Dairy Split Session II

Dairy Herd Management Update

Maurice White, *Presiding*

Reproductive Management—New Approaches to Old Problems

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Introduction

Current economic conditions and those predicted for the future dictate that dairy herd managers continue to improve productive efficiency and reduce costs of production in order to maintain herd profitability. Fine-tuning financial, crop and herd management practices will pay dividends during the period of challenging economic pressures that are predicted to lie ahead. None of these management areas is more important than any of the others, but neither can any be neglected. Doing all the little things right all the time will become even more important in the future than it is at present.

Veterinarians as herd health and reproduction consultants have important roles to play in providing valuable services to dairy farmers as they seek to improve herd management practices and increase the profitability of their herds. One objective will be to assist them in preventing the loss of the more than $100 million that Pelissier attributed to suboptimal reproductive performance in U.S. dairy herds in 1982 (1).

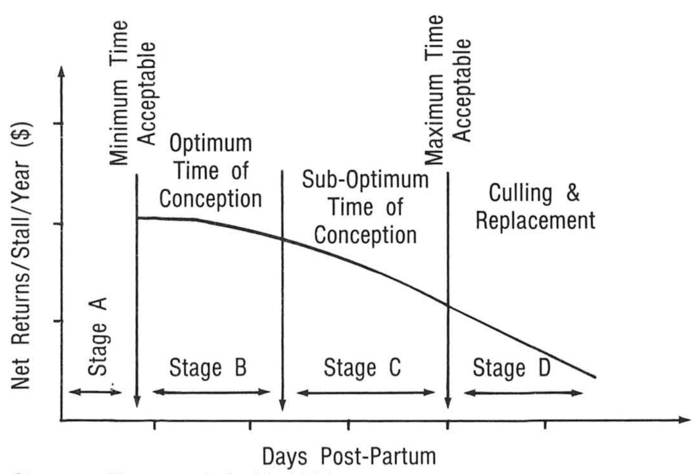
This paper briefly summarizes new information and new reproductive management tools that are useful to veterinarians as they work with their clients to improve reproductive efficiency in dairy cattle.

The Economics of Improved Reproductive Performance

The first challenge faced by those who work with farmers to improve reproductive efficiency is to create an awareness; both an awareness that a problem exists and an awareness that such improvements will indeed improve the profitabiltiy of the herd.

Recent research at Cornell studied how days open affects profit as measured by yearly returns over variable costs (2). Figure 1 illustrates the general relationship between economic returns and the time of conception that was found in this study. When all the variable costs (feed, semen, breeding fees, veterinary charges, etc.) and returns (milk and calves sold) were considered, net return per cow was highest early in Stage B (the optimum time of conception). Returns began to decline early; very shortly after the minimum acceptable time of conception (Stage A, the voluntary waiting period). Costs for culling for reproductive failure were not considered. Only cows that become pregnant need to be considered for establishing the optimum time for conception.

FIGURE 1. The General Relationship Between Time of Conception and Economic Returns.

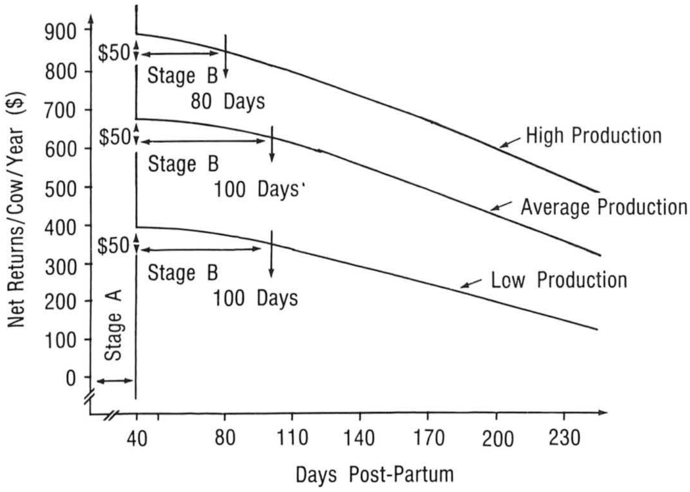


Oltenacu, Flanagen & Smith 1984

Several factors might affect the shape of the curve that relates time of conception to profit. They include: level of production; lactation number; season of calving; shape of the lactation curve and economic conditions. Perhaps level of production is the one about which most farmers have questions.

The relationships between profit and days open for three M.E. production levels (low, 12,000#; medium, 16,000#; and high, 20,000#) are shown in Figure 2. For the purposes of

FIGURE 2. Optimum Time of Conception For Cows In Third Lactation and Older as Affected by Production Level.



Oltenacu, Flanagen & Smith 1984

this example "normal" lactation curves, third lactation and older cows and 1984 economic conditions were assumed. The voluntary waiting period was assumed to be 40 days. The optimum time of conception was defined as the interval during which the net returns over variable costs were within $50 of the maximum expected return for any given cow.

The results clearly indicate that regardless of production level, net returns per cow per year are optimum when cows become pregnant within 80-100 days after calving. It is important to note, however, that this is the *optimum* time of conception. When cows fail to conceive within the optimum period, Stage C (the suboptimal time of conception when returns are lower, but conception is still more profitable than culling and replacement) must be defined.

Stage C is where adjustments are made for high producing cows. For maximum profit the goal should be conception before 80-100 days postpartum, but they are allowed longer "suboptimal" intervals than lower producing cows if they fail to become pregnant.

Evaluating the Herd

Once awareness of the importance of reproductive efficiency has been established, attention must be given to identifying the causes of suboptimal performance. Reproductive performance parameters and goals are discussed elsewhere in these proceedings. A detailed discussion will not be repeated here. Suffice it to say that accurate and up-to-date records are an absolute requirement if herds are to be evaluated and progress is to be monitored. Computerized health and reproduction record systems (DHIC and microcomputer based) are widely available and extremely useful in this regard.

Many of the systems provide both lists of cows and averages of various reproductive performance measures. Care must be exercised when interpreting the averages. They can be misleading. The distribution can be more important than the average. For example, in one herd that we studied the average projected calving interval for 65 pregnant cows was 12.5 months. However, a closer look at the records revealed that the intervals for 19 of these cows (29%) averaged 150 days. Many cows had short calving intervals (11.5-12.5 months). These short intervals reduced the average to a respectable number and hid the problem cows that represented an income loss of nearly $3000 in this herd of 100 cows.

Remember, too, that the DHIC calving interval figure is a minimum projected calving interval that is calculated based on the last reported breeding date. Obviously, some cows are not going to conceive to their last reported breeding, so their actual calving interval will be longer than the projected interval. The actual calving interval in many herds is 0.3 to 0.5 months longer than the projected minimum calving interval.

Three primary factors affect herd reproductive performance: 1) the voluntary waiting period to first service; 2) heat detection efficiency; and 3) conception rate. Farmers often ask when to start breeding their cows after calving. The recommendation may not be the same for all herds. It depends on the conception rate and the heat detection efficiency in the herd. In herds where the conception rate is 60% or higher and 75% or more of the heat periods are observed, a 12-13 month calving interval can be obtained if cows do not receive their first insemination until the first estrus observed after 60 days postpartum. When conception rate and (or), estrus detection efficiency are lower, first insemination must occur sooner in the postpartum period if long calving intervals are to be prevented. Early postpartum breeding compensates for conception and estrus detection problems.

The Team Approach to Reproductive Management

One of the reasons for farmers finding reproductive management so difficult is the large number of factors that interact to determine the reproductive efficiency of the cows in their herds. Some of the major factors are listed below:

- ▲ Herd Management
  - Calving management
  - Heat detection
  - Nutrition
- ▲ Health Management
  - General health
  - Reproductive health
- ▲ A.I. Management
  - Bull fertility
  - Semen quality
  - Semen handling
  - Insemination timing and technique

When improvement in reproductive efficiency is desired or a solution to herd reproductive problems is sought, each area must be systematically considered. For top performance, activities in each area must provide optimum results. A breakdown in any one may seriously affect performance even though all the others are operating at optimum levels.

The development of a reproductive management team that includes farm personnel, the veterinarian, the A.I. representative and other like the nutritionist and Extension agent is often the key to success. In many problem situations the collective expertise of all the team members has never been utilized. Team members have never talked together about the problems for which they are all seeking solutions.

Metabolic and Reproductive Disorders Reduce Performance

Health disorders are among the factors that effect reproductive performance. Thirty-three herds (2852 lactations) that were enrolled in the herd health program from the New York State College of Veterinary Medicine were studied to determine the incidence of disorders and their effects (3). The herds were considered to represent a typical cross-section of New York herds (Table 1). Note that the range across all herds is shown separately for each measure of performance. The highest producing herd did *not* have a 14.4 month calving interval.

TABLE 1. Description of cooperator herds.

	Range Across Herds		
	Lowest	Middle	Highest
M.E. Milk (lb)	10,798	17,270	20,567
Days to 1st service	65	78	125
1st Service Conception	31	47	63
Days Between Services	26	41	56
Calving Interval (Mo.)	12.0	12.7	14.4
Days Open	85	105	158

The range in the rates of incidence of disorders across herds is shown in Table 2. Retained placenta (24 hours or more) and metritis were the most common disorders treated; 12% were treated for each. Nine percent of the cows were treated for cystic ovaries. Milk fever was diagnosed in 7%. On the average the incidence of all other disorders was low in these herds. However, there were large differences among herds. The incidence rates of ketosis, milk fever, retained placenta, and cystic ovaries exceeded commonly stated bench marks for good performance in more than 50% of the herds despite the use of a regular herd health program.

The relationships among health and reproductive disorders were studied to determine if the occurrence of one disorder increased the odds that a cow would suffer a second or third disorder. These relationships in second lactation and older cows are shown by the arrows in Figure 3. Direct and indirect relationships can be observed by following the arrows from one disorder to another and then to reproductive performance and culling. For instance, milk fever directly increased the risk of 3 reproductive disorders (dystocia, retained placenta and metritis). In addition, milk fever and retained placenta were indirectly risk factors for cystic ovaries because they directly increased risk of metritis. Similar relationships were observed in first calf heifers except that there were no cases of milk fever.

The relationships among these disorders in mature cows are more precisely described below.

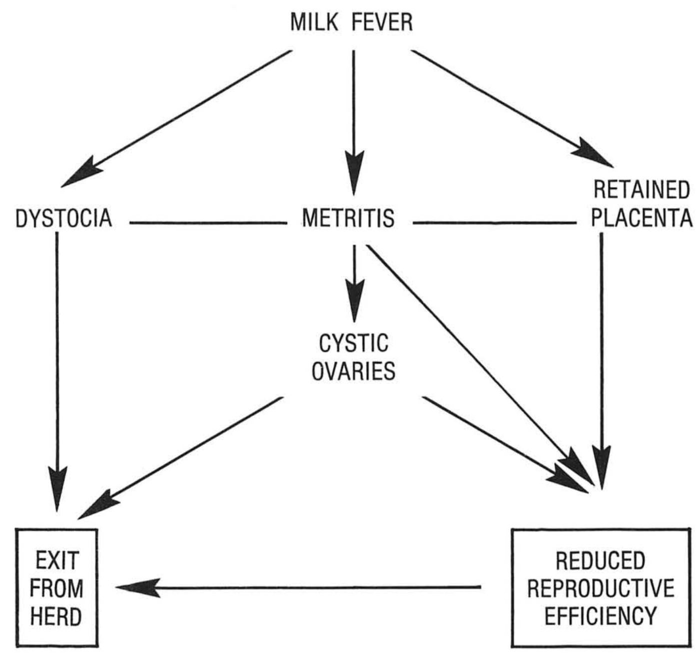
▲ Cows treated for milk fever were:
- 4.2 times more likely to require veterinary assistance at calving.

TABLE 2. Incidence of metabolic and reproductive disorders in cooperating herds.

Disorder	Range Across Herds in Cases per 100 Calvings[1]		
	Lowest	Middle	Highest
Reproductive			
Assisted calvings[2]	0	8	22
Retained placenta	0	8	30
Metritis	1	11	44
Cystic ovaries	0	8	22
Abortions	0	1	7
Metabolic			
Milk fever	0	4	14
Ketosis	0	1	11

[1] Includes both 1st lactation and older cows.
[2] Includes both farmer-and vet-assisted calvings.

FIGURE 3. Relationships among health and reproductive disorders, reproductive performance and culling.



- 2.0 times more likely to suffer retained placenta.
- 1.6 times more likely to be treated for metritis even if they did not have retained placenta.

▲ Cows requiring veterinary assistance at calving were:
- 3.7 times more likely to be culled.
- 3.5 times more likely to be treated for metritis, but not more likely to suffer retained placenta.

▲ Cows with retained placenta were 5.8 times more likely to be treated for metritis.

▲ Cows with metritis were 1.7 times more likely to be treated for cystic ovaries.

The occurrence of milk fever or one reproductive disorder increases the chances that a cow will suffer from a second disorder and possibly a third in a "snowballing" effect. For example, herds with a high incidence of milk fever can expect more problems with difficult calvings, retained placenta, metritis and cystic ovaries than herds that have dry cow programs that minimize the incidence of this metabolic disorder.

The effects of the reproductive disorders on reproductive performance and culling are shown in Tables 3 and 4. Performance in 1st lactation cows was calculated separately in order to determine if the effects were different from those in older cows. Reproductive disorders were diagnosed and treated in 27% of the 786 1st calf heifers in these herds. Ten percent required farmer or veterinary assistance at calving.

TABLE 3. The effects of reproductive disorders on reproductive performance and culling in first lactation cows.

	Days to 1st Service	1st Service Conception (%)	Services per Cow[1]	Days Open	Percent Culled
No disorders	78	49	1.6	104	16
Assisted calving only[2]	85	47	1.6	126	13
Retained placenta only	68	35	1.8	108	7
Metritis only	87	45	1.8	108	11
Cystic ovaries only	102	50	1.9	133	8
2 or more disorders	92	50	2.0	112	33

[1] Average number of breedings per cow, not services per conception.
[2] Includes both farmer-and veterinarian-assisted calvings.

TABLE 4. The effects of reproductive disorders on reproductive performance in 2nd lactation and older cows.

Status	Days to 1st Service	1st Service Conception (%)	Services per Cow[1]	Days Open	Percent Culled
No disorders	76	47	1.6	105	29
Assisted calving only[2]	90	38	1.6	116	52
Retained placenta only	86	40	1.6	114	35
Metritis only	86	38	2.0	119	31
Cystic ovaries only	91	40	2.1	136	29
2 or more disorders	85	30	1.8	131	47

[1] Average number of breedings per cow, not services per conception.
[2] Includes both farmer-and veterinarian-assisted calvings.

The incidences of the other disorders were low (1-6%).

Seventy percent of the 2066 second lactation and older cows suffered no reproductive disorders. Reproductive performance was excellent in these cows: 76 days to first service and 105 days open (12.7 month calving interval).

It is important to remember that all these herds were enrolled in a herd health program that included monthly or biweekly herd visits for reproductive exams and treatments as well as emergency service as needed. In spite of these programs, reproductive performance was impaired in cows in which disorders were diagnosed and treated. Apparently, current treatment procedures are not entirely effective in preventing a severe reduction in reproductive efficiency when disorders occur. Therefore, at present it appears that the key to preventing losses due to reproductive disorders must be found in their prevention, not their treatment.

Using Milk Progesterone Assays to Troubleshoot and Solve Estrus Detection Problems

Estrus detection continues to be the major factor limiting reproductive performance in most herds. Rapid milk progesterone assays are now available for use in identifying these problems (unobserved estrus and estrus detection errors).

Estrus detection efficiency was recently studied using this technique in 476 herds (4558 cows) in the Northeast (4). Milk samples were obtained on the day of insemination and again on day 21, 22, or 23 after breeding. Cows with low progesterone in both samples failed to conceive and returned to estrus, but rebreeding occurred in only 55% of these cows.

Estrus detection errors (inseminating cows that are not in estrus) are the cause of low conception rates in some problem herds. Milk progesterone assay on the day of insemination is useful in determining the extent of this problem. Low levels of the hormone indicate that the cow is in the estrous phase of the cycle. (However, breeding may not have occurred on precisely the correct day, since progesterone remains low for about 7 days around the day of estrus.) High levels of progesterone indicate that the cow was not in estrus. In the study cited above, the estrus detection error rate exceeded 10% in more than 30% of the herds.

The effect of estrus detection errors and relying too heavily on secondary signs of heat (breeding cows that are near heat, but too early or late for conception to occur) is illustrated in Tables 5 and 6.

TABLE 5. The Effect of Heat Detection Errors on Conception Rate.

Status	Milk Progesterone Level	Number Bred	Conception Rate[1]
Not in heat	High	25	0
In or near heat	Low	49	61%
TOTAL	—	74	41%

[1] Based on rectal examination at 40-50 days after breeding.
Smith, 1980.

TABLE 6. Heat Signs and Conception Rate.

Signs of Heat	Milk Progesterone Level	Number Bred	Conception Rate[1]
Standing	Low (in or near heat)	163	55%
Not standing	Low (in or near heat)	197	37%

[1] Based on rectal examination at 40-50 days after breeding.
Smith, 1980.

Establishing Effective Estrus Detection Programs

Recommendations for effective estrus detection have not changed. However, there is new research information that emphasizes why recommendations must be followed and short cuts avoided if a large percentage of estrous periods are to be identified. This information should be useful in encouraging better estrus detection programs in problem herds.

Sexually active animals must be present if signs of estrus are to be easily observed. North Carolina researchers studied the effect of stage of the estrous cycle on mounting activity in Holstein heifers (5). Ninety-four percent of the attempted mounts were made by heifers that were either in estrus or near estrus (Table 7).

TABLE 7. Mounting activity varies with stage of the estrous cycle.

Stage of Cycle	Total Attempted Mounts	% of Mounts
Luteal	56	5.2
Preestrual	203	18.9
Estrual	717	66.9
Postestrual	96	9.0
Total	1072	100.0

Helmer and Britt, 1985.

When only one heifer in a group was in estrus and there were no others near estrus, the heifer that was in estrus stood to be mounted only once in 30 minutes. In contrast, when two were in estrus at the same time, each stood about 3.5 times during a 30 minute observation period.

For good estrus detection it appears to be necessary that sexually active animals be present. This suggests that the use of prostaglandin to induce several animals to cycle at the same time can be used to improve estrus detection efficiency.

Alternatively, testosterone-treated cows and heifers or estradiol-treated steers can be utilized to increase mounting activity. Cows or heifers should be given 200 mg of testosterone three times weekly until they become active. Treatment should then continue at a frequency that will maintain mounting behavior. Steers should not be treated with testosterone. A 800-1000# steer should receive 15 mg of an estradiol each week.

The North Carolina research also illustrates the importance of the duration of the heat observation period. Since animals apparently stand only once every 10-15 minutes, each estrus check should last a minimum of 30 minutes. Scheduled checks should occur only when cows are free to interact and not after feeding or in the holding area. However, barn personnel must remain alert for estrous behaviour at all times.

Location (footing) also affects mounting and standing activity. In North Carolina (6) cows were observed for 30 minutes on a dry, grooved free stall alley and then moved to a dirt lot and observed for an additional 30 minutes or vice versa. Mounting and standing activity were more than twice as great on dirt as they were on concrete (Table 8).

TABLE 8. Effect of location (footing) on mounting and standing activity.

Activity	Dirt	Concrete
Total mounts[a]	7.1	3.1
Average mounts[b]	3.4	1.9
Total stands[a]	6.4	2.9
Average stands[b]	3.3	2.0

Britt, 1985.
[a] Total activities during an induced heat.
[b] Average activities during a 30-minute heat check.

Anestrous Cows

In well fed, well managed herds 90% of the cows have resumed normal estrous cycle activity by 60 days postpartum. However, recent Cornell research utilizing milk progesterone assays to monitor reproductive status indicates that as many as 25-30% of the cows in herds with low reproductive efficiency are not cycling by 65 days after calving.

One of the primary reasons for postpartum anestrus is energy deficiency during the early postpartum period. Butler et al. (7) reported that the first postpartum ovulation occurred after energy balance had reached a minimum and began to return toward zero, even though the cows remained in negative energy balance. There was a negative relationship between the severity of negative energy balance during the first 3 weeks after calving and the interval to first ovulation. Stevenson and Britt (8) reported similar findings based on changes in body weight during the first 6 weeks postpartum.

Field studies continue to indicate that farmers have more problems with higher producing cows (9). However, recent studies in research herds suggest that most of the variation in energy balance soon after calving (and presumably many of the nutritionally based reproductive problems) is due to differences in dry matter intake (nutritional management) rather than level of milk production (10). A recent Cornell study (11) on the effect of body condition and changes therein supports these findings and suggests that body condition scoring is a useful tool for determining if negative energy balance is a cause of reproductive problems. Cows were condition scored using a 5 point (1 = emaciated to 5 = obese) system (12) and grouped according to body condition loss during the first 5 weeks postcalving: severe, loss of more than one condition score; moderate, loss of 0.5 to 1.0 condition score; and minor, loss of less than 0.5 condition score. Excessive body condition loss was associated with poorer reproductive performance (Table 9).

TABLE 9. The relationship between body condition loss and reproductive performance.

	Body Condition Loss		
	Minor	Moderate	Severe
Days—1st ovalation	20	27	40*
Days—1st observed estrus	48	42	50
Days open	76	119*	110*
Services/conception	1.4	2.1*	2.0*
Heats detected (%)	76	79	60

Perkins, Smith and Sniffen, 1984 (Unpublished)

*P < .05 VS cows with minor condition loss.

Estrous Cycle Control Programs

Estrous cycle control using prostaglandin or Synchromate B is potentially useful for concentrating and therefore, improving estrus detection and breeding activities. Currently approved programs don't permit the elimination of heat detection. Conception rates are higher if the animals are observed and inseminated based on a detected estrus (Table 10).

Therefore, we have recently been studying a method that combines the use of an intravaginal progesterone delivery device (PRID) in combination with prostaglandin (Lutalyse) for use in heifers (13). The PRID is placed in the heifer for a period of 7 days. One day prior to its removal a single injection of prostaglandin (PG) is administered. All heifers are then inseminated "by appointment" at about 84 hours after PRID removal. The PRID + PG method was compared with the two-dose prostaglandin at an 11-day interval and Synchromate B systems with "appointment breeding" according to the manufacturers directions. The results are shown in Table 10.

TABLE 10. First service conception rates in dairy heifers after heat cycle control using PRID + PG, PG (2 doses at an 11-day interval) or Synchromate B[a].

		1st Service Conception	
	Total Heifers	Overall	Range[b]
No treatment	91	73%	62%—89%
PRID + PG	93	66%	56%—80%
PG — 2 doses	90	52%	38%—70%
Synchromate B	87	51%	

Smith, Pilbeam and Hansel, 1984.

[a] All hefers were bred at a single, preset time according to manufacturer's recommendations or at about 84 hours after PRID removal for PRID + PG.

Other research has been directed at methods for using prostaglandin to control estrus in milking cows. Several groups have demonstrated the usefulness of this drug for inducing estrus in cycling cows that have not been observed in heat (14, 15, 16; Table 11).

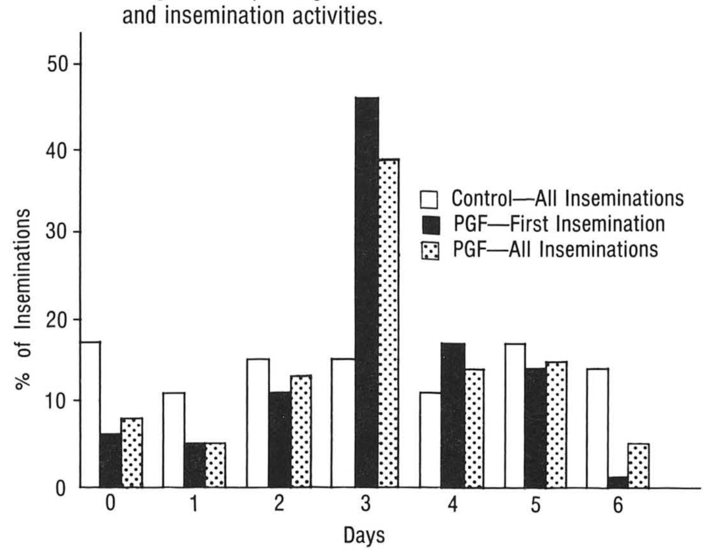
TABLE 11. Days for examination to conception in "no heat" cows with and without prostaglandin treatment.

	Days to Conception	
Study	Prostaglandin	No Prostaglandin
Michigan (15)	19	42
Kansas (14)	29	42
New York	26	32

Note the variation in results across these studies. Differences probably reflect differences in estrus detection efficiency in the herds that were studied. The NY herds presumably had better heat detection, so untreated cows were inseminated and conceived sooner. The variation in treated cows cannot be explained, but it is believed that similar differences are observed in the field. Success also depends on the accurancy of rectal palpation. Approximately 15% of the cows treated by 4 veterinarians in the NY study were not in the proper stage of the estrous cycle as determined by progesterone analysis to respond to prostaglandin. Rapid milk progesterone assays now permit fine-tuning of these diagnostic procedures which should result in an improved response. An interesting finding in NY was that problem cows were not receiving prostaglandin until about 100 days postpartum. Earlier treatment is advised for maximum benefit.

More recently work has emphasized the use of estrous cycle control to "program" reproductive management in groups of lactating dairy cows. Seguin (17) reported that the treatment of all eligible cows during a herd check that was

FIGURE 4. Programmed prostaglandin treatment concentrates estrous and insemination activities.



Sequin, Tate and Oterby, Minnesota, 1983.

scheduled for the same day each week resulted in 46% of the first services and 39% of all services occurring on the third day after the visit. Eight-two percent of all (first and repeat) breedings were within four days of a visit (Figure 4).

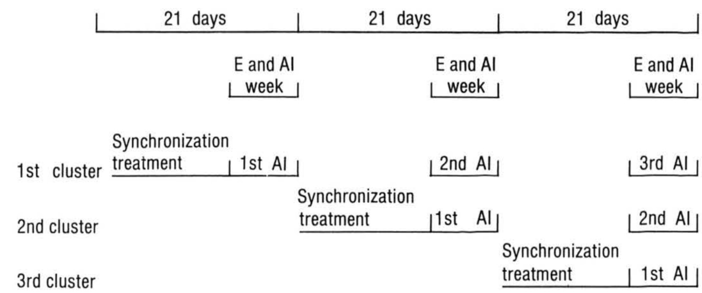
Folman *et al* (18) and more recently we at Cornell have tested the PRID + PG system for programming reproduction in dairy herds. The scheme is illustrated in Figure 5. Estrus detection is not eliminated, but it is reduced and concentrated to one 7-day period out of every 21 days. Eighty-eight percent of all breedings in treated cows occurred within the estrus detection and insemination weeks. Conception rates after breedings based on detected heats did not differ between treated and control cows (49%). Similar percentages were pregnant within 120 days (68%) and at the end of the trial (93%).

It is apparent from the results of these studies that it is now possible to use estrous cycle control procedures to program dairy herd reproduction. In well managed herds, the result should be improved reproductive performance and greater labor efficiency.

The Bottom Line

Optimizing reproductive efficiency will continue to be critical to dairy herd management programs that seek to maximize profits. Although new management information and techniques will continue to become available, reproduction is likely to challenge even the best of herd managers. There will be a continuing and possibly growing demand for veterinarians to work with conscientious herd managers and their reproductive management teams to identify the weak links in the reproductive management program and to select management practices that will improve herd performance. Health and reproductive disorders, nutrition, and estrus detection must continue to receive primary emphasis.

FIGURE 5. A heat cycle control program using PRID + PG to concentrate heat detection and insemination activities into one out of every three weeks.



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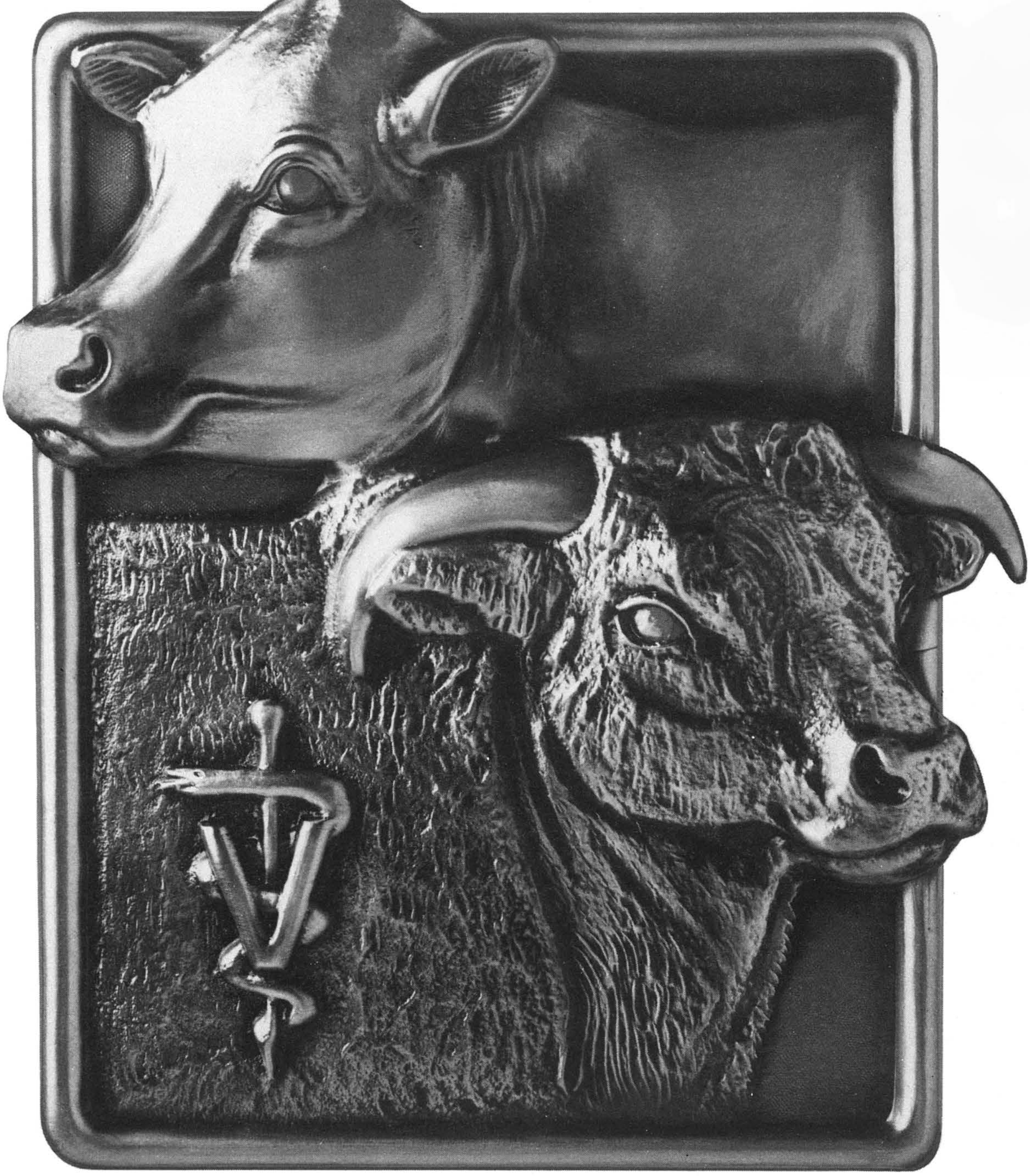

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