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Dairy Update

REPRODUCTION MANAGEMENT TECHNOLOGIES — November, 1985

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INTRODUCTION

Think back five years -- 1980. How is today's profitability being affected by the management decisions you made one, two -- five years ago? Knowing what you know now, what would you change? The bad news is you can't go back and make those changes. The good news: today's decision and actions will make a difference in 1986 and beyond.

Dairy reproduction and genetic management decisions and actions usually have a delayed response. The profit consequences of a missed heat won't be felt for 9-12 months. The payoff of using high P.D. sires begins 2-1/2 to 3 years after selected and continues for 2 to 3 generations. The delayed response does not diminish their importance. As you are looking back from your future in 1990, will today's decisions and actions please you?

What reproductive performance level will yield the greatest economic return? When all factors are considered, a 12-13 month calving interval is considered the most profitable target. This should be accomplished with little culling for reproductive failure. Estimated average daily losses increase from about $2 per day after 120 days open (13 mo. CI) to over $4 daily as open days are extended. Therefore, the major economic challenge is to target for a 12-13 month interval and minimize the number of cows with extended calving intervals (14+ months).

The factors affecting the economic consequenes of reproductive performance include:

1. number of calves born yearly affects future herd replacement rate and future genetic improvement and potential animals available for sale.

2. cows culled for poor reproductive performance reduces opportunity to cull for production or increases the cost of raising more herd replacements needed to maintain the herd size.

3. maintenance of a herd calving pattern that fits the labor available, and peak seasonal performance periods. This is of greatest importance on diversified farms.

4. pounds of milk produced per day of a cow's life in the herd. Short calving intervals usually result in cows spending more days producing nearer their peak levels; however, this requires firm management to insure at least 50-day dry periods so not to reduce the performance of the subsequent lactation. The challenge of longer calving intervals is to keep cows producing at profitable levels and avoid dry periods over 70 days. Generally the profitability of lower producing (below 14,000) cows is enhanced with short calving intervals (12 months or less). Calving intervals of high producing cows may be extended to 13 or 13.5 months without jeopardizing milk per day oflife. The optimum interval for first lactation cows is about 13 months because of their greater persistency.

TODAY'S TECHNOLOGY A FOUNDATION FOR FUTURE INNOVATIONS

A. Heat Detection

As can be seen, optimal dairy cattle reproduction efficiency is no longer something for the neighbors. It is an essential level of performance for every dairy farm. The consequences of poor reproductive performance are too great for most dairy farms to survive under current economic conditions.

The old adage that "the rich get richer and the poor get poorer" not only seems to hold true in the world of finance but also holds true for dairy management. Those who are already doing a good job in managing the dairy herd always seem better able to capitalize on new advancements in dairy production technology. Thus, the successful implementation of emerging technology can only be built upon a solid foundation of basic reproduction management.

It is assumed that use of superior A.I. sires will continue to be the basis of dairy herd genetic improvement in Minnesota. It has been clearly established that those using herd sires cannot maintain a competitive edge genetically. A national survey estimates that 85% of dairy farmers use A.I. on 82% of their cows and 68% use A.I. on 57% of their heifers. Clearly there is room for more extensive A.I., especially in heifers.

Poor heat detection is recognized as the single greatest obstacle to successful A.I. programs on nearly all dairy farms. Minnesota DHI records indicate that +20,000 herds are more successful at heat detection than state average performance. Yet 76% of +20,000 herd owners indicated heat detection as the major reason for reproductive failure.

Minnesota studies involving large numbers of cows show that detection of heat is more of a management problem than a cow problem. Ninety percent of all cows thought to be anestrus (not showing heat) were cycling normally. Only 10% of supposedly anestrus cows were actually not cycling as a result of some pathological problem.

Well fed and healthy cows will normally begin to cycle by approximately 20 days post partum (after calving). Not all of these early ovulations are accompanied by strong heat signs. However, by 60 days post partum, nearly 100% of normal cows are cycling and expressing normal heat signs. Whether or not these cows are observed in heat depends on the intensity of heat detection efforts. This fact is clearly verified in a summary of three studies found in Table 1.

Table 1. Percentage of normal cows detected in heat at first, second, and third ovulation when maintained under different systems of observation

Observation system	Ovulation First (20 days)	Second (44 days)	Third (64 days)
(1) Continuous 24 hr. observation			
(a) King, et al.	50%	84%	100%
(b) Williamson, et al.			100%
(2) Casual (herdsman)			
(a) King, et al.	20%	44%	64%
(b) Williamson, et al.			56%
(c) Morrow, et al.	23%	46%	64%

How can we improve our heat detection skill? One obvious answer is to simply spend more time looking for cows in heat (Table 1). However, for dairy farmers already pressed for time perhaps a better answer would be to spend more productive time looking for cows in heat. A periodic review of the scientific knowledge about the behavioral and physical signs of heat is useful for dairy managers. Since reproduction is a complex physiological process, it is easy to become confused about the significance of various heat signs and how they relate to the optimal time for breeding. Study of the University of Minnesota Ag. Ext. Folder AG-FO-2018 Detection of Heat in Dairy Cows is recommended.

The definition for heat is standing to be mounted by another cow. The average length of time a cow will be in standing heat is 12-18 hrs. However, twenty percent of heats are less than 6 hours duration and 25 percent of cows are mounted less than 30 times during heat. In stanchioned herds the average length of heat may be only 8 hours. To further complicate heat detection efficiency, it has been found that most of the mounting activity occurs at awkward times for observation, between 6:00 p.m. and 6:00 a.m. (Table 2). Recent studies verify that 65% of cows come in heat during the night and that 22% of these cows are out of heat by morning and were not observed at either the late PM or early AM observation.

Not all cows will show standing heat. In a Canadian study only 78% showed standing activity. Therefore, 22% of these individuals must be selected on other than standing signs. Observation of clear estral mucous is a helpful sign. Yet even where there is careful observation, estral mucous is seen in only 68% of cows in heat (Table 2). Using a flashlight at night and the early morning heat checks in a dimly lit barn will help spot the very reflective glistening estral mucous discharge.

Table 2. Distribution of time of onset and behavioral manifestations of heat

Onset of Heat

6:00 PM - 6:00 AM	6:00 AM - 6:00 PM
65%	35%

Behavioral Signs of Heat

Standing	Mounting	Mucus
78%	62%	68%

Hackett & McAllister JDS, 1984

Weather may affect expression of heat. Severe cold, storms or severe heat tend to depress expression of heat. Footing and condition of feet and legs have also been shown to be important factors in the expression of heat. A recent study shows that there was twice the amount of mounting activity on dirt exercise lots as compared to grooved cement (Table 3). Considering the significant differences observed between dirt and grooved cement, what might they be with wet, slippery and/or icy cement?

Table 3. Comparison of expression of heat on concrete and dirt exercise lots.

	Avg. mounts per 30 min.	Avg. stands per 30 min.
Dirt	3.4	3.3
Grooved concrete	1.9	2.0

Britt, et al., JDS, 1985

In Minnesota circumstances often make it difficult to keep reproductive efficiency high. It may be necessary to change heat detection management procedures during the winter. It may be advantageous to check heat during midafternoon, for example, when temperatures are more bearable for you and the cows. During late winter most of the cows that freshened in fall and early winter will be bred. Therefore, there will be few cows in heat at any one time and thus less activity. Extending the observation periods 15-30 minutes when there are fewer cows potentially in heat may improve heat detection efficiency (Table 4).

Table 4. Number of stands per hour for various numbers of heifers in heat.

Number in heat	Stands per heifer per hour
1	4.5
2	7.5
3	8.4
4	12.4
5	10.8

Helmer & Britt, JDS, 1985

Untimely observation of cattle may affect the farmer's ability to see cows showing heat. For example it is unlikely that farmers will observe hungry cows in heat express behavioral signs of heat when they are busy eating at the feed bunk. Observation for heat should occur during times when cows are contented and not busy eating.

From these facts it is clear that in order to achieve maximum heat detection efficiency, even with a full understanding of heat signs, cows need to be observed three times each day when they have opportunity to interact with other cows. A disciplined, strategically organized approach to heat detection can give satisfactory results without continuous observation of cattle.

Clear identification of all animals is very important especially as herd sizes increase. Studies have shown that up to 20% of cows bred are not in heat either because of mistaken animal identity or poor understanding of heat signs. Good records are also essential, not only for the anticipation of heats but also for the diagnosis of herd reproduction problems. The minimum information needed to develop a reproduction record should include: all calving dates, heat dates, breeding dates, rectal exam results. Professional experience has been that only marginal A.I. success can be achieved when reproduction records are not kept.

B. Heat Detection Aids

Heat detection aids have improved heat detection efficiency and accuracy. Used correctly, they are a good supplement to visual observation, particularly since continuous observation is impractical. Yet only 35% of dairy farmers nationally are using the available heat detection aids. Perhaps this is because most of the available aids are primarily useful when the cows are in loose housing where activity and mounting activity can be monitored.

There are many heat detection aids on the market today. Future developments of new heat detection products look promising. Regardless, we must always remember that heat detection aids are not meant to substitute but to supplement visual heat detection. Without a good understanding of the behavioral and physical signs of heat in relation to the proper time of breeding, heat detection aids will not be as effective.

In one study Kamar heat mount detectors, when used with good visual observation, improved efficiency of heat detection 16% and accuracy 14% (Figures 1 and 2). Painting the tail head with an exterior enamel or latex house paint achieves similar results as Kamar patches. The advantage of tail painting is that it is less expensive to use and less prone to false positives resulting from crowded conditions and accidental triggering on free stall dividers. An effective strategy for use of Kamars or tail paint is that they be used on all cows not seen in heat by 42 days after calving or not in calf at pregnancy diagnosis.

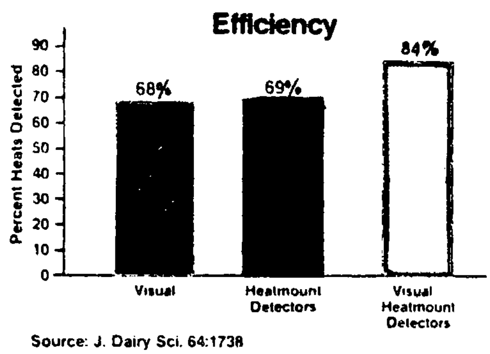


Figure 1.

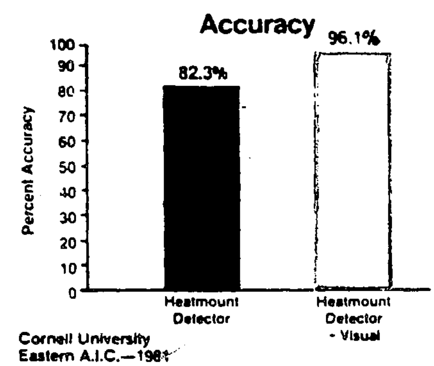


Figure 2.

Bright colored chalk or livestock marking crayons used over the tailhead and rump is another method similar to Kamar detectors and tailpaint. The disadvantage of this procedure is the necessity of remarking the cows daily. Some operators, however, find this feature an advantage because it forces closer daily visual observation of the cows.

Surgically altered bulls or androgenized steers, heifers or cows fitted with chin ball markers have proven successful for some dairy operations. Obviously it is safer from the human standpoint to have no bulls on the farm, yet some contend that the presence of the bull enhances heat activity. Ink levels in chin ball markers must be maintained. The method is more effective if more than one marker animal is used in two day shifts. Removal of those marked animals improves heat detection efficiency especially when more than one cow is simultaneously in heat.

Pedometers have proven themselves as excellent heat detection aids for free stall herds. Peaks in physical activity coincide with estrus 75% of the time in commercial dairy herds (Figure 3, Lewis et al.) An advantage of pedometer use is the ease in automating collection of data and selection of cows in heat. Similar activity monitors have been tried in stall barn housing with mixed results. It appears that this approach in stall barn units may be greatly affected by stall size, cow comfort, and normal daily routine within the barn.

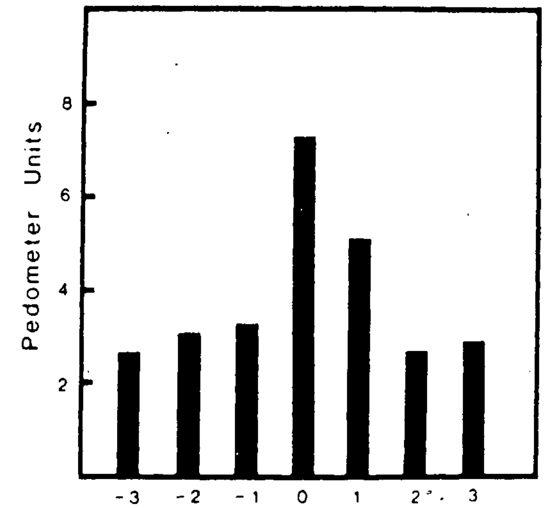


Figure 3. Changes of pedometer units in relation to day of estrus (n = 55) of dairy cows (n = 50). Bars are means and standard error of the mean from the model used to analyze the data = 32. Changes of pedometer units varied (P<.001) with day relative to estrus.

Video cameras placed strategically within a free stall housing unit or in view of exercise lots with monitors in the office or home show some promise. Time alloted to view the videos, barn lighting, and physical layout are factors that need consideration.

Attempts have been made to capitalize on the physio-chemical changes in vaginal mucous of cows in heat. Vaginal probes have been developed to measure changes in electrical conductivity of vaginal mucous. The lowest electrical resistance or pH is consistent with time of heat (Figure 4). Obviously this type of methodology has appeal in a stall barn operation since the technique is not dependent on animal interaction.

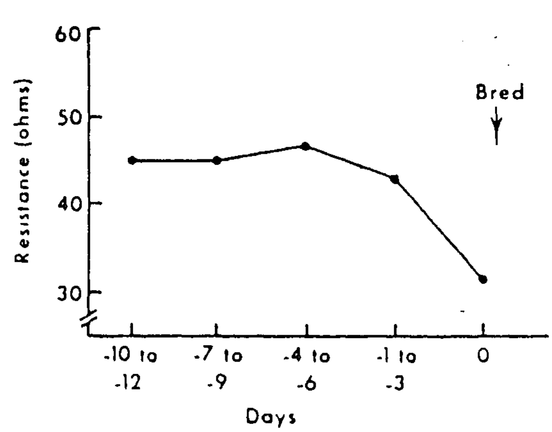


Figure 4. Electrical resistance measurements of the anterior vagina prior to and on the day of insemination.

Foote, et al. JDS, 1979

Research would indicate that comparable pregnancy rates can be achieved with visual observation or vaginal probes. However, the variation between cows and the often small increment changes in electrical conductivity may cloud interpretation. For effective use, cows need to be "probed" routinely. These facts, coupled with the concern over proper instrument sanitation as well as the initial expense of the instrument, may discourage implementation of the device.

Vaginal temperature is lowest the day prior to estrus and increases on the day of estrus (Figure 5). However, ambient temperature as well as disease processes may alter ability to make accurate heat predictions. Presently large scale studies are being conducted on a computer interface heat detection system using vaginal temperature devices. This procedure may have promise for both stall barn as well as loose housing.

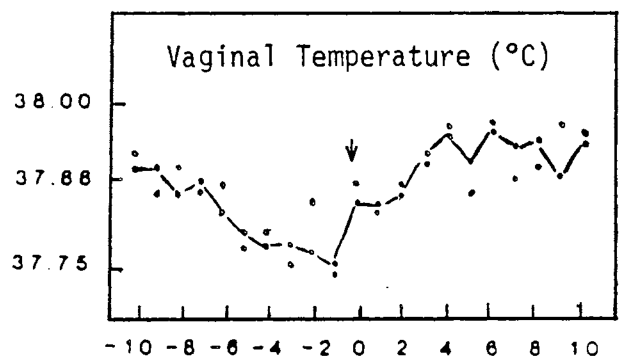
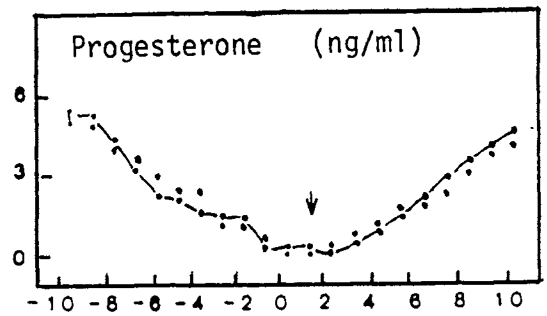


Figure 5. Changes in vaginal temperature throughout the estrus cycle.

Lewis & Newman, JDS, 1984.

USDA researchers are experimenting with prediction of heat by estrus-related odors found in milk. Dogs trained to respond to the odors from cows in heat were able to accurately identify 76% of the cows in heat in one trial and 83% in another trial. Variations both in the intensity in estrus-related odors among cows and the variation in the ability of dogs to detect the odor are some of the problems being encountered.

It has long been known that milk progesterone is lowest at the time of heat and that progesterone levels remain high during mid-cycle and during pregnancy (Figure 6). The recent development of a cow-side milk progesterone test could be useful in the management of problem breeders to help determine the time of heat. It should be pointed out that milk progesterone is low for 2-3 days around the time of heat, so that the exact time of heat could not be determined by milk progesterone alone. In addition, such techniques could be used to check cows showing signs of heat but who have been previously diagnosed pregnant. It should be pointed out that in this situation the milk progesterone should be high regardless of the apparent normal expression of heat. To breed this cow could cause abortion. The use of the cow-side milk progesterone test as a routine pregnancy diagnosis tool, however, would not be recommended because it is neither sufficiently accurate (80%) nor, at this time, cost effective for this purpose ($3/cow plus $3/control standard).



Days of Cycle

Figure 6. Changes in milk progesterone during the estrus cycle.

There are other physiological factors associated with the time of heat that are interesting but not yet of practical significance. On the day of heat, the average heart rate of a cow normally slows (Figure 7) and blood prostaglandin is also at its lowest level (Figure 8). The average daily milk yield declines slightly from 1 day before heat until 2 days after heat before returning to its normal mid-cycle level (Figure 9).

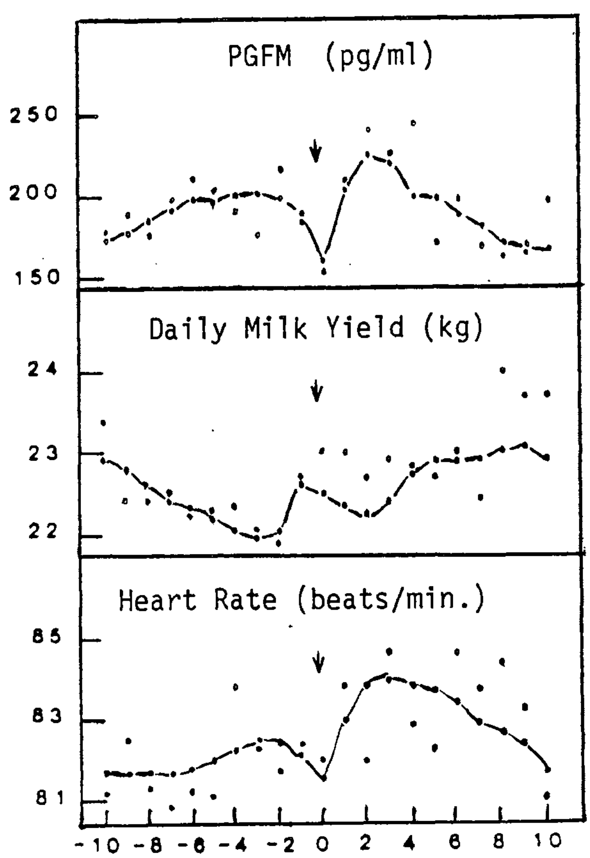


Figure 7.

Figure 8.

Figure 9.

Days Relative to Estrus

Heat prediction is enhanced when more than one heat related physical and/or behavioral changes are used. Studies confirm that not only heat detection efficiency but also accuracy is significantly improved. Canadian workers are presently studying the simultaneous changes in activity, body temperature and milk yield as predictors of heat. It is perhaps by this method that we can expect development of accurate, automated heat prediction methods that require minimal or no necessity of visual observation. It appears that most of this technology presently emerging will be more easily adapted to the larger free stall housing herds.

C. Heat Synchronizing Drugs

Forty-four percent of the nation's dairy farmers report use of estrus synchronizing drugs in their herd breeding and reproduction programs. Strategic use of heat synchronizing drugs can improve heat detection efficiency. In addition, reasonable pregnancy rates can be achieved using "breeding by appointment" schemes without observation for heat. When an adequate nutrition program is being used, assuming normal heifer growth and sexual maturation, heat synchronization drugs are an effective means of increasing A.I. among youngstock. If a progressive breeding program is being used, the best genetics are in the heifers. Relative to the herd's average genetic base, the heifer calves from those first calf heifers should have the best genetic merit in the herd. Yet only 57% of heifers across the U.S. are bred to A.I. bulls. In addition most heifers are not bred to freshen at 24 months (average age at 1st calving Minn. DHI = 28 months) adding significantly to replacement rearing cost ($30-50/month).

Progestins (Synchromate B) and prostaglandin (Lutalyse, Estrumate) use are excellent means of facilitating increased usage of A.I. in heifers and reducing replacement rearing costs by calving closer to 24 months.

Prostaglandins have been used in reproductive management schemes for lactating dairy cows in Europe for 10 years. Recent approval of prostaglandin (Lutalyse) in lactating cows in the U.S. has cleared the way for their use here. Since cows in most dairies are bred year around, reproductive management schemes using estrus control agents for dairy cows must be repeated frequently.

Quite often farmers in Minnesota make the observation that as more cows become pregnant in the herd, it becomes increasingly difficult to find the remaining open cows in heat. It is important to recognize that the number of cows that are in heat or close to heat greatly influences the ability of dairy managers to detect heat. Table 4 shows that as you increase the number of animals in heat from 1-3 the amount of mounting activity triples. Thus, observation of heat becomes easier. Therefore, the problem many upper-Midwest dairies contend with is that with fewer cows simultaneously in heat, expression of behavioral heat signs is less likely. Using prostaglandins to synchronize heats so that several cows are in heat simultaneously should enhance heat detection efforts, particularly in the smaller upper-Midwest dairy herds.

Controlling estrus activity to allow more favorable labor utilization by eliminating heat detection on some days of the week has also been researched at the University of Minnesota. The basic scheme used was a single injection upon rectal palpation of a corpus luteum followed by observation and breeding based on standing heat. In this study, average days open was reduced 18 days. A twelve-month calving interval was maintained without breeding any cows before 55 days after calving. Heat detection was eliminated 3 days of the week while extra attention was given to heat detection on the 4 days they were expected to be in heat. Fertility of the prostaglandin-treated cows was somewhat higher than controls, most likely because the herdsmen's anticipation of heat and occurrence of simultaneous heats improved accuracy of heat detection, subsequently resulting in more optimal timing of A.I. The cost benefits of such a program will vary from farm to farm but an estimated cost benefit ratio in this research, not including labor savings, was 4:1 (Table 5).

Table 5.

Controlled Breeding Program for Lactating Dairy Cows Using Weekly Prostaglandin (PG) Treatments to Allow Artificial Insemination (AI) to be Limited to Four Days Each Week

	Days of the Week						
Week	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1	XXX[a]	XXX/PG	XXX	___	detection and AI[b]		___
2	XXX	XXX/PG	XXX	___	detection and AI		___
3	XXX	XXX/PG	XXX	___	detection and AI		___
4	XXX	XXX/PG	XXX	___	detection and AI		___
5	XXX	XXX/PG	XXX	___	detection and AI		___
6	XXX	XXX/PG	XXX	___	detection and AI		___
7	XXX	XXX/PG	XXX	___	detection and AI		___

[a]XXX = Day without detection.
[b]Detection and AI must be done on each of Days 4 through 7.
[c]Pregnancy examinations can be scheduled, as appropriate.

This technique may not be successful on all farms. Australian studies indicate that general prostaglandin use should not be recommended on farms where conception rate is below 45%. Most upper Midwest farms are not visited weekly by a veterinarian as part of a routine reproductive health program, as was the case in the Minnesota study. Therefore, some other variation of the experimental scheme would have to be implemented. Table 6 represents another scheme that may better fit a monthly reproductive check program.

Table 6.

Controlled Breeding Program for Lactating Dairy Cows Using a 13-Day Prostaglandin (PG) System Alternately with 8-Day Periods of No Heat Detection or Artificial Insemination (AI)

	Days of the Week						
Week	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1	___	___	___	___	___	___	___
2	PG	___	___	___	___	___	XXX
3	XXX[a]	XXX	XXX	XXX	XXX	XXX	XXX
4	___	___	___	___	___	___	___
5	PG	___	___	___	___	___	XXX
6	XXX	XXX	XXX	XXX	XXX	XXX	XXX
7	___	___	___	___	___	pregnancy exams[b]	
8	PG	___	___	___	___	___	XXX
9	XXX	XXX	XXX	XXX	XXX	XXX	XXX

[a]XXX = Day without detection.
[b]Pregnancy examinations are most advantageous if they are done just before the next prostaglandin treatment.

In summary, research has established that heat detection has the most significant influence on overall reproductive performance. There is considerable room for improved heat detection on Minnesota dairies. There are many effective heat detection aids but most are dependent on cow interaction. New York studies show that each 1% improvement in heat detection at the 35%-55% level resulted in a 1-day decrease in calving interval.

D. <u>Conception Rate</u>

Conception rate is another major factor affecting herd reproductive performance. Conception rate should not be confused with non-return rate often spoken of by A.I. technicians. Conception rate is the number of confirmed pregnancies per number of inseminations. The non-return rate is a presumed pregnancy because an A.I. technician was not called back to re-breed a cow. Non-return rates are generally 15-20% higher than true conception rates. Average conception rate is 50%. Optimal average conception rate is 60-70% in cows and up to 75% in heifers. It is important to understand what the expected conception rate should be. One should anticipate that all cows that are bred will normally return to heat in 21 days. Return to heat outside the normal 18-24 day interval may indicate: the cow was not in heat when bred, the cow is pregnant but showing heat or that there is some abnormal reproductive problem. Post breeding heat detection would be greatly improved if more farmers would accept this reality. A good measure of your post-breeding heat detection would be the percentage of cows confirmed pregnant at vet. check. If 80% or more of the cows presented for pregnancy exam are confirmed pregnant, then your post-breeding heat detection is good.

It is a fact that accurate heat detection and the resulting optimal timing of A.I. are positive steps toward achieving acceptable conception rates. It is known that the major cause of repeat breeders (normally cycling cows bred 3+ times) is improper timing of A.I. Other factors affecting conception rate are A.I. technique, semen quality and handling, nutrition and herd health.

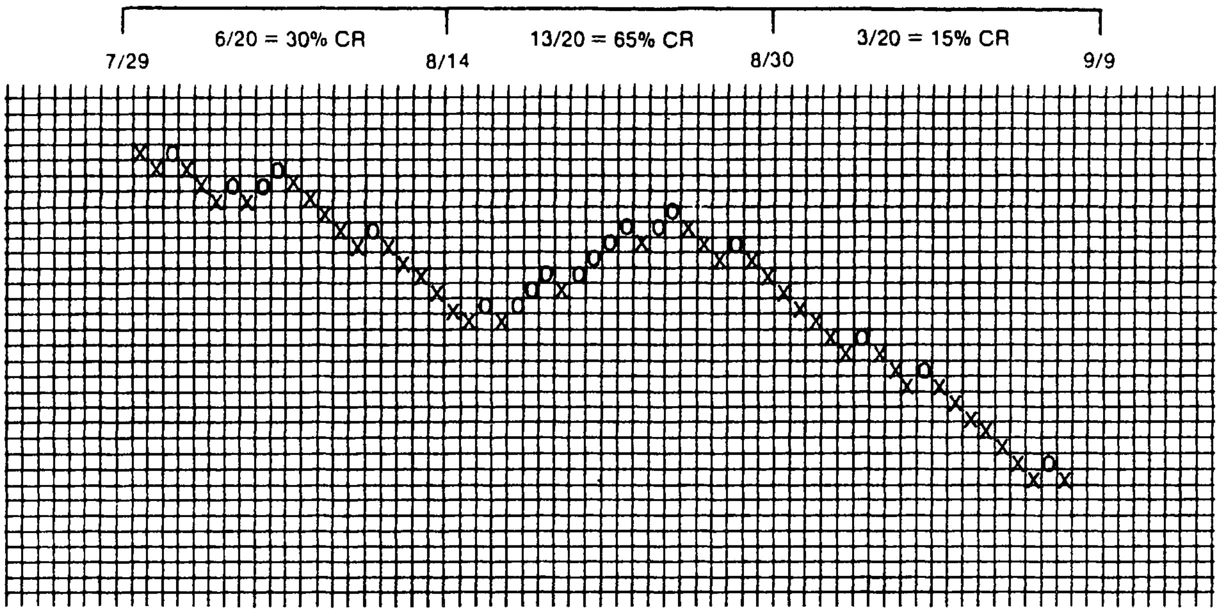
It is estimated nationally that 44% of producers do their own inseminating. As would be expected, variation in A.I. skill and experience is great. The most common error in A.I. technique is improper placement of the semen. It is crucial that semem be consistently placed in the body of the uterus (Table 7).

Table 7. Influence of the site of semen deposition on conception rate.

	Conception rate
Uterus	55%
Cervix	39.7%
Vagina	12.5%

Gwazdauskas, NAAB, 1978

Owner technicians should monitor their performance. Construction of a simple Q Sum Graph (Figure 10) is a very effective tool to monitor breeding performance. The Minnesota DHI Reproduction Report Monthly Reproductive Cycles table and the Reproductive Activity chart will aid in monitoring conception rates.



o = Successful service
x = Unsuccessful service
CR = Conception Rate

Q-Sum Graph

Sequin, et al. 1983

Figure 10. Cumulative summation (Q-Sum) graph used to determine a herd's breeding success. At each palpation for pregnancy from a specific breeding, an "O" is placed in a square to the right and up one square. For each breeding not resulting in a pregnancy, an "X" is placed in a square to the right and down one square from the previous mark.

E. Repeat Breeders

Repeat breeders are a concern of every dairy farmer. A repeat breeder is a normally cycling cow bred 3 times and not yet pregnant. In a herd with optimal reproductive performance (60% conception rate) you would expect to find 16% repeat breeders. Accurate heat detection and proper timing of A.I. will solve most repeat breeder problems. For example, virtually all repeat breeding problems are solved when a bull is loose in a herd. In most repeat breeders, ovulation is out of optimal synchrony with insemination. Attempts have been made to chemically manipulate ovulation to optimize ovulation time relative to the time of insemination. Studies have shown that gonadotropin-releasing hormones (GnRH) injected at the time of insemination improve conception rate at the 3rd service (Table 8). Recommendations would be to only use GnRH at the third and later services when economics justify its use. Basically the economics of GnRH use depends on the conception rate resulting from the treatment, the cost of the drug, and the cost of the semen being used. Generally use of GnRH is economically justified at a 10% improvement in conception rate when using $25 semen and $8 GnRH.

Table 8. Effect of GnRH injection on conception rates in repeat breeder cows.

	GnRh (100 mg)	Control (2cc saline)
% Pregnant	73	48
% Open	27	52

n = 346 Lee, et al. Am. J. Vet Res. 1983

F. <u>Nutrition</u>

Nutrition is often cited as a cause for reproductive failure but is rarely documented in field studies in Minnesota. Forage analysis followed by careful balancing of rations will prevent most nutritionally related reproductive failures. It is known that cows in negative energy balance have a lower conception rate than those in positive energy balance (Table 9). Maximizing Dry Matter Intake (DMI) early in lactation will have considerable effect both on minimizing the inevitable negative energy balance in high producing cows and reaching a positive energy balance by the time breeding is anticipated Table 10.

Table 9. Effect of weight on reproductive performance.

	Weight gain	Weight loss
Cows bred	1,368	911
Pregnancies	911	234
Conception rate (%)	67	44
Services/Conception	1.5	2.32

Hollon & Braton JDS, 1971

Table 10. Effect of feed intake in early lactation on reproductive performance.

	High Intake	Low Intake
Interval to first estrus (days)	40	51
Services/conception	1.57	1.94
Calving to conception (days)	82	100

Grainger & Wilhelm, 1979 Aust. Vet. J.

Beta-carotene, vitamin E, and selenium presently are receiving considerable attention as nutrients important to reproductive performance. Are there any particular feed additives that stimulate cows to exhibit stronger heats, have few cystic ovaries or improve conception rates? Certainly deficiencies of required nutrients will eventually have detrimental effects on reproductive physiology. Consequently, restoring the deficient nutrients to the ration will result in improved reproductive performance. Vitamin A has been established as an essential nutrient in reproduction. Beta-carotene is the natural precursor of vitamin A found in forages, which is converted in the intenstinal mucosa and liver into active vitamin A. High concentrations of beta-carotene in the ovary have provoked the question is beta-carotene itself a required nutrient essential to normal reproduction? Research to date is inconclusive. At this point, it seems inadvisable to routinely recommend beta-carotene when adequate levels of vitamin A are present in the ration. Modest supplementation may be justified in cattle with poor conception rate when the ration is high in corn silage or poor quality forage.

Selenium deficiencies are known to increase incidence of retained placenta. It has also been suggested that selenium deficiencies are associated with increased incidence of metritis and cystic ovaries. It appears that selenium deficiency prior to calving especially predisposes the cow to these reproductive disorders. It is doubtful that selenium deficiency occurs on most Minnesota dairies where trace minerals and other supplements containing selenium are fed at the prescribed 0.1 ppm level. Although requirements for vitamin E have not yet been established for dairy cows, the feeling among dairy nutritionists is that it should be supplemented in the ration at the rate of 50-100 I.U./cow/day. Studies have shown that providing Vitamin E improves the efficiency of selenium treatment.

G. Body Condition Scoring

Body condition scoring is an effort to, by visual appraisal, evaluate the nutritional program relative to the stage in the productive cycle. A scoring system with a 1-5 scale has been devised to measure body condition of dairy cows. Cows are scored on appearance and palpation of back and hindquarters. A score of 1 is poor condition and 5 is overcondition. It is highly desirable to have a cow properly fit if cows are expected to produce milk and reproduce at maximum efficiency. Relative to reproductive performance, studies have shown that cows with a moderate condition score had the highest pregnancy rates. Cows in poor condition responded with higher conception rate only after extra feeding. Cows gaining condition during mid-to-late lactation had both less efficient milk production and more days open. Cows showing no significant increase in body condition during lactation had the greatest efficiency of production and fewer days open. Skillful use of such a scoring system could aid dairy farmers in fine tuning the nutritional management in the herd so that both optimal production and reproductive performance is a reality. Recent studies indicate that where early lactation nutrition is carefully managed, there is no recognized decline in reproductive performance of high producing cows compared to herd average herdmates.

H. Reproductive Health Programs

Cow health is critical to optimal reproductive performance. Fertility declines as cow age increases or when incidence of clinical reproductive disorders and other health problems are increased. Most cows are relatively fertile through their fifth lactation, after which there is definite decline in breeding efficiency. Cows with major reproductive disorders (metritis, cystic ovaries) take longer to show heat, have longer intervals between calving and first insemination and longer days open. This is particularly true when these abnormalities go unattended and persist beyond 60 days into the lactation. At this point these conditions may often become refractory to treatment and result in infertility.

The major cause cited by farmers for involuntary culling is unsatisfactory reproductive performance, usually a sequel to clinical reproductive disorders. A herd goal of less than 10% involuntary culls is desirable. Studies have shown that reducing involuntary culling and extending productive life from 3.3-5.3 lactations could result in 20% more earned income per cow. Consequently, strengthening herd health management is a valid avenue toward improved reproductive performance and reduced involuntary culling.

Problems in herd reproductive performance are multifactoral in nature. For example, it has been consistently observed that cows with milk fever often have difficulty calving, leading to higher incidences of retained placenta, metritis and cystic ovaries. Figure 11 is a good example of the flow of reproductive problems in a dairy herd.

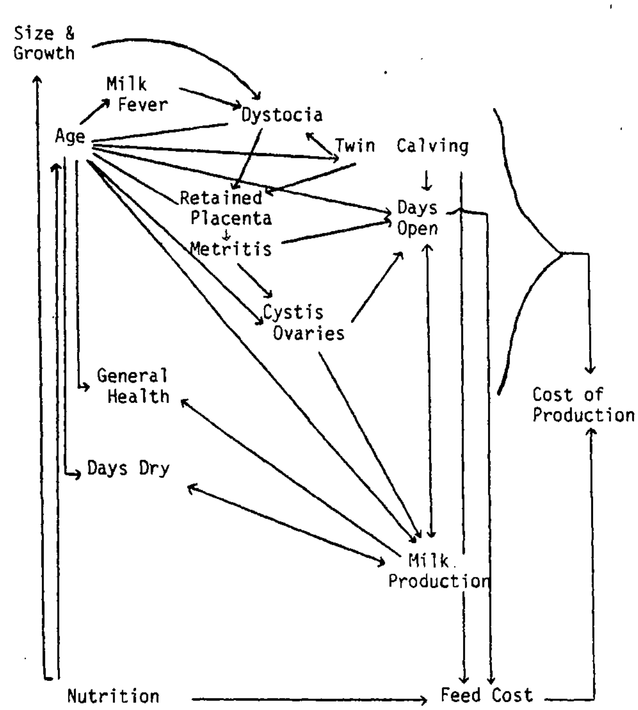


Figure 11. Interrelationships between primary reproductive disorders and other factors and their eventual effect on cost of production.

* Direction of arrow indicates possible causal relationships.

Timely recognition of reproductive failure or infertility is crucial to avoiding serious losses due to reproductive inefficiency. The use of routine veterinary herd fertility programs will facilitate early recognition of clinical reproductive disease (cystic ovaries, metritis, etc.) so that timely treatment will lessen the number of days affected cows stand open. Herd specific vaccination programs will lessen infertility and abortions due to subclinical diseases. Early pregnancy diagnosis (prior to 42 days) will reduce days lost due to presumed pregnancy. West Virginia studies showed that while managerial practices can greatly influence the incidences of reproductive disorders, veterinary intervention had the greatest impact in reducing the consequences of reproductive disorders.

Even more important than treatment of diagnosed reproductive disorders is implementation of strategies to avoid their occurrence in the future. If more than 25% of post calving cows require treatment, there should be a careful review of: dry cow programs, the frequency of calving assistance, calving procedures used, sanitation of calving area, heifer nutrition and growth, and policy on use of calving ease bulls on heifers.

Veterinary herd health programs are worthwhile. Evidently many dairy farmers think so too. Fifty-four percent of dairy farmers across the U.S. are enrolled in some form of routine herd health program. Eighty percent of herds with over 20,000 lb herd averages are involved in herd health programs with a veterinarian. Ninety-six percent of all veterinary administered herd health programs have as the major component herd fertility programs.

Study of the economics of herd health programs is convincing. Formal dairy herd reproductive health programs yielded an increase of $55/cow/year in an Ohio study. Input costs were little more than the tradtional health program except that timing of the routine herd health program allowed prevention rather than treatment. Return on the increased investment for routine herd health services in the Ohio study was 36:1. Even in herds where there was a relatively conservative veterinary herd health policy, returns were $3 per $1 invested. NMC has estimated that initiation of an effective mastitis control program in the average dairy herd has a return on investment ratio of 1:16 the first year. A recent Michigan study demonstrated that when veterinary expenses were utilized for prevention programs rather than treatment, there was $112 return for each $5 spent.

In an era of narrow profit margin, rugged competition and complicated production technology, there is less room for error. No one can do it all. The successful dairy of the future will have a competent veterinarian as part of his management team.

I. Reproduction Records Systems

Even the most skilled farm manager-veterinarian team will be unable to significantly improve reproductive performance without the use of good records. Records not only serve to monitor the success or failure of veterinary procedure, but also define reproductive management deficiencies which must be remedied if total success is to occur. Many farmers, during stressful economic times, entertain the idea of reducing costs by dropping enrollment in DHI or other computerized production management program. Why bite the hand that feeds you? Where good record systems are fully utilized, the economic return on investment is good (Table 11). For more efficient use of Minnesota DHI reproduction records, refer to University of Minnesota Folder, AG-FO-2835, Minnesota DHI Reproduction Information.

Table 11. Comparison of DHIA to Non-DHIA Herds

	DHIA	Non-DHIA
Herds	7,526	17,474
Cows per herd	48	31
Milk pounds per cow	14,798	10,356
Average percent fat	3.74	3.52
Fat pounds per cow	554	365
Value of dollar product per cow	$1,907.00	$1,346.00
Income over feed cost per cow	$1,162.00	$ 696.00
(above data is based on January 1, 1984 data)		

PERFORMANCE TESTING DOES PAY!

Micro-computer application for the herd specific manipulation of management information will have great impact on future dairy management. Software is now available and currently being developed that will enhance DHI systems allowing tailored reports specifically generated for solution of herd problems with the capability of calculating cost/benefit ratios.

REPO: DAIRY HERD REPRODUCTIVE ANALYSIS

Dairy producers should routinely assess their reproduction opportunities for increasing profit. REPO is a micro-computer program that compares the present status of the herd with what could be if the management goals were achieved. The program shows where improved management will make the largest gains: improve heat detection, improve conception, or begin breeding earlier after calving. Economic savings are estimated comparing the target goal performance with current performance. The program also projects the calves born and units of semen needed at the target level of performance.

User inputs for REPO are the management target goals, and information from the DHI herd reproduction summary. A sample printout of the program is attached.

ERD OWNER: John Dairy , Anytown, Minnesota

esired Goals

Number of Cows	55	cows
Percent Heats Detected	60	%
Conception Rate	60	%
Begin Breeding	50	days
Cull After	180	days open

urrent Herd Status(DHI Report)	--Current Herd Performance-- Preg. Cows	Posbly Preg.	Problem Cows	Average Herd Perform
Number Cows	27	3	6	55
Days to 1st Breeding	99	66	77	93
Days Open	138	66	152	141
Services Per Conception	2.00	1.00	3.20	2.22
Calving Interval	13.70	11.30	14.20	13.79
% Extnded Clving Int.(+14 mos)	33	0	67	39
No. Open after 3 Services				57

hanges Possible if Goals are Reached

	NOW		GOAL
Days to Begin Breeding	53	days	50
Days to 1st Breeding	93	days	74
Days to Conception	26	days	15
Heat Detection Days	51	days	16
Days Open	141	days	92
Calving Interval	13.82	mo's.	12.24
Percent C.I.>14MOS.	39	%	4
Units of Semen per Cow	2.22	units	1.74
$'s per cow per day open	1.00	$	.00
Ave Cost Per Cow	-40.55	$	.00
Est. % Heats Detected	48	%	60

stimated Herd Savings if Goals Are Reached..........

	-Days----	----%----	----$----
Time of 1st Breeding	-995.12	37.61	995.12
Conception Failure	-557.22	21.06	557.22
Heat Detection	-1,093.86	41.34	1093.86
otal Herd Savings	-2,646.20 days	$	2646.20

Cows to be culled	2	cows
Percent C.I.>14MOS.	4	%
Cows open	2	cows
Cows not found in heat	0	cows
No. calves born in 12 mos.	45	calves
No. Heifer calves born	23	females
Total units of semen needed	93	units
Units of semen per heifer calf	4.09	units

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