evaluated the efficacy of the use of VMER to detect estrus in the cow; and proffered that its use may not significantly alter the herdman observation and would increase the cost of labour. This may therefore be the reason why the use of VMER in the cow is not widely practices on a commercial scale. However, despite all the misgiving in the use of VMER for heat detection in the cow, it is being advocated by Smith *et al.* (1989); that the use of reproductive tissue impedometry with telemetric sensors implanted in the genital tissue of the cow could be a highly effective automated electronic method of estrus detection the cow.

The use of transrectal ultrasonography: The use of transrectal ultrasonography for early pregnancy diagnosis has the potential to improve reproductive efficiency within a herd by reducing the period from A1 to pregnancy diagnosis to 26 to 28 days with a high degree of diagnostic accuracy (Pierson and Ginther, 1984). Furthermore, use of ultrasound could minimize embryonic loss that may occur after manipulation of the reproductive tract and conceptus during pregnancy diagnosis using rectal palpation (Paisley *et al.*, 1978; Vaillancourt *el al.*, 1979).

Intra-vaginal progesterone releasing devices (PRID and CIDR): The development of controlled intra-vaginal progesterone releasing devices such as the PRID (progesterone-releasing intra-vaginal device; DEC-InterAg, Hamilton, New Zealand) allowed the development of long-term hormonal treatments, which minimized the requirement for repeated handling of animals and circumvented delivery problems associated with the feeding of oral progestogens or injecting progesterone (Garcia-Winder *et al.*, 1987; Geary *et al.*, 1998).

Use of PRID and HCG: Moreira *et al.* (2001) reported that in combined use of norgestomet implants and HCG in suckled beef cows when implant were removed 53% of cows were in induced oestrus cycles compared with 0% of cows that did not receive implants.

Use of PRID and oestradiol: Many researchers have demonstrated that oestradiol stimulates ovulation and expression of oestrus following progesterone treatment and reduced the interval to inception, compared with untreated controls (Burke *et al.*, 2000; Burke *et al.*, 2001). However, variable results were demonstrated in resumption of oestrus and conception rate in cows treated with progesterone (PRID, CIDR, implants or oral use) alone or in combination with estradiol (Ulberg and Lindley, 1960; Saiduddin *et al.*, 1968; Brown *et al.*, 1972; Miksch, 1978; Fike *et al.*, 1997; Taufa *et al.*, 1997; Rheoles *et al.*, 1998a; Rhodes *et al.*, 1998c; Verkerkre *et al.*, 1998; Hanlon *et al.*, 2000; Xu *et al.*, 2000; Mcdougall; 2001; Rhodes *et al.*, 2001b; Rgides *et al.*, 2002).

Use of PRID, GnRH analogues and $PGF_2\alpha$: Use of PRID may be combined with GnRH analogues for the additional effect of inducing ovulation and the formation of a corpus luteum (XU *et al.*, 2001a). They further stated that following progesterone device removal, $PGF_2\alpha$, is generally injected to ensure oestrus in cows. In another study they further reported higher conception rates to first insemination and interval to conception decreased by inclusion of GnRH (Lamb *et al.*, 2001). The use of GnRH agonist at the commencement of progesterone treatment and PGF 2a, at the end, produce good responses in anestrous beef and dairy cattle (Stevenson *et al.*, 2000; Xu *et al.*, 2000).

Use of GnRH analogues with PGF $_2\alpha$: The capacity of GnRh analogues to induce ovulation during the postpartum anovulatory anestrous period, as described above, has been used in program in combination with $PGF_2\alpha$, to initiate resumption of oestrus cycle, without the requirement for exogenous progesterone treatments. A protocol developed for use in dairy cows that have resumed estrous cycles involves the sequential injection of GnRH, $PGF_2\alpha$ and GnRH at intervals of 7 and 2 or 2.5 d, respectively, with all treated cows being inseminated 16 to 24 h after the final injection of GnRH, wihout oestrous detection ('Ovsynch' or 'Intercept' (Stevension *et al.*,, 1996; Geary *et al.*, 1998; Lammonglia *et al.,* 1998; Rivera *et al.*, 1998; Peters, *et al.*, 1999).

INSEMINATION TIME

There are new tests and equipment that allow one to electronically determine when a cow was first mounted or identify increased movement or identity that could be associated with heat. Blood profiles can also be used to identify hormonal changes related to animals coming into heat. In addition the use of ultrasound technology has been an excellent tool for determining the time of ovulation.

Proper timing of insemination results in a large number of healthy sperm being available to fertilize the egg soon after its release. By insemination too early in the heat period, many sperm cells will die by the time the cows ovulate. By inseminating too late, the egg will have aged, deteriorated or died before the sperm reaches the site of fertilization.

For best conception results many researcher recommend insemination of cows and heifers 12 h after they are first seen in standing heat.

HERE ARE SOME FINDING

- There is rather even distribution throughout the day as to when the onset of oestrus is first detected (Nebel *et al*., 2000).
- The average time that the cows stand for mounting is 7.1+5.4 h (Dransfield *et al*., 1998).
- The average number of time a cow in hear was mounted was 8.54+6.6 (Dransfield *et al*., 1998).
- Ovulation occurs at 27.6+5.4 hour after the first mount (O'Connor, 1993; Walker *et al*., 1996).
- Semen is generally thought to be capable of fertilization for at least 18-24 h after insemination (O'Conner, 1993).
- Standing heat last for 15-18 h (O'Conner, 1993).
- Fertile life of egg is 10-20 h (most fertile period 8-10 h) (O'Conner, 1993)

From the available information, it is evident that oestrus in cattle is a random event therefore cows come into heat at any hour of the day. They indicates that cows ovulate between 17 and 38 h (Average 27 h) after the start of standing to be mounted. Therefore cattle should be inseminated during the last half of standing heat. Voh. 1994 recommend a guide for cows first seen in standing heat in the morning (am) would be inseminated in the afternoon (pm) and those observed standing in the evening will be bred the next morning. This system need frequent observation (at least 4 times a day) and cows are allowed to interact and exhibited mounting/standing hebaviour. Furthermore, insemination are based on standing heat, not secondary signe (O' Conner, 1993; Voh, 1994; Mai, 2002;).

EVALUATION OF HEATDETECTION EFFICIENCY

For continuously improving in herd reproductive efficiency, it is useful periodically to compare the herd's heat detection efficiency with specific, realistic management goals. Complete and accurate records including all heat, services and veterinary examination findings are needed to calculate heat detection efficiency. Some dairy processing centers and herd management computer programs provide a heat detection. Due to inaccurate heat detection many cattle may be inseminated those are not in true oestrus. Inefficient heat detection may result in many unobserved or missed heats. Many reproductive problem may also occur in herds those experience both inaccurate and inefficient heat detection (O'Connor, 1993; 1998).

(I) Characteristics of herds with heat detection errors

- Oestrous intervals between 3 and 17 days exceed 10%
- Oestrous intervals between 25 and 35 days exceed 10 to 15%
- Cows inseminated one day and again within three-days exceed 5%
- Several cows are checked pregnant to a service earlier than the last one recorded.
- Several cows calve normally three to six weeks before the expected calving date

(II) Characteristics of herds with missed heats

- Very few heat are observed and recorded before first service.
- Average days to first service exceed 80 days when voluntary waiting period to first service is 60 days.
- Average interval between breeding exceed 30 days.
- Oestrus intervals between 38-45 and 55-65 days exceed 15%.

(III) Oestrous detection goals:

- Eighty five percent of the cattle are detected in oestrus by 60 days postpartum
- Days to first service are 75
- Sixty percent of oestrous intervals are between 18 and 24 days
- Ratio of the number of 18-24 to 36-48 days oestrous intervals exceeds 4:1.
- At least 70% of the heats are detected.

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