Estrous synchronization programs for the dairy herd

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Topics Include:
Introduction
Prostaglandin programs
Ovsynch program
Presynch program
Additional considerations for all programs
Requirements of controlled breeding programs
Summary
INTRODUCTION

The major factor limiting optimum reproductive performance on many farms is failure to detect estrus in a timely and accurate manner. Several prostaglandin (PG) products are available for use in synchronizing estrus in heifers and lactating dairy cattle. These products were originally used to treat individual cows that had not exhibited heat by the time of desired first service. Several controlled or programmed breeding programs have been developed for synchronizing groups of lactating cattle.

In contrast to synchronization of estrus of dairy heifers and beef cattle, controlled breeding of the lactating herd is conducted on a continuing basis. Such programs must allow for the introduction of cows that become eligible for first insemination after calving and for cows that do not conceive to the initial insemination of the program. Controlled breeding can be directed to cows that possess a corpus luteum (CL), as determined by rectal palpation of the ovaries or administering PG to all open cows within a breeding group without palpation. The potential advantages of controlled breeding are listed below.

<table>
<thead>
<tr>
<th>Potential advantages of controlled breeding</th>
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<tbody>
<tr>
<td>1. Improve the efficiency of heat detection.</td>
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<tr>
<td>2. Achieve more timely first service.</td>
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<tr>
<td>3. Reduce the variation in calving intervals among cows.</td>
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<td>4. Possibly reduce involuntary culling for reproductive reasons.</td>
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<td>5. Concentrate labor for reproductive management to specific periods.</td>
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<td>6. Improve the pregnancy rate.</td>
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PROSTAGLANDIN PROGRAMS

1. Controlled breeding using ovarian palpation

Initially, controlled breeding programs were based upon ovarian palpation by a veterinarian to determine which cows had a functional CL, and thus would likely respond to PG. Such a program could be set up on a weekly, biweekly, or monthly schedule. However, the monthly program is not recommended, since too much time will elapse between injections.

With these programs, all cows eligible for breeding after the voluntary waiting period (55 to 75 days) are palpated on a given day of the week. Cows with a CL receive PG and are observed for heat several times daily on days 2, 3, 4, and 5, post-injection. Cows exhibiting standing behavior are inseminated accordingly. Cows without a CL, and those not observed in heat following the initial PG injection, are examined again during the next veterinary visit. This program continues on a routine basis and cows remain on the program until diagnosed pregnant or until a specific number of repeat inseminations have been attempted.

Appointment insemination after injection with a standard PG program is not recommended because the interval from the PG injection to onset of heat varies depending on the stage of the cycle when PG is administered. Therefore, the age of the CL and status of the developing follicle determine time to the onset of the heat following the PG injection. Cows in the early (day 7 and 8) and later (day 15-17) stages of the cycle tend to exhibit heat between 48 and 72 hours post-injection. However, cows in mid-cycle have a more variable pattern of response, which may be why appointment insemination generally has not been successful.
One of the essential factors for a successful controlled breeding program using palpation is accurate diagnosis of a functional CL. Combined data from four studies summarized at the College of Veterinary Medicine at the University of Illinois revealed that 20 percent of the cows selected by palpation for treatment with PG were not likely to respond, and 30 percent of the cows not selected for treatment could have been treated because functional luteal tissue was present. This does not indicate poor palpation technique, but suggests the difficulty in determining with a high degree of accuracy the functional status of the CL based on CL size and firmness. Furthermore, some corpora lutea are present but not palpable. Generally, veterinarians can easily distinguish between a CL and a follicle. However, it is more difficult to determine whether the CL is at a stage of development when it is likely to respond to PG.

2. Controlled breeding without ovarian palpation

Since several studies have shown a significant error rate in determining the presence of a functional CL based on palpation, other programs have been designed so that all eligible cows are injected with PG without ovarian palpation. Although PG will be administered to some cows that do not have a functional CL, this error is less costly than failure to administer PG to eligible cattle possessing a CL.

A. 7-day program

Cows eligible to be bred are injected with PG on a given day of the week. Cattle observed in heat are inseminated, and those not seen in heat are reinjected on the same day of the following week. This system is repeated on the third week, after which a veterinarian examines the cow. This practice is frequently referred to as the Monday morning program, since administering PG on Mondays will induce most heats between Wednesday and Saturday. Thus almost all inseminations will occur on weekdays. A second option is the Saturday AM program, where cattle are injected on Saturday so that inseminations occur on Monday through Thursday. A study was conducted at the University of Pennsylvania to compare controlled breeding programs in four herds with and without use of rectal palpation to determine ovarian status (presence of a CL). One synchronization program involved weekly PG injections every Monday to eligible cows that were 50 days postpartum. Cows observed in estrus were inseminated, and those not in estrus were injected the following Monday. Cows not seen in estrus after three weekly injections were examined, treated appropriately, and returned to the program.

The second program was the reproductive program currently used in the four herds. This consisted of either weekly or biweekly PG programs based on the presence of a CL via rectal palpation for all cows more than 50 days postpartum (similar to the program described in the section titled Controlled breeding using ovarian palpation). A summary of the trial results is presented in Table 1.

Fifty percent of the cows on the weekly program without palpation were pregnant by 97 days, compared to 110 days for the program using rectal palpation. There was a numerical increase in first service conception rate. However, the major factor contributing to the improved performance in the weekly PG program was the reduction in days to first service. Partial budget analysis showed that it cost $3.73 more per cow to use the program without palpation, but this program reduced the median days open by 13. An estimate for the cost of a day open over 90 days is $2 and the net benefit was $22.27/cow [(13 days x $2) - $3.73]. However, the 7-day program requires considerable time observing for heats.

B. 11-day or 14-day program

The 11-day program is a modification of the original two-injection program that was used when prostaglandins were introduced in 1979 for synchronization of beef cattle and dairy heifers. Based on the voluntary waiting period (VWP), eligible cows that receive PG are observed for heat two to five days after injection and inseminated accordingly. Cows that do not exhibit heat are re-injected 11 days later, observed for heat, and inseminated. Injections are continued at 11-day intervals until heat is exhibited. Some veterinarians may prefer to examine cows that fail to exhibit heat after the second or third PG injection.
Table 1. Reproductive performance and costs associated with two controlled breeding programs

<table>
<thead>
<tr>
<th>Item</th>
<th>Weekly PG program without palpation</th>
<th>Traditional PG program with palpation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cows</td>
<td>156</td>
<td>154</td>
</tr>
<tr>
<td>Average days to 1st service</td>
<td>72.5 *</td>
<td>78.3</td>
</tr>
<tr>
<td>First service conception (%)</td>
<td>46.9</td>
<td>42.0</td>
</tr>
<tr>
<td>Inseminated cows pregnant (%)</td>
<td>85</td>
<td>82</td>
</tr>
<tr>
<td>Cows culled (%)</td>
<td>16.8</td>
<td>14.5</td>
</tr>
<tr>
<td>Doses of PG</td>
<td>555</td>
<td>169</td>
</tr>
<tr>
<td>Cost of PG ($3/dose)</td>
<td>1665</td>
<td>507</td>
</tr>
<tr>
<td>Number of rectal palpations</td>
<td>547</td>
<td>835</td>
</tr>
<tr>
<td>Cost of palpations ($2/each)</td>
<td>1094</td>
<td>1670</td>
</tr>
<tr>
<td>Total cost ($)</td>
<td>2759</td>
<td>2177</td>
</tr>
<tr>
<td>Cost difference per cow ($)</td>
<td>3.73</td>
<td>–</td>
</tr>
<tr>
<td>Median days open per cow</td>
<td>97</td>
<td>110</td>
</tr>
<tr>
<td>Net benefit assuming $2/day open</td>
<td>$22.27</td>
<td>–</td>
</tr>
</tbody>
</table>

* denotes significance

Adapted from Kristula et. al. 1992, J. Dairy Sci 75:2713

The potential disadvantage of the 11-day program is that repeat injections and periods of concentrated heat detection and insemination do not occur on similar days of subsequent weeks. That means that scheduling farm labor and a veterinarian is more complicated.

The 14-day program is similar to those described above, with the exception that there is a 14-day interval between injections for cattle that do not exhibit heat following the previous injection. Frequently dairy producers, veterinarians, AI technicians have asked: why do the newer systems use a 14-day interval between PG injections instead of the original 11-day interval? Obviously, the 14-day program fits conveniently into a management schedule, but there is also a physiological reason for the change.

In 1990, Israeli researchers compared the 11- and 14-day intervals between PG injections in lactating cows. Although the conception rates to AI were similar for both groups, the percentage of cows that conceived within 30 days after first service and within 150 days after calving were significantly greater in the group given PG 14 days apart. The reason for the improvement with the 14-day program is likely due to more cows being in the diestrous stage of the cycle after the initial injection. Cows in diestrous are responsive to PG and more likely to exhibit heat. Therefore, the 14-day is the program of choice.

C. Setup PG treatment prior to breeding period

Targeted Breeding

An aggressive program, termed targeted breeding has been used. Cows are administered PG prior to the end of the VWP. The purpose of this treatment is to synchronize (setup) cows into a stage of the cycle, when they are most likely to respond to the breeding shot of PG administered.
PROSTAGLANDIN PROGRAMS (continued)

14 days later. Generally with this system, cows are not inseminated if they exhibit estrus following the initial PG injection.

Once a VWP is established for the herd, cows are listed chronologically according to calving dates. Those cows within 14 days of the end of the VWP are administered the setup shot. Fourteen days later, the cows receive the first breeding injection of PG and are observed for heat two to five days after injection and inseminated accordingly. Cows that do not exhibit heat are reinjected 14 days later, observed for heat, and inseminated. Injections are continued at 14-day intervals until estrus is exhibited. Some veterinarians and producers may prefer to examine cows that fail to exhibit heat after the third PG injection. Others may wish to appointment breed at a specified time after the third injection.

D. Modified Targeted Breeding - GnRH + PG system

This system (Figure 1) improves the targeted breeding program by using Gonadotropin Releasing Hormone (GnRH). It involves insemination of cows detected in heat following the synchronization program and timed insemination of those cows not observed in heat.

Eligible cows receive PG 21 days before the end of the voluntary waiting period (VWP). This is followed by a GnRH injection 14 days later and a second PG injection 7 days after the GnRH injection. During the three days following the last PG injection cows are inseminated based on observed heat. Cows not observed in heat by 72 hours post-PG injection are inseminated between 72 and 80 hours. Thus all cows are inseminated.

Figure 1. Modified Targeted Breeding Program

<table>
<thead>
<tr>
<th>PG</th>
<th>GnRH</th>
<th>PG</th>
<th>Timed, AI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup</td>
<td>Breeding Shot</td>
<td>and AI</td>
<td>72-80 hrs.</td>
</tr>
<tr>
<td>14 days</td>
<td>7 days</td>
<td>3 days</td>
<td></td>
</tr>
</tbody>
</table>

*Timed AI-cows not observed in heat

OVSYNCH: GnRH-PG-GnRH PROGRAM - TIMED AI

The Ovsynch program has been developed which synchronizes ovulation which results in better conception rates to timed AI than can be achieved with traditional PG programs. An injection of GnRH or one of its analogs followed seven days later with PG has been shown to synchronize estrus effectively. GnRH affects follicular growth by causing either ovulation or luteinization of the dominant follicle and prevents estrus until after the PG injection, which causes the corpus luteum or luteinized follicle to regress. A new dominant follicle forms and is available to be ovulated by the second GnRH injection given 48 hours after the PG injection, (Figure 2). This program synchronizes follicular development and ovulation. This allows for effective timed AI.

During an initial study, inseminations were timed between 20 to 24 hours after the last GnRH injection, Table 2. Since the original study, more recent research determined the more optimal interval to be 10-20 hrs. Compared to control cows on the same farms observed twice daily for estrus without use of a synchronization program, pregnancy rates at the first insemination were similar between controls and
synchronized cows. However, days to first insemination, days open, and the proportion pregnant by 60 to 100 days in milk were improved for the synchronized group.

According to these results the Ovsynch program is effective in improving the percentage of cows pregnant by 60 and 100 days in milk and may reduce the days to first service. Based on several recent field trials, adjustments in the time intervals between injections and insemination have been made (see Figure 2). The timing of the first GnRH injection is not critical. However, the timing of the other injections is critical so that insemination occurs at a reasonable time of day. Some points to consider when using this program:

1. The conception rate with Ovsynch is generally lower compared to insemination after detected estrus. However, the advantage is that all cows are time-inseminated without estrus detection. It will likely increase pregnancy rate early in the breeding period.

2. This program should not be used for heifers.

3. Conception rates based on ultrasonography at 25 to 35 days after insemination, were slightly greater when the insemination was made at 16 hours after the second GnRH injection compared to other time intervals.
OVSYNCH: GNRH-PG-GNRH PROGRAM (continued)

4. If a cow exhibits estrus before the completion of the hormonal treatments, she should be inseminated and the remaining injections should not be administered. One of the major concerns with this program is that few cows exhibit estrus following the complete hormonal treatment. The likely reason for the general lack of estrus is that the second GnRH injection stimulates the release of luteinizing hormone (LH). This induces the follicle to ovulate, terminating estrogen production and allowing for the formation of a corpus luteum. Estrogen is responsible for expression of signs of heat.

5. It may be useful for cows that simply do not express estrus after several attempts with PG.

6. This program is also useful in herds where cattle are not turned-out for heat detection on a routine basis.

7. Eliminates heat detection prior to first service.

8. Handle cows 4X in 10 days - must develop a system.

9. Caution - since timed breeding is used on first service, dairy producers may be less diligent in "catching" return heats.

10. Some studies have shown that a half dose of GnRH is effective. Caution - can you be assured the smaller dose is completely delivered?

As with any new management practice one should make the decision about adopting the program based upon the labor and drug costs and anticipated success rates. If the procedure is adopted, make sure enough breeding results are obtained before making the decision as to whether to continue or discontinue the program.

PRESYNCH PROGRAM

The purpose of the Presynch program is to synchronize a group of cows into a stage of their cycle (days 5-12) when they will have a high probability of responding to the Ovsynch system. It is a timed breeding program.

Approximately 28 days (+ 3 days) prior to the initiation of the Ovsynch program a group of cows receive an initial injection of PG. The program can be initiated at a specified number of days postpartum depending on the VWP selected by the herd manager. Cows can be assigned to the group within + 3 days of the target. This is followed by a second PG injection 14-days later. Ideally, the Ovsynch program is initiated 12-days after the second PG injection. However, to simplify the program, the Ovsynch program can be initiated 14-days following the second PG injection. Thus the injections are on a two-week schedule to this point. Figure 3 illustrates the sequence of injections.

**Figure 3. Presynch - Ovsynch System**

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PG-1  PG-2  GNRH  PG  GNRH  TIMED AI
28 ± 3 days  42  54  61  63  64 VWP
bST*  bST*
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* bST may improve results when given at first GnRH inj. or breeding

DAS 01-35  Estrous synchronization programs for the dairy herd  6
PRESYNCH PROGRAM (CONTINUED)

There are more injections with the Presynch program but there is better synchrony of ovulation. A comparison of the two systems is presented in Table 3. This research was conducted at the University of Florida and Kansas State University. Other research from Florida has shown a beneficial effect of administering bovine somatotropin (bST) either at the time of the initial GnRH injection or at the time of timed insemination (see Figure 3).

Table 3. Comparison of Presynch and Ovsynch

<table>
<thead>
<tr>
<th>Location</th>
<th>Ovsynch</th>
<th>Presynch</th>
<th>1st Serv. Preg. &amp; # of cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas State</td>
<td>29.3%</td>
<td>42.8%</td>
<td>274</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>269</td>
</tr>
<tr>
<td>Univ. Florida</td>
<td>34.9%</td>
<td>46.0%</td>
<td>304</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>313</td>
</tr>
</tbody>
</table>

ADDITIONAL CONSIDERATIONS FOR BOTH PROGRAMS

Pregnancy examinations

Incorporate routine examinations for pregnancy into a controlled breeding program so that open cows can be identified early and recycled back into the program. Resynch: An aggressive program called resynchronization (Resynch) of open cows that were inseminated can be used to reduce the interval between services for cows determined to be open at pregnancy examination. All cows that are inseminated received GnRH 7-days prior to scheduled pregnancy examination. Cows determined to be open receive a PG injection on the day of palpation and a second injection of GnRH is administered 36-48 hours after the PG injection. This is the Ovsynch program. These cows are inseminated between 10-18 hours following the GnRH shot.

Estrous detection aids

Apply chalk, crayon, paint markings, or Kamar patches to cattle at the time of PG injection. This should enhance the efficiency of estrous detection with the PG program.

Numerous cows in estrus simultaneously

Inducing estrus in groups of cattle improves the likelihood of detecting heat among the herd because mounting and standing behaviors increase when several cows are in estrus, Table 4.

Table 4. Effect of number of cows in heat on mounting activity.

<table>
<thead>
<tr>
<th>Number of cows</th>
<th>Average mounts per cow in heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11.2</td>
</tr>
<tr>
<td>2</td>
<td>36.6</td>
</tr>
<tr>
<td>3</td>
<td>52.6</td>
</tr>
<tr>
<td>4 or more</td>
<td>49.8</td>
</tr>
</tbody>
</table>

REQUIREMENTS OF CONTROLLED BREEDING PROGRAMS

A. A high percentage of the cows must be cycling normally. Nutritional, environmental, or disease factors that cause anestrus or repeat breeding must be corrected before starting a controlled breeding program.

B. Although the Presynch and Ovsynch programs will induce some anestrous cows to ovulate, pregnancy rates will significantly increase in relation to the percentage of cows that are cycling at the onset of the program.

C. Research has shown that pregnancy rates for the Ovsynch and Presynch programs are significantly higher for cows with Body Condition Scores (BCS) $\geq 2.5$ compared to cows with BCS $< 2.5$.

D. Herd managers and veterinarians must make a commitment to the estrous synchronization program.

E. Accurate records must be kept. A list of eligible cows must be updated regularly.

F. Efficient and accurate heat detection for the specified days is essential when using the PG program.

G. Herd managers and veterinarians must adhere to the time schedule for injections, heat detection, insemination, and pregnancy examinations.

SUMMARY

All the estrus synchronization programs described in this publication are effective. Results from several field studies reveal that controlled breeding programs for lactating cattle are beneficial when the level of management was good before the program was adopted. The overall objective of these systems is to develop and use a plan whereby a high percent of herd becomes pregnant in early lactation.

Goal: achieve a pregnancy rate greater than 25%. Pregnancy rate equals heat detection rate X conception rate during a 21-day period.

If herd and reproductive management practices are poor, then the benefits of such programs will not be obtained. Controlled breeding should be considered a tool to improve reproductive efficiency through a systematic, timely, and labor efficient management of reproductive events.

Which system is best? If your heat detection program is effective and manageable, then estrous synchronization may not be appropriate for your operation. However, if poor heat detection has been the limiting factor to achieving good reproductive performance then consider a synchronization program. If heat detection efficiency is good but you want to focus heat detection to specific periods then prostaglandin programs are appropriate. Ovsynch and Presynch are the programs of choice when heat detection is poor or you prefer a timed AI program.

There is a synchronization WEB site:
- [www.iowabeefcenter.org](http://www.iowabeefcenter.org)
- It describes most synchronization programs
- There is a calendar for most programs
- Herd specific costs can be entered.
- Cost per cow is calculated.

This publication is available in alternative media on request.

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