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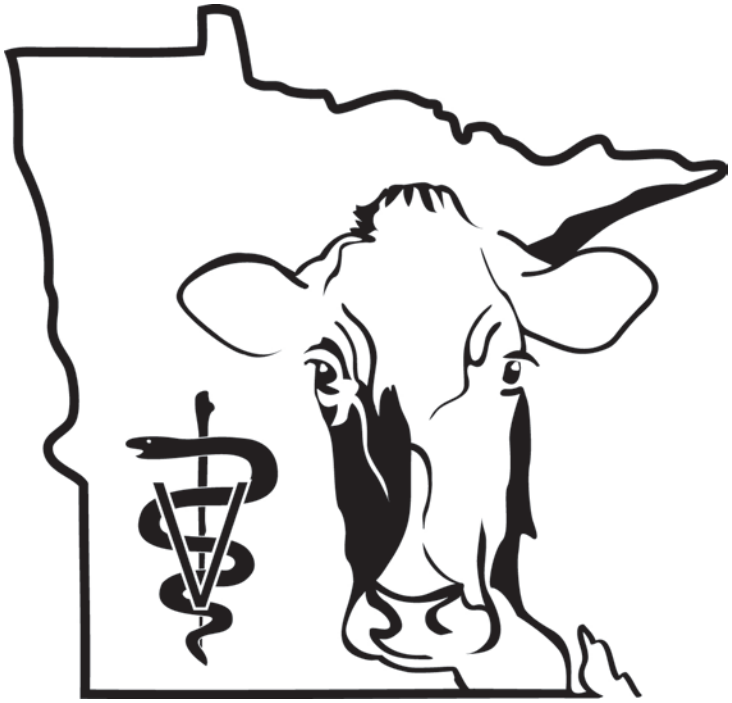

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SYNCHRONIZATION PROGRAMS FOR AI IN HEIFERS

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Minnesota dairy farmers (>80%) use artificial insemination (AI) for the majority of matings in cows but only 60% used AI for the majority of matings in heifers (Hammond, 1988). The primary reason to use AI in dairy breeding is the greater genetic potential for milk production available via AI proven sires. A second reason to use AI in heifers is the genetic estimate for percent of difficult births in heifers (%DBH) is unknown for natural service sires. With AI, sires proven to have below average %DBH can be used as service sires in heifers to minimize calving difficulties.

A second Minnesota dairy problem is that age at first calving averages 27 months rather than the 24 months recommended for economic efficiency. With an average cost of $45 for each month freshening is delayed beyond 24 months, Minnesota dairy farmers are losing $135 per heifer. The primary reason for delayed first calving is that heifers are not bred in a timely manner.

Controlled breeding programs, i.e., regularly scheduled estrus synchronization, can make it easier and less costly for dairy farmers to use the advantages of AI in breeding heifers and can help assure that heifers are bred in a timely manner. Through selection of an appropriate synchronization breeding program to meet the management objectives of the dairy, heat detection and breeding or appointment breeding of heifers can be scheduled to most efficiently manage labor resources and use semen from proven AI sires.

There are several controlled breeding programs available to facilitate AI use in replacement heifers. Selection of a controlled breeding program should consider cost, labor requirements, expected outcomes, and adequacy of facilities to handle heifers.

ESTRUS CONTROL or SYNCHRONIZATION PRODUCTS

Seven commercial compounds are currently available in the U.S. to singly or in combination control or synchronize estrus in heifers.

LUTEOLYTIC PROSTAGLANDINS

Lutalyse (dinoprost tromethamine, 25 mg dose), The Upjohn Co., Kalamazoo, MI

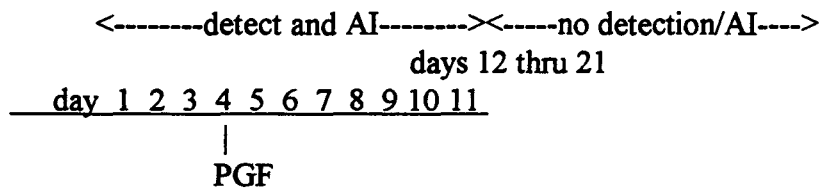
Bovilene (fenprostalene, 1 mg dose), Syntex Animal Health, West Des Moines, IA

Estrumate (cloprostenol, 500 ug dose), Miles Inc., Agriculture Division, Animal Health Products, Shawnee, KS

service with others equally spread among the 55, 85 and 100 hr services.

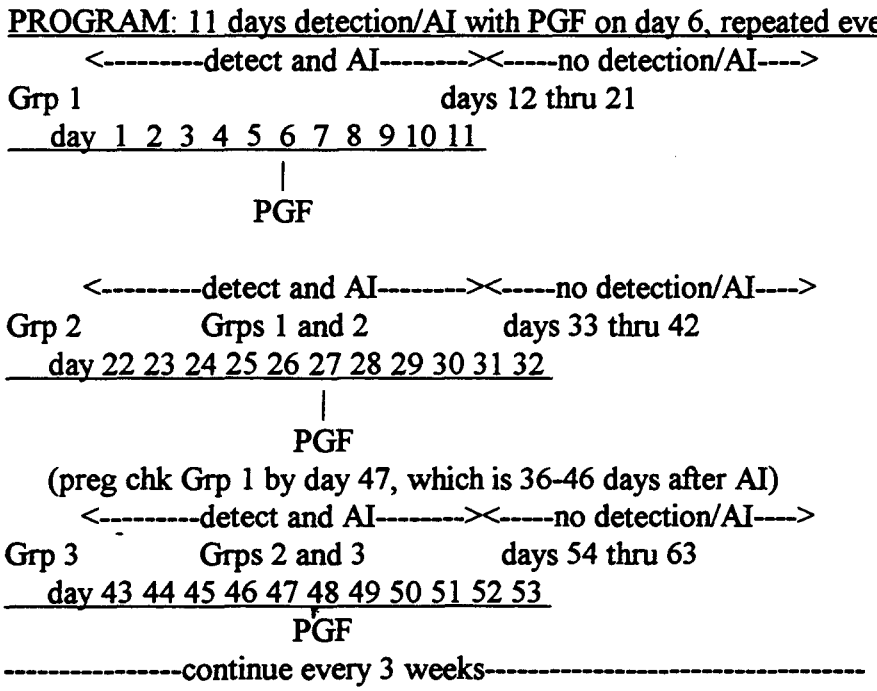
Single Injection PROSTAGLANDIN PROGRAMS

1. **Observe for Estrus and AI for 5 days, Treat Remainder with PGF on day 6, & Observe and AI for 5 More Days.**



This was one of the first single injection programs proposed when PGF products were introduced, and it has been popular in beef herds. An advantage is that the 5 day pretreatment period can be used to predict results of the day 6 PGF treatment. Since about 5% of the heifers should be in estrus each day if the group has no anestrus problem, about 20 to 25% of a heifer group should be observed in estrus during the pretreatment period. If less than 20% of the heifers are observed in estrus during the pretreatment period, it is likely that either many heifers are not cycling or estrus detection is poor. In either case, the synchronization program is in trouble unless adjustments are made. For example, the basis for the day 6 PGF injection in individual heifers could be changed to being based on palpation of a mature CL, if economically justified, rather than giving it to all group members yet to be bred.

This method can be used on a repeating basis, as most dairy farm situations would require. A diagram showing this method repeated every 3 weeks follows:



observed estrus or by appointment. For best appointment AI results in this single PGF injection regime with heifers, double AI should be used about 60 and 80-84 hrs after PGF.

Seguin etal (1983) tested a weekly PGF breeding management system versus conventional heat detection and AI system for dairy herds; that included 99 stanchioned heifers--51 as controls and 48 in the PGF system. In the PGF system, a DVM visit occurred each week for palpation of cows and heifers ready for breeding and PGF was given when a mature CL was found. AI was based on once daily AM heat detection. The program was conducted in 3 consecutive fall through spring breeding seasons. Only the heifer results are presented here (Table 1).

Table 1. Effect of a Weekly PGF Breeding System on Heifer Reproductive Performance.

	Controls	PGF System
No. Assigned	51	48
No. Bred	51	48
No. Conceived	49	47
Days to:		
--first AI	21 ± 16^{a}	8 ± 10^{b}
--conception	38 ± 31^{a}	20 ± 20^{b}
No. treated with PGF	-----	43 (90%)
No. PGF doses used	-----	51
No. estrus in 2-5 days	-----	44 (86%)

[ab]Means with different superscripts differ significantly (P<.01).

Reproductive performance, i.e. days to first AI and to conception, was improved for heifers in the PGF system relative to controls. Pregnancy rate by day from PGF treatment to AI day was 67% on day 2 (n=18), 71% on day 3 (n=17) and 67% on day 4 (n=3).

Double Injection PROSTAGLANDIN PROGRAMS

1. Two PGF injections 11 to 14 days apart, with either estrus detection from 36 to 108 hrs or timed AI at 60 to 72 hrs after the second PGF.

Most field trials using double injections of PGF have spaced the injections 11 days apart. Since 60 to 65% of the heifers are in estrus 36-96 hrs following the first injection, most heifers will be on day 7 or 8 of the cycle at the time of the second injection. Stage of the estrous cycle at the time of PGF treatment affects the interval from treatment to estrus and conception rate, especially to timed AI. Heifers in the early luteal phase (days 7-9) return to estrus 12-30 hrs earlier than those in mid to late luteal phases. As a consequence, heifers treated in the early luteal phase have lower conception rates than heifers treated in the late luteal phase if timed insemination at 80 hrs is used.

Smith etal (1984) found a lower pregnancy rate for control dairy heifers than for heifers given the double PGF method with 80 hr appointment AI (Table 1). However their estrous detection and conception rates in control heifers were both exceptionally high at 93% and 78% respectively, so their pregnancy rate for control heifers (73%) was higher than is usually seen on commercial dairies. For commercial dairies, the 52% pregnancy rate for heifers bred by appointment may compare very favorably with pregnancy rates for heifers inseminated based on observed estrus, but this result may discourage some. Three potential reasons for this lower pregnancy rate after the PGF regime were cited: 1) poor synchrony of estrus, 2) failure of

Table 1. Comparison of Pregnancy Rate in Heifers following Double PGF injection 11 days apart and Timed AI at 80 hours to Controls (Smith etal 1984 JAS 58:792)

	Control	**2 PGF 11 days apart**
No of Heifers	93	90
% in Estrus	93 (25 d)	[Appt AI but 84% in 5 d]
% Pregnant	73	52

a significant number (16%) of heifers to respond to the second PGF injection and/or 3) improperly timed AI.

There are 2 potential solutions to this problem. The first is to give the second injection of PGF 14 days after the first. This moves the majority of heifers from days 7 or 8 to 10 or 11 at the second PGF injection. This will increase the interval from treatment to onset of estrus and may increase the proportion of heifers in estrus within the 24 hours preceding the appointment AI at 80 hours. This also has the advantage that PGF injection schedule will be the same every other week. The second alternative is to shorten the interval from the second PGF injection to timed AI from 80 to about 60 hrs and leave the PGF treatments at 11 days apart.

This method can also be used on a repeating basis, as is shown with a repeating 3 week interval in the following diagram:

PROGRAM: Double PGF 11 days apart, repeated every 3 weeks

Grp 1 detect & AI
PGF PGF <36-96hr>
day 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Grp 2 detect & AI
PGF PGF <36-96hr>
day 22 33 35 36 37 38 42

(preg chk Grp 1 by day 54, 37-41d after AI)
Grp 3 detect & AI
PGF PGF <36-96hr>
day 43 54 56 57 58 59 63
----------continue every 3 weeks----------

Interval between repeat services in the same heifer
--21 days possible
--if found OPEN by day 53 etc, 1X PGF--> 42 days possible
for 2X PGF--> 63 days likely

ADVANTAGES
--limited (72 hrs/21 days) heat detection
--no heat detection possible for first AI
--good control on interservice interval

DISADVANTAGE
--2 doses PGF for each first AI

2. Observe for Estrus and AI Heifers Following the First PGF Injection. Heifers not observed and bred following the first PGF injection are re-injected 11 to 14 days later, and those heifers are either bred on the basis of observed estrus or bred by appointment.

Fogwell etal (1986) reported results of a synchronization demonstration project involving 2,966 dairy heifers in 45 Michigan herds. The basic program was 2 PGF injections 11 days apart followed by observation for estrus and AI 12 hours after detection of estrus or appointment AI 80 hours after the second injection of PGF. Pregnancy results for 7 variations of the program were reported (Table 2). The 2 programs which resulted in the lowest conception and pregnancy rates were those where heifers were only inseminated by appointment at 80 hours after the second injection.

Table 2. A comparison of various approaches to breeding management with a double PGF injection 11 days apart. (Fogwell 1986 JDS:69,1665)

Program for Insemination		No. of Heifers	Concept' Rate,%	Preg' Rate,%
1st PGF	2nd PGF			
AI at Estrus	AI at Estrus	650	61.4	58.8
AI at Estrus	AI at Estrus or 80 h	335	60.9	57.9
AI at Estrus	No AI	231	69.7	60.1
No AI	AI at Estrus	255	66.1	52.9
No AI	AI at estrus or 80 h	694	55.2	50.7
AI at estrus	AI at 80 h	72	36.6	37.5
No AI	AI at 80 h	517	42.4	42.4

It is also important to report that 247 (8.3%) of the heifers were rejected from the trial due to abnormal reproductive anatomy, n=44; pregnancy, n=53; cystic ovarian disease, n=71; and being prepubertal, n=79. Results from the same trial (Table 3) show several interesting points: 1) a majority of farmers wanted to do some estrus detection after PGF treatment (65.5% of the heifers bred), 2) a higher pregnancy rate for AI based on estrus detection (62.8%) versus AI at 80 hrs (39.2%), 3) higher fertility at estrus observed after the first PGF injection (65.4%) than at estrus observed after the second PGF

Table 3. Fertility by Basis for AI After PGF in Heifers

Basis for AI	Number of heifers	-------Pregnancy Rate------- Mean	Minimum	Maximum
AI at estrus				
--after 1st PGF	766	65.4%	47.6%	95.9%
--after 2nd PGF	1025	60.9%	33.3%	92.3%
AI at 80 hr after 2nd PGF	945	39.2%	0.0%	85.7%

Fogwell etal, 1986 JDS:69,1665.

Table 4. Summary of 5 Field Trials in Beef Heifers Using SMB

	Control		SMB Heat Detection		SMB Appt AI	
	n	%	n	%	n	%
Total No Heifers	276		307		375	
5 d Estrus Rate	87	31.5	288	93.8	375	(100)
5 d Preg Rate	58	21.0	97	31.5	214	57.1
21 d Estrus Rate	259	93.8	297	96.7		
21 d Preg Rate	175	63.4	119	38.8	253	67.5

Spitzer etal 1981 JAS 53:1-6

Table 5. Summary of a Field Trial in Dairy Heifers Using SMB

	Control		SMB Heat Detection		SMB Appt AI	
	n	%	n	%	n	%
No. Heifers	79		79		80	
Estrus, (5 d SMB; 25 d CTRL)	74	93.7	66	83.5	75 (80)	93.8 (100)
Conception Rate	53	71.6	48	72.7	44	55.0
Pregnancy Rate		67.1		60.8		55.0

Anderson etal, 1982. Theriogenology 17:623

Note in the Spitzer trial (Table 4) the low 21 day pregnancy rate for the SMB group inseminated based on heat detection relative to that trial's control and SMB/appointment AI groups. This was not seen in the similar trial by Anderson etal (Table 5).

SMB versus Double PGF Synchronization with Appointment AI in Heifers.

Seguin etal (1989) used 7 groups of beef or dairy heifers to compare pregnancy rates of heifers synchronized with PGF 11 days apart and time inseminated at 61 ± 1 hours post-treatment with heifers synchronized with SMB and time inseminated at 49 ± 1 hours following implant removal (Table 6). Pregnancy rates in 5 cycling groups were 53% for 77 heifers synchronized with PGF and 45% for 75 heifers synchronized with SMB, but only 18% for 34 heifers treated with the PGF system and 21% for 33 heifers treated with the SMB method in 2 groups that were not cycling. The conclusion was that the PGF and SMB methods "were equally effective for cyclic heifers and equally ineffective for noncyclic heifers".

The SMB method can also be used on a repeating basis, as is shown with a repeating 3 week interval in the following diagram:

PROGRAM: Syncro-Mate-B (SMB) repeated every 3 weeks

Grp 1 **detect & AI**
(in---------SMB---------out) <36-96hr>
day 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Grp 2 **detect & AI**
(in---------SMB---------out) <36-96hr>
day 22 31 33 34 35 36 42

Grp 3 **detect & AI**
(in---------SMB---------out) <36-96hr>
day 43 52 54 55 56 57 63

(preg chk Grp 1 by day 63, 45-47d after AI)
Grp 4 **detect & AI**
(in---------SMB---------out) <36-96hr>
day 64 73 75 76 77 78 84

----------continue every 3 weeks----------

Interval between repeat services in the same heifer
--21 day possible
--if found OPEN by day 63, 63 day interval likely

Advantages
1. Good synchrony of estrus which allows heifers to be bred by appointment 48 to 54 hours after ear implant removal

Disadvantages
1. High Labor Requirement. Heifers must be restrained to place and remove implant from ear.
2. Expensive. Cost of drugs to the producer is about $10 per treatment.

Feeding Melengestrol Acetate (MGA) Followed by PGF

MGA is fed to control estrus at the rate of 0.5 mg per head per day for 14 days. Upon withdrawal of MGA from feed, heifers come into a synchronized estrus; however, fertility is reduced if heifers are bred on the first estrus following MGA feeding. Heifers treated with PGF 16 to 18 days after the MGA feeding have a synchronized estrus beginning 24 hours post-injection.

This system requires that heifers are being fed some concentrate or total mixed ration that assures each heifer gets the required MGA each day.

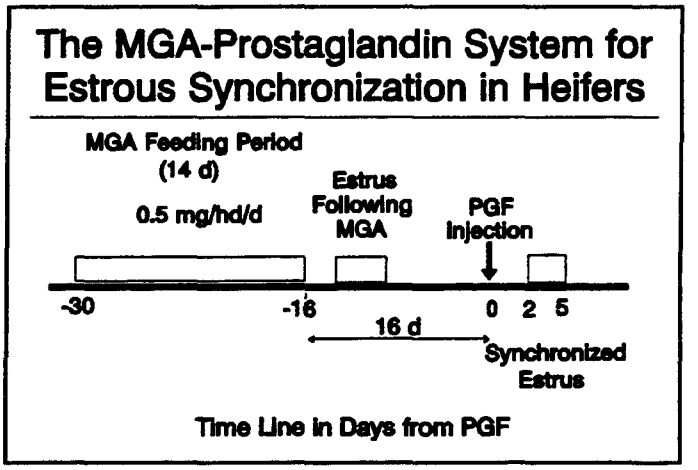


Figure 1. MGA-PGF Synchronization

Brown etal (1988) compared this synchronization method with the SMB program in beef heifers (Table 7). Their estrus response rates were nearly equal, but a marked advantage in fertility at the synchronized estrus, i.e. synchronized conception rate, for the MGA-PGF program was observed and this produced a pregnancy rate advantage for the MGA-PGF method.

Table 7. MGA-PGF and SMB Estrus Synchronization Programs

	MGA-PGF		SMB	
	number	**mean**	**number**	**mean**
Estrus Response (Heat in 120 h)	157	83.4%	153	90.2%
Synchronized Conception Rate	131	68.7%	138	40.6%
Synchronized Pregnancy Rate	157	57.3%	153	36.6%

Brown etal, 1988. Theriogenology 30:1-12

Advantages
1. Low labor requirements assuming heifers are being fed a supplement.
2. Low cost relative to other methods of synchronization.
3. High conception and pregnancy rates.

Disadvantages
1. Program requires about 35 days which may not readily lend itself to initiating a new group of heifers in the same pen each month.
2. Need feeding system that will deliver MGA to each heifer every day.

GnRH followed by PGF 7 days later, GnRH 1 day later, and AI heifers by appointment 24 hours later.

Pursley etal (1994) reported on a new combination procedure that may improve synchrony of estrus in cows and heifers so that the need for estrus detection is eliminated and AI by appointment with normal fertility could be possible. Although limited information on this procedure is available, this work is the result of recent understanding of the follicular wave physiology during the bovine estrous cycle and their influence on estrus synchronization. In recent conversations (April, 1995), these authors said this method may work much better in dairy cows than in heifers. More results are needed before this method can be recommended.

SUMMARY

Dairy farmers generally understand and accept that AI has real advantages over natural service for breeding replacement heifers. Many now using natural service would switch to AI if time, effort and facility requirements were reasonable. There are now several estrus control or synchronization methods available that may satisfy the time and effort concerns. Each potential method has basic principles that **MUST** be followed and then some options which allow some program modification for each situation. Taken together these principles and options create relative advantages and disadvantages for each method. Our purpose here has been to present each method that is currently commercially available in the United States.

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