Estrus Detection and Estrus Detection Aids

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Summary

There is no substitute for good management. Each animal should be identified carefully. The herdsman should know all signs of estrus or impending estrus. In addition, for visual detection of estrus to be highly effective, sufficient time must be taken at least twice a day to catch animals with a short estrus period. Presently there are two visual aids to estrus detection which provide potential 24-h surveillance. One aid is a pressure sensitive device mounted on the back of each cow which can be triggered when the cow stands for mounting. The second one is a marking device worn by sexually aggressive animals which will stripe with colored ink the back of estrous animals as the marker animal mounts and dismounts. Both devices are effective when used properly. Other tests of changes in cervical mucus, vaginal characteristics, temperature, blood flow, and hormone changes in blood and milk are either not sufficiently reliable or else simple enough yet to be practical aids for routine detection of estrus in dairy cattle. Milk progesterone can assist in characterizing problem cows.

Introduction

Accurate estrus detection is a key to efficient reproduction and to high milk production. The goal of a good estrus detection program is to identify estrus positively and accurately in all cycling animals and consequently to identify the animals not cycling. There are many changes which take place during the estrous cycle of a heifer or cow (14), but many of these changes are highly variable among animals and are impractical to measure routinely. This discussion will emphasize several manifestations of estrus which either might be measured relatively simply and directly, or measured with estrus detection aids. Some consideration will be given to the influence of different physiological states and management conditions upon the difficulty of detecting estrus. No attention will be given here to optimum breeding programs. This is either the topic of other speakers, or it recently has been reviewed (25, 35), or may be unknown. Proper detection of estrus is essential in any planned breeding program using hand mating, especially to capitalize on superior sires available through artificial insemination. Otherwise, the cow will not have a chance to become pregnant and produce milk and offspring.

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Identification and Recording

The animal must have positive identification such as a brand, semi-permanent painted number, neck chain, or a large ear tag. With large operations the individual often cannot identify the animal by its appearance, particularly if the animal is partially obscured. Neck chains, while reliable, are difficult to see in a group of animals. This may lead to faulty records due to guesswork in recording the number. The best system, in my opinion, is the use of large clear brands or numbers painted as high as possible on both sides of the animal. A neck chain or mark on the flank is helpful in the milking parlor. A high vantage point, binoculars, and good lighting (including a flashlight) are all helpful in surveying a large group of cows or heifers for estrus. A convenient system of recording numbers on the spot, such as in a small pocket notebook, is a must. The numbers then can be quickly entered into the permanent records and on the barn chart or breeding wheel.

The Problem of Estrus Detection

The best single criterion that a cow is in estrus is to see her stand when mounted by another animal. Not all cycling animals show this clearcut behavioral sign of estrus. Some may bawl, be restless, or show other secondary signs of estrus that only an astute observer will detect. Particularly shortly after calving many "silent heats" occur (12, 32, 49, 53). Morrow (32) palpated cows regularly and compared findings with visually detected estrus (Table 1). The first ovulation after calving usually was a "silent" one, but by 60 days postpartum most of the animals had ovulated two to three times, and 64% had been observed in estrus, similar to observations by Trimberger and Fincher (49). By 90 days 93% of the cows had been seen in standing heat. A summary of 14 studies (12) yielded an average of first ovula-

TABLE 1. Postpartum intervals to estrus and ovulation [32].

Ovulation after calving	Cows in estrus, %		Days elapsed	
	Standing	Silent	Normal cows	Abnormal cows[a]
1st	23	77	15	34
2nd	46	54	32	55
3rd	64	36	53	76

[a] Cows with dystocia, milk fever, ketosis, and other problems within the 1st wk after calving.

tion at 39 days postpartum and first estrus at 55 days postpartum.

Ovulation and estrus occur later after parturition in high producing cows than in low producers (29, 32). Data from Marion and Gier (29) are in Table 2. Thus, if high milk production is associated with a delay in estrus, it becomes even more important to detect each estrus in time to breed cows for calving about once per year.

With high producing cows it is difficult to maintain high feed intake and a positive nutritional balance. The detrimental effect of a negative nutritional balance is shown in Table 3 for beef cattle. Estrus was more severely delayed and conception rates depressed by low feeding in cows than in heifers, presumably due to the lactational stress on nursing mothers. Duration of estrus also may be decreased by low feed intake.

Visual Detection of Estrus

While some cows may not cycle in time to breed for a 12 to 13 mo calving interval, the major problem appears to be primarily one of sharpening tools for detecting estrus rather than a problem of inducing it. Zemjanis et al. (53) found that about 90% of the cows reported by dairymen as being anestrus were cycling. So it is worth reviewing signs of estrus. Most importantly an animal in estrus stands when mounted, and the hair over the rump may be ruffled. Other signs are (a) the cow is restless, noisy, and walks along fences; (b) cow stands up when others are lying down; (c) cow nudges, sniffs, and mounts others; (d) cow raises her tail when contacted by others; (e) vulva is pink and swollen; (f) there may be a clear mucus discharge from the vulva; (g) appetite and milk production decrease. Discussions of symptoms of estrus are available (21, 52, 53). Not all dairymen are good observers, especially of the subtle indications of oncoming estrus. These are especially important, along with records of preceding heat dates, to predict when estrus will occur. Zemjanis et al. (53) found that records, along with palpation to predict the next estrus for the dairyman, was the most successful treatment for anestrus (78.5% of 522 cases came into estrus within 23 days and 69.1% conceived).

TABLE 2. Effect of milk production on estrus and ovulation [29].

Milk production (kg/day)	Days after parturition to	
	First ovulation	First estrus
< 22	13.1	28.4
22 – 30	14.0	33.1
> 30	15.5	36.9

TABLE 3. Feeding, estrus, and fertility in beef cattle [5].

Trait		Feeding[a]			
		Low low	Low high	High low	High high
Showing estrus after calving, %					
Heifers	60 days	49	39	65	62
	90 days	83	93	81	95
Cows	60 days	17	45	81	80
	90 days	22	85	86	85
Conceived to 1st service, %					
Heifers		51	71	42	62
Cows		33	65	42	67

[a] The heifers were fed 2 kg TDN (low) or 3.7 kg TDN (high) the last 140 days of gestation, and then further subdivided into low and high groups following calving. Pregnant cows were wintered on 2 kg TDN (low) or 4.1 kg TDN (high). After calving 3.6 kg TDN was low; 7.3 kg TDN was high.

In herds enrolled in Dairy Herd Improvement Associations a sheet listing all cows fresh for 30 days or more might be helpful to emphasize the need to start checking for estrus before it is time to breed at 60 days postpartum. Some animals missed may be detected as having been in estrus 1 to 2 days previously from metestrus bleeding (often seen as a red mucus discharge on the tail). With this recorded the next estrus can be predicted and surveillance concentrated on such animals starting about 18 to 19 days hence.

Donaldson (8) reported that heat checks for 1 h at 0700, 1500, and 2300 detected 90% of the animals found in estrus with 24-h surveillance. Detection at 0630 and 1530 was 89% as efficient as continuous observation. Delaying the early morning estrus check reduced the efficiency. Beerwinkle (3) found that dawn and dusk checks were 94% as efficient for beef cattle as thrice/day checks. In one unpublished

study we found 67% of the dairy cows were in estrus in the morning. At the evening check 45% were no longer in estrus. So the way total time spent observing animals is divided throughout the day is important.

The present trend toward larger herds and efficient feeding arrangements minimizes the contact between cow and herdsman. Time must be set aside for this important task of estrus detection. In loose housing the dairyman is kidding himself if he thinks that he can detect heats effectively simply by glancing at the cows as they come into the holding area or through the milking parlor at milking time. He must set aside 20 to 30 min the first thing in the morning as cows get up, and do the same thing again late in the day, or after all but those in heat go to bed at night. The job may be boring, but it is vital. In stanchion barns similar watching of the animals as they are turned out twice daily (at least those needing estrus checks) should be practiced.

Also, there are successful dairymen who seldom turn cows out all winter and rely on secondary symptoms to detect estrus. They keep good records and are careful observers. In summary, successful estrus detection requires:

1) Ability to recognize multiple symptoms of estrus and symptoms associated with forthcoming estrus.

2) Sufficient time to observe all animals. A dairyman simply cannot do this job properly while doing anything else.

3) Checking for estrus at least two times per day to avoid missing short heats. While estrus normally lasts 15 to 18 h, it may be as short as 6 h, particularly under unfavorable hot environmental conditions (13, 48).

Nonvisual Changes During Estrus

There are many changes in cervico-vaginal mucus associated with estrus (23, 27, 34, 39, 52). Mucus becomes less viscous, crystallization patterns shift as NaCl content increases (39), electrical resistance (22, 31, 36, 42, 46) and dry matter content of mucus decreases, and there may be a decrease in vaginal pH (34, 43, 54). Penetration of cervical mucus by spermatozoa is affected (44). Temperature increases slightly at the onset of estrus and declines more precipitously before ovulation. Blood flow increases (1). There is slight cyclical variation in vaginal cytology (14). Peroxidase declines (27). Hormonal changes in peripheral blood have been reviewed recently (15). Milk reflects circulating hormone concentrations (16, 18). Estrual changes to be useful in detecting estrus must be reliable, consistent, and easy to measure.

Visual Aids for Estrus Detection

There is no substitute for the eye of the skilled observer and manager who observes his cattle for estrus. With good dawn and dusk checks he can detect about 90% of the heats. Visual aids are not substitutes which will overcome bad management. In fact, visual aids used poorly will be costly and yield poor results. At the same time, in the hands of a skilled manager they may be a useful adjunct to the estrus detection program, especially where time and space may make direct visual detection inconvenient and costly. Detection aids may serve as training aids also when inexperienced persons need confirmation of their suspicions that an animal is in behavioral estrus.

Video tape. Video tape recorders playing for brief periods when estrus checking is inconvenient may extend the period of visual observations. These can be played back at convenient times. This system would not likely save time and may be mainly of research value.

Detectors on cows. A device on a cow which records that she has been mounted with sufficient force and duration to indicate that she stood for the mounting can be a help. This (a) potentially provides a 24-h per day continuous checking; (b) when placed on the top of the cow changes can be seen from a distance; (c) the device can be triggered at an unseen point in time and place, but the mark is preserved until animal identity is established. The most widely used device of this type is the KaMaR Heatmount Detector (2, 3, 9, 17, 25, 41). In an early test Baker (2) found 72 out of 80 heifers were positive with 8 losing the detectors, and 4 of the 72 were false positives as judged by rectal palpation. Visual observations for 15 min every 3 h from 0700 to 1800 missed 26 heifers, including some that went into and out of estrus at night. Similar findings were reported by Boyd and Hignett (7). Beerwinkle (3) found that 30% of 152 KaMaR detectors applied to wet animals were lost. All but 6% of the remainder were triggered the day before estrus (31%) or the day of estrus (33%).

We have found the KaMaR Detectors quite useful as long as they are properly placed and replaced. It does take time to do this, and simple gate-chute or stanchion arrangements save time. The need to replace lost detectors can be reduced by thoroughly gluing them and being sure that there are no supports against which

the animal can rub the top of its rump. Do not clip the hair. When replacing a detector, clip the red plastic off the canvas base with a pocket knife and glue a new detector over the old base.

It helps to have an aggressive cow in the herd to mount others in heat. Also, this may stimulate cows with a weak estrus to show stronger signs. We have stood for 1 h and seen nothing in estrus. When we have added a new animal, particularly a sexually aggressive one, sexual activity often started almost immediately. Under these conditions many dairymen report that the detectors reduce the time required visually to observe cows in heat, and some are caught that otherwise would be missed.

Williamson et al. (51) observed a herd of 107 dairy cows (30 or more days postpartum) continuously 24 h per day for 21 days in a 2.2 to 2.5 ha paddock. Observation towers and spotlights were used at night. Cows were palpated weekly. The herdsman and two trained observers (one in the milking shed and one in the holding area to look for heats at the time of milking) were compared. Results are in Table 4.

The KaMaR Detector was the most efficient method, although it also has drawbacks besides cash expense for the detectors. Some detectors are lost by rubbing or licking (25% lost in this study), and others are falsely triggered either partly or fully. Lost detectors in a good housing arrangement usually mean they are rubbed off during estrus and should be considered positive. Falsely triggered ones usually mean they were mounted too far back on a small animal or there are overhead obstructions to rub against. Partly triggered ones often result from animals caught in the feed bunk and ridden several times by another one in estrus. A small heifer may have a device fully triggered. The frequency of partly triggered devices can be reduced if animals in estrus are removed. Leave a partly triggered detector on another day. If it is still partly triggered the next day, it was probably an accident and should be replaced. With crowding, false triggering is more frequent. If the animal is coming into estrus, the device will be triggered fully the next day. Again, leave the device on 1 more day before changing it so as not to waste detectors. Either glue a new one over the old base with the plastic bubble sliced off, or if this is a third detector, peel the second one off and glue the new one to the original base.

TABLE 4. KaMaR detectors for checking estrus in cows [51].

Method used (21-day period)	Cows detected (%)
Watched 24 h/day	89
KaMaR detector	98[a]
Herdsman	56[a]
Two trained dairymen	56[a]

[a] Percent of cycling cows detected.

Some dairymen use detectors only on cows not seen in estrus by about 50 days. Others may use them as the major method of estrus detection in a program somewhat as follows:

1) Select animals fresh 30 to 40 days;
2) Mount detector in proper location;
3) Use plenty of glue. Don't clip hair;
4) Put brightly colored tape on tail of cows to observe;
5) Record heats when detector is all red;
6) Change red detectors; replace lost ones;
7) Breed at proper time.

These detectors catch cows and heifers in estrus.

Another system that can work is marking the tail head of each animal with orange crayon each morning. Any cow showing a smudged or erased mark the next morning probably has been in estrus.

Olds (33) is developing a transmitter attached to a device mounted somewhat as the KaMaR Heatmount Detector. Signals for each cow could be transmitted to a central receiver and identified.

Chin ball mating device. This device (24) combines a colored marker with, hopefully, a sexually aggressive animal wearing the device to help stimulate as well as to find those cows with weak symptoms of estrus. The extent to which the presence of a bull or other sexually active animal may increase the intensity of estrus in cows, if at all, is not known. Mating or stimulation of the reproductive organs will hasten ovulation in the cow (30, 37). In sheep, rams and their odors may synchronize ewes (19).

The device is a halter with a built-in ball point pen that rolls a band of paint on the back of a cow in heat mounted by the wearer of the halter (24). The line is important. Spots from chin resting are not indicative of estrus, although such a spotted cow may be coming into estrus. A cystic cow can use the halter, but we found such cows variable and unreliable checkers. Surgically prepared bulls or selected active steers with implants are better. The ink reservoir holds enough ink to last about 1 wk.

Ink color should be chosen to show clearly. Bulls circulate among the herd and select those in heat for marking. The effectiveness depends primarily on having a sexually active bull and keeping ink in the reservoir. Some bulls waste a lot of ink in remounting one female. Thus, they may run out of ink and miss other females. Removing females in estrus after marking reduces overmarking.

There are many ways of preparing bulls so that they cannot copulate and spread venereal disease. These are amputation of the penis either posterior to the scrotum (26, 47) or anterior to the scrotum (10). The penis can be deflected and the prepuce relocated (20, 38, 50). The penis can be anchored either posterior (11) or anterior to the scrotum (4), or the prepuce can be obstructed (6). A device on the market called "Pen-O-Block" (5009 Vernon Road, Tallahassee, FL) can be installed easily in the sheath, but it may have complications.

Many bulls have been prepared by each technique successfully. The first three procedures require the most surgery and several weeks for the bull to heal prior to use. We find that deviating the penis in calves is fast and easy. Bleeding is occasional with penectomy. Preputial obstruction, especially with the "Pen-O-Block", is simple to perform, and the bull can be used for estrus detection almost immediately. Some bulls lose libido and about 1/3 develop complications. However, the block is reversible. Bulls that fail to work or other bulls no longer needed can have the obstruction removed. They can be used as cleanup bulls, especially in a beef cattle operation, or be sold.

In an experiment at Cornell with 32 virgin heifers deviated bulls were effective in detecting most heifers in estrus. Three different systems were compared for 21 days each. One system was a visual check by the herdsman for about 30 min at 0800 and 1700. The second system was visual observation plus two bulls with Chin Balls turned into a yard for 1 h each time at 0600 and 1800. Finally, animals were grazed on pasture with two bulls continuously. The bulls had different colored ink so that possible bull preferences and differences in libido could be determined. There were differences among bulls in mounting activity, but in general all marked cows were marked by both bulls with this low ratio of marker bulls to heifers. Bulls were effective in detecting estrus as shown in Table 5. Steers with testosterone implants can be used, particularly if they are naturally active. We observed as much individual variability among bulls as among implanted steers.

TABLE 5. Use of bulls with a chin ball for detecting estrus in dairy heifers.[a]

Method used (21-day period)	Detected in heat (%)
Visually 2 ×/day	72
Marked by bull, 2 ×/day	87
Seen by persons but not marked by bull	13
Exposed to bulls on pasture continuously[b]	80

[a] McDonald and Foote, unpublished data, Cornell University, 1973.

[b] Out of ink 1 to 2 days.

We have had Chin Balls on cystic cows and on deviated bulls in dairymen's herds. The bulls have been the most reliable estrus checkers. In one herd with loose housing where the dairyman kept especially good records and inseminated the cows himself, the bull marked 59 out of 115 cows before the dairyman spotted them. This is partly due to the fact that at times when the dairyman was extremely busy with outside work he relied on the marker bull. At the same time this bull may have been overworked, and the dairyman recorded 33 cows in estrus that the bull did not mark. Cows marked by the bull appeared to conceive at a slightly higher rate following insemination (64% pregnant) than those only observed by the dairyman (45%). Does this mean that a few of the latter animals in the large loose housing area may have been misidentified as being in estrus? Of course, the marked animals can be seen at any time and their numbers checked. The color does not fade for several days.

Beerwinkle (3) conducted an extensive study with penectomized bulls equipped with Chin Ball markers for detecting estrus in beef cows kept in pastures ranging in size from 65 to 129 ha with up to .4 animal per ha. Cows were visually checked daily at 12-h intervals. About 3 h were required for each check. Table 6 shows that with a ratio of 30 cows per bull nearly all of the cows observed in standing estrus also were marked. As more cows per bull were studied, the efficiency of estrus detection declined. Markings were less clear, probably due to fewer mountings.

An active bull may run out of ink soon. To decrease multiple markings of the same cow and excessive drain on the ink reservoir, freshly marked cows should be removed from the herd until they are out of estrus.

TABLE 6. Estrus detection with different ratios of beef cows to marker bulls for 19 days (3).

Criteria	Cow: bull ratio		
	30:1	60:1	100:1
Cows, no. per pasture	210	295	300
Bulls, no. per pasture	7	5	3
Visually detected in estrus (%)	74	71	79
Estrus cows marked (%)	95	66	51
Marked, not seen standing (%)	4	1	1
Animals marked/bull	21	28	41

In a milking herd under more confined conditions, and part of the herd pregnant, one bull may be used for up to 100 cows. It could be advantageous to have two bulls if convenient housing can be arranged. Bulls could be rotated weekly with a fresh supply and a different color of ink. This facilitates observing newly marked animals and takes care of the ink resupply problem. Also, it provides a reserve if one bull loses libido or becomes ill.

Teaser bulls with lateral deviation of the penis (but no markers) have been used in Russia for many years (40, 45). When turned in with cows after calving, more cows are seen in estrus during the first 2 mo postpartum. It is not clear from the abstracts whether this increase resulted from an induction of behavioral estrus or whether more cows are easily observed in standing estrus. Pregnancy rates were high, and the number of days open was reduced.

In New Zealand, with a short breeding season for dairy animals, marker bulls may be used to intensify estrus checking. After the breeding season they are used to determine if the cow apparently became pregnant to the AI service. This is important in identifying sires of progeny which may form part of the progeny test (28).

When intact bulls are used as cleanup bulls or with heifers the marking device can serve as an indication of the breeding date. To some extent such a marker bull can be used also as an indication of pregnancy. A few pregnant animals also will exhibit estrus, so a pregnancy check still is necessary.

Clearly marker bulls are effective estrus checkers with variability among bulls and among techniques used to prepare the bulls. There is no good evidence on the effect of operative procedures on libido. We have used the lateral deviation method. Bulls can protrude the penis, and libido has been unaffected over the 2-yr life of the bull. The "Pen-O-Block" is the simplest method but the bull may pass the block and breed the cow.

Marker bulls provide effective, continuous detection of estrus; they may stimulate estrus; there is positive identification of cows in estrus; they may save time; and they can be used to check for returns to service. Disadvantages include the danger of having a bull around; initial expense and time required to prepare bulls surgically before they can be used; the bull may lose libido; he may select favorites and miss others; and the marker can be damaged and run out of ink.

The importance of having a sexually aggressive animal in the group of cycling cows deserves special emphasis. We systematically have watched animals for extended periods without seeing any estrual behavior. Almost as soon as a bull is turned in with the group activity may pick up considerably. Partly, this may be the introduction of a new animal. A surgically prepared bull without a Chin Ball might be useful in triggering KaMaR detectors. This emphasizes three points in detecting estrus:

1) Create conditions favorable for animals to show symptoms of estrus (avoid slippery floors, etc.).

2) Know all symptoms of estrus and take enough time, several times a day, to catch all cycling animals.

3) Alternatively use estrus aids (on cows or bulls) properly for good 24-h per day checking, and still record new heats twice per day.

Non-visual Methods of Estrus Detection

Rectal palpation. This technique can be used to predict the next estrus, and it may be as effective as treatment (53). The approach is limited by the shortage of available veterinary service. However, a well-trained layman inseminating his own cattle could find this a helpful adjunct to his breeding program.

Vaginal mucus. Changes in cervical mucus, such as "ferning", viscosity, and biochemical constituents, have been found (23, 27, 39), but no simple, consistent, and reliable tests have been developed. One serious problem is the difficulty of obtaining representative cervical mucus for assay. However, various probes to measure changes in electrical resistance *in situ* have received considerable attention, especially in Europe (22, 36, 42, 46). Associated with the increased chloride content, electrical resistance decreased sharply (42).

In our herd we were unable to find clearcut changes throughout the estrous cycle when about 30 cycling cows were probed 2 to 3

times/day for 25 days. This agrees with another report (51). However, the frequent probing may have caused irritation which could produce erratic results. While the method does not appear to be reliable and simple enough as now developed to have practical application, further development may be warranted. Possibly some *in situ* reusable electrodes to measure and transmit mucus changes reflecting estrus and ovulation can be developed.

Other vaginal measurements. Vaginal cytology, pH, and temperature do not have well defined changes at estrus that lend themselves to accurate predictions. Abrams et al. (1) have found thermal conductance altered by the increasing vaginal blood flow associated with estrus. No simple measuring device is yet available.

Hormonal changes. Characteristic changes in blood progesterone, estrogen and luteinzing hormone (15) permit estrus to be anticipated accurately. These are important monitors of the estrous cycle, but blood samples are not easy to take routinely in the field nor are assays for minute quantities of hormones suited to the milkhouse.

Fortunately milk reveals cyclical patterns of hormones (16, 18). Milk samples can be obtained easily from lactating cows. Progesterone is actually higher in milk than in peripheral blood. In our studies composite milk has about 10 ng of progesterone/ml of milk. First milk samples will be lower (16, 18) and tail end samples much higher in the steroids because they are mostly associated with the fat. Fat increases several fold from the beginning to the end of milking.

Controlled estrus. If the dairyman does not wish to check for estrus at all, perhaps it soon will be possible to control ovulation in cattle. These cows will be bred at a standard time following treatment rather than following a check for estrus. The catch is that you must also concentrate on other aspects of the synchronization to get the cows pregnant. It may be more interesting than simply watching for behavioral signs of estrus, but it also can be more expensive.

Most good cattlemen will still rely on some visual detection of estrus. However, either heatmount detectors and/or marker bulls can be effective supplements to watch heifers and cows at times that are not convenient for direct visual observation. Since heifers, especially on pasture, are not easy to watch, a bull wearing a "Pen-O-Block" and a Chin Ball may make estrus detection simple enough to encourage dairymen to breed some of these heifers artificially to herd improving sires. Certainly in beef cattle on pasture such a scheme is helpful if artificial insemination is to be practiced.

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Development and Use of a Computerized Reproductive Management Program in Dairy Herds

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Abstract

Reproductive inefficiency is a major economic loss to most dairymen. Recent estimates for the United States indicate that this problem alone accounts for annual losses of $540 million. Studies during the past several years have illustrated clearly the need for a complete, computerized record system for reproductive management. The Reproductive Management Profile has been developed to provide the dairyman with a current and complete reproductive record on each cow and heifer in the herd. The forms for recording and reporting reproductive events have been condensed to a simple pocket format.

Computer analysis is designed to coincide with routine herd examination by a veterinarian. The output includes all routine reproductive events such as calving, estrus, and breeding dates. In addition, two projected heat dates, days open, reproductive disorders, other disorders, uterine conditions, and ovary conditions are listed. Monthly and annual summaries help make this a complete record system.

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Introduction

Low fertility is one of dairy management's major problems. Due to the economic magnitude of this problem and the difficult task of maintaining high reproductive performance, a simple, complete and current record of the reproductive status of each cow in a herd is essential. To be of effective use in management, a record system must present measures of reproductive efficiency by taking into account the various measurable factors that affect the reproductive life of a cow. These include calving dates, estrus, breeding dates, reproductive complications, treatments, and many others. By recording and accumulating this information, complete and current records are obtainable on each animal in the herd so that decisions on reproductive management can be made before problems become serious.

A useful computerized reproductive management system must (1) provide a simple means of recording data on the form, (2) have short turn around time, (3) be easy to interpret and make decisions by, and (4) be economical. With these characteristics, the Reproductive Management Profile (RMP) system was developed.

Measures of Reproductive Efficiency

Initial stages of the development of the RMP system involved a review of measures for evaluating reproductive efficiency. The major measures of efficiency have involved services