

Estrous Synchronization Programs for Dairy Cows and Heifers

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Introduction: Although milk production as measured by rolling herd averages has increased markedly for dairy herds in the Western United States over the last decade, reproductive performance of these herds has declined significantly. Average days open have increased by 25 days and fertility has declined as measured by an increase of 0.37 services per conception and first service conception rates have declined from 49.4 to 43.9 percent over the last decade. Heat detection rates for dairy herds at the major dairy record processing centers average slightly over 40 percent. Poor heat detection rates and declining fertility are the primary factors contributing to the reduction in reproductive performance of dairy herds. Two things have evolved over the last decade to help dairy producers improve the reproductive performance their herds. The first factor is better means of measuring the reproductive performance of herds and measuring the response to reproductive interventions. To be able to evaluate the success of various reproductive interventions, producers need a measure of reproductive performance that is current and sensitive to changes. Pregnancy rate has developed as the best measure of herd reproductive performance. The second factor is the advent of new estrous synchronization programs. It is important to be aware of the various programs that are available, to understand what can be expected in outcomes from implementations of the programs and to know the pros and cons of implementing these programs. This paper will review the use pregnancy rate as a tool to measure of reproductive performance of dairy herds and the various estrous synchronization programs for dairy.

While the dairy record processing centers provide us with summaries on the reproductive performance of dairy herds, very little information is available on the reproductive performance of replacement dairy heifers other than the average age at first calving. The accuracy of this parameter is questionable as the producer frequently estimates the age at first calving for purchased heifers to be 24 month. In contrast to the amount of information that is available on estrous synchronization programs in dairy cows, relatively little information is available on estrous synchronization programs for replacement dairy heifers. Pharmacia has recently received FDA approval for use of the Eazi-Breed CIDR insert in replacement dairy heifers. This technology provides producers and calf ranch managers a new tool to effectively synchronize estrus in replacement heifers and allow for artificial insemination.

Measuring reproductive performance of dairy herds

Pregnancy Rates

One of the things that has become apparent through the decade of the nineties was that the old measures of herd reproductive performance such as days open and conception rate were often not providing a clear, timely, or useful picture of the herd's actual reproductive performance. Days open is an example of a measure is frequently used to monitor the reproductive performance of herds but may even provide misleading information. The actual calculation of days open includes three categories of cows. The first category is the interval from calving to conception for cows that have been confirmed pregnant. At any given point in time in most herds, it is rare for more than fifty percent of the cows in the herd to have been confirmed pregnant. To include more cows in the herd, DHI-Provo included a second category of cows.

These are cows with breeding dates but the outcome the breeding had not yet been determined. The interval from calving to the last breeding for these cows is included in the calculation of days open for the herd. It becomes obvious that this is an extremely optimistic number as only about one third of the cows will conceive to this last breeding date and two thirds of the cows will fail to conceive and will have an even greater interval to be included in the days open calculation. The third category of cows included in the calculation of days open are cows that are greater than thirty days beyond the voluntary wait period and have not yet serviced. The current days-in-milk for these cows is included in the calculation of days open for herd. This has to be considered an even more optimistic number since these cows will have an even greater number of days than their current days-in-milk when they actually become pregnant. In addition to the concerns about the calculation of days open, there are concerns over the lag, momentum, and bias associated with days open. Momentum is the amount of “weight” that carried into the calculation of the parameter with old or historical data. The implication that because of the large amount of historical data in the measure, it takes a long time before days open changes when there is a either good or bad change occurs in current days open.

Pregnancy rate is the percentage of pregnancy eligible cows that become pregnant in a twenty-one day period of time. It is driven by two of the most important factors determining herd reproductive performance: conception rate and the rate of heat detection. Three ways that pregnancy rate can be used monitor reproductive performance of the herd: 1) cross-sectional pregnancy rates, 2) longitudinal pregnancy rate, and 3) cohort pregnancy rates. With the advent of systematic breeding programs, it becomes especially important to have a measure of herd reproductive performance that allows the producer to know how the breeding program is performing in a timely manner.

Cross-sectional pregnancy rates.

The calculation of cross-sectional pregnancy rates is done by dividing the past year into twenty-one day intervals of time. Within each of those intervals, the pregnancy rate for all the pregnancy eligible cows is determined. Within each of those intervals there will be cows that will be receiving their first service through fourth, fifth, or even later services. Cross-sectional pregnancy rates are useful in evaluating the seasonal effects such as heat stress on pregnancy rates.

Longitudinal pregnancy rates.

Longitudinal pregnancy rates are calculated for the first and each subsequent estrus cycle after the voluntary waiting period. It is important to appreciate that the pregnancy rate for first estrous cycle after the voluntary wait period includes cows that have just had their first estrous cycle following the voluntary wait to cows that their first service over a year ago. This is particularly useful for monitoring the rate at which the herd is getting pregnant following the voluntary wait period.

Cohort pregnancy rates.

Cohort pregnancy rates are calculated for groups of cows by period of freshening. It can be done for calving within one, two, four, or eight-week periods of time. The number of weeks to include to create a cohort group is determined by the number of cows freshening within that period. Ideally, cohort groups should contain a minimum of 20 to 25 cows. Cohort groups can be used to monitor first cycle, cumulative three cycle, cumulative six cycle, and program compliance rates for systematic breeding programs.

Take home messages:

Pregnancy rate is an essential tool for measuring reproductive performance of dairy herds. Cohort pregnancy rates can be an effective tool for measuring the success of systematic breeding programs and the best means of monitoring for changes in the reproductive performance of the herd.

Estrous synchronization programs for dairy cows

Ovsynch

Ovsynch, which was introduced in 1995, was really the first estrous synchronization program for dairy cattle with an effective timed insemination (TAI) component. Prior to the introduction of Ovsynch, luteolytic prostaglandins (PGF_{2a}) had been used to synchronize estrus followed either by estrous detection or a with two timed inseminations at a 24 hour interval. The double inseminations were necessary with appointment breedings to achieve reasonable success because the timing of ovulation was quite variable following the PGF_{2a} injection. The Ovsynch program consists of an injection of GnRH followed in seven days by an injection of a PGF_{2a}. Forty-eight hours after the PGF_{2a} injection, the cows are given a second injection of GnRH that further improves the synchrony of ovulation so with a timed insemination can be done at 0 to 24 hours (Figures 1 and 2). The pregnancy rates at the various intervals from the second GnRH to the TAI are shown in Table 1. The initial pregnancy rates were determined using ultrasonography 25 to 35 days following AI for determining pregnancy status. The highest pregnancy rates were achieved for cows inseminated at 16 hours after the second GnRH injection. However, the calving rate was only four percentage points better for the cows inseminated at 16 h compared to the cows inseminated at the time of the second GnRH injection. Dairy management frequently finds that it is difficult to get good lock-ups at times other than at a routine daily lock-up time making a lock-up for insemination at 16 h after the second GnRH injection difficult or impractical. With only a four percentage advantage in calving rate, producers may accept a loss of this advantage as an equitable trade if cows can be locked-up, identified, treated with GnRH and bred at the same time of the day.

The success of an Ovsynch program is affected by several factors. Two field studies have reported that there is a marked improvement in pregnancy rate when cows are inseminated after 70 to 75 days-in-milk (Table 2). Several studies have observed that the incidence of anestrous or anovulatory cows at 60 to 70 days-in-milk ranges for 20 to 30 percent. It appears that the prevalence of anestrous cows is herd dependent. Within herds the prevalence of anestrus for first lactation cows is usually two to four times greater than in second lactation and older cows. In a recent trial, the pregnancy rate of cycling cows was 37% compared to 10% for anovulatory cows (Gumen, et al., 2002). The pregnancy rate is usually lower for cows that have had periparturient health problems such as dystocia, stillbirths, retained fetal membranes, and metritis.

Take home messages:

- 1) Ovsynch is an effective estrous synchronization for cattle with a pregnancy rate of approximately 30 percent.
- 2) Ovsynch is, as the name implies, an effective means of synchronizing ovulation but not necessarily estrus. If cows are observed for estrus, approximately 15% of cows will display a standing estrus and 85% will be bred by a TAI. Experienced inseminators may not be comfortable in inseminating cows that lack estrous mucus and uterine tone associated with breeding by TAI.
- 3) Pregnancy rates were better for cows synchronized with Ovsynch when cows were inseminated after 70 to 75 DIM than earlier in lactation. Some producers are able to accomplish the same proportion of pregnancies in one cycle following an Ovsynch program that previously took them two or three estrous cycles to accomplish when cows were bred on the basis of observed heat without a systematic breeding program.
- 4) Pregnancy rates are better for cows that are cycling at the initiation of the Ovsynch program than for anestrus cows. However, Ovsynch will induce some of the anestrus cows to cycle. Although the pregnancy rate is lower for the anovulatory cows than cycling cows with Ovsynch, the pregnancy rate for the anovulatory cows bred by TAI following is still better than if cows were not treated and not bred.
- 5) The pregnancy rate for cows that have periparturient health problems has been considerably lower than for cows that have had an uneventful periparturient period.
- 6) The conception rates for replacement heifers bred on an Ovsynch program have been disappointingly low.

Co-Synch is sometimes used as a description for a specific format of the Ovsynch program when cows are bred at the same time as they receive the second GnRH injection in the protocol.

Select Synch is a term used to describe a program that consists of a GnRh injection followed in seven days by a PGF_{2a} injection. After the PGF_{2a} injection, cows are observed for estrus and bred on the basis of a standing heat. The advantages of this program are the reduced cost associated with one less GnRH injection than with the Ovsynch program. The potential disadvantage of this program is that the heat detection rate is less than the service rate for Ovsynch and that the ovulation rate may be less following the PGF_{2a} injection than after second GnRH injection in the Ovsynch program. In one trial (Cartmill, et al., 1999) the pregnancy rate for cows on the Select Synch program was 17.5% vs. 31.3% for cows on the Ovsynch program. The AI submission rate is usually considerably lower for cows on the Select Synch program compared to a program that has a TAI component. Some trials have also shown that the ovulation rate is significantly higher when cows are treated with either GnRH or estradiol which will induce an LH surge after the last PGF_{2a} injection.

Pre-Synch is a term used to describe a program that consists two injections of PGF_{2a} administered at a fourteen day interval with the second PGF_{2a} administered 12 to 14 prior to an Ovsynch program. Three field trials have compared the pregnancy rates achieved with the Ovsynch program vs. the Pre-Synch program. The pregnancy rates for the cows on the Ovsynch program ranged from 29 to 38 percent compared pregnancy rates of 43 to 48 percent for cows on the Presynch program. In these trials, there was a 10 to 14 percent point advantage in the pregnancy rate for the cows on the Pre-Synch program over the Ovsynch program. Vasconcelos, et al., 1997, has show that pregnancy rates of cows entering an Ovsynch program were affected by the day of the estrous cycle cows were at when they received the first GnRH injection. Cows that were between day 5 and 12 of the estrous cycle had the highest pregnancy rates. By “pre-synching” cows with two injections of PGF_{2a}, prior to the first GnRH in the Ovsynch program a higher proportion of cows are between days 5 and 12 of the estrous cycle when they receive the first GnRH injection.

Take home messages:

- 1) Pregnancy rates can be improved by 10 to 14 percentage points over the pregnancy rates achieved with an Ovsynch program.
- 2) Because five injections are given over a five-week period to execute the Pre-synch program, some dairies experience a problem in getting all the injections into cows in at the correct times. A failure to get cows to get the injections done at the appropriate times will reduce the success of the program

Heat-synch is an estrous synchronization protocol that substitutes an injection of ½ cc of ECP[®] at 24 h after the PGF_{2a} for the last GnRH in the Ovsynch protocol. By substituting ECP[®] for GnRH, more cows display estrus than with GnRH. In a comparison of Heat-synch to Ovsynch protocols, Pancarci, et al., 2002, reported that 66.6% of the cows on the Heat-synch protocol were detected on the day of TAI compared to 20.0% of the cows on the Ovsynch protocol. In the same paper, the authors reported the average number of mounts per cow on the Heat-synch protocol was 20.2 using the HeatWatch[®] system which considerably greater than the 7.2 mounts per heat reported by Nebel, 1997, for cows having spontaneously occurring heats. Because more of the cows on a Heat-synch protocol have estral mucus and uterine tone at the time insemination, experienced inseminators usually prefer breeding cows synchronized on the Heat-synch protocol compared with Heatsynch protocol.

Take home messages:

- 1) A greater proportion of cows will show estrus on the Heat-synch protocol than on the Ovsynch protocol.

- a. The Heat-scynch protocol requires estrus detection for the best pregnancy rates. Dairies that aren't willing detect estrus may do better with either Ovsynch or Pre-synch protocols.
 - b. The greater proportion cows that have estral mucus and increased uterine tone at the time of insemination inspire greater inseminator confidence.
 - c. The proportion of cows detected in estrus following the ECP injection has diagnostic value. A low proportion of cows detected in estrus suggests that there is either a problem with the intensity of heat detection or a high proportion of anestrous cows.
- 2) The pregnancy rate for cows bred on the basis of a standing heat is considerably higher than the pregnancy for cows bred by TAI. A strategy to take advantage of this difference in pregnancy rate is to breed the cows observed in standing estrus with more expensive, proven-sires and use less expensive young sires for the TAI breedings.

Estrous synchronization programs for dairy heifers

Eazi-Breed CIDR[®]

Pharmacia began marketing the Eazi-Breed CIDR[®] for use in beef cows and beef and dairy heifers on June 17, 2002 in the United States. The protocol consists of inserting the CIDR in the vagina of the heifer for seven days. On the sixth day following insertion of the CIDR or one day before removal, the heifers are treated with a regular dose of Lutalyse[®]. On the seventh day following insertion, the CIDR is removed and heifers are observed for estrus (Figure 3). In Pharmacia's pivotal trials for CIDR approval in dairy heifers, 275 heifers were randomly assigned to one of two treatment groups: a single i.m. injection of 25 mg Lutalyse or administration of a CIDR insert for 7 days with an i.m. injection of 25 mg Lutalyse on day 6 of the 7-day CIDR insert administration period (CIDR + PGF_{2a}) (Chenault, et al., 2002). The synchrony of estrus in the CIDR + PGF_{2a} group was improved in comparison with the PGF_{2a} group, with 83 vs. 59%, respectively, in estrus over the 3 d after CIDR inserts were removed. Over the first nine days of the breeding season, 90% of the CIDR + PGF_{2a} group were detected in estrus compared to 63% of the PGF_{2a} group (Figure 4). No differences were detected between treatment-groups in first service conception rate to artificial insemination (AI) over the first three days (58 vs. 64%) or the entire 31-day AI period did not differ among treatment groups. Among the 136 heifers administered CIDR inserts, 10.3% of the animals lost their inserts before the scheduled day of removal. Eight inserts were lost from a group of 10 heifers in one pen. In non-pivotal studies in dairy heifers the loss rates was 1.2%. Mild vaginitis, observed in nearly all heifers at one location, was resolved by the time of AI and did not adversely affect conception rates.

Take home messages:

- 1) There are several advantages to using artificial insemination to impregnate replacement heifers. They include: a) the ability to select calving-ease sires to reduce the risk dystocia in heifers having their first calf. b) to use proven sires to increase the rate of genetic improvement in the herd.
- 2) The Eazi-Breed CIDR is an effective means of synchronizing estrus in a very high percentage dairy heifers and concurrently achieving the normally high conceptions rates seen with heifers bred on the basis of standing heat.

MGA and PGF_{2a}

In this estrous synchronization for replacement dairy heifers, melengestrol acetate (MGA) is fed at the rate of 0.5 mg per head per day for 14 days to suppress estrus. Upon withdrawal of MGA from feed, heifers come into a synchronized heat; however, animals are NOT bred as fertility would be decreased. Nineteen days after withdrawing the MGA, an injection of Lutalyse is given and animals are observed for estrus for 5 days. Any animals not observed in heat are bred by appointment 72 hours post-injection.

Take home messages:

- 1) The major disadvantage to this program is the length of time required from program onset to insemination.
- 2) The advantages of this program include:
 - a. There are very low labor requirements; heifers are fed the MGA and only have to be restrained for one injection and for insemination.
 - b. Costs are minimal relative to other synchronization programs.
 - c. Pregnancy rates are excellent.

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Ovsynch

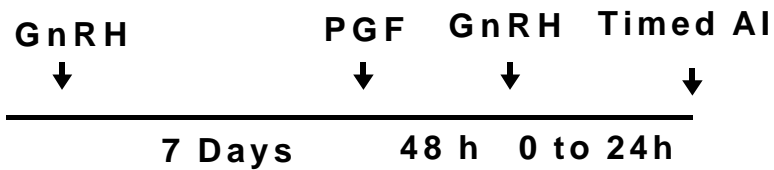


Figure 1.

Figure 2. Calendar for injections with Ovsynch program

Week 1	S	M GnRH	T	W	Th	F	Sat
Week 2	S	M PGF	T	W GnRH ← TAI →	Th	F	Sat

Eazi-Breed CIDR®

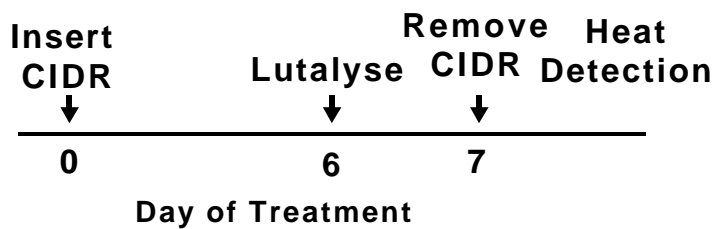


Figure 3.

Percentage of Dairy Heifers in Estrus in Nine Days Following CIDR

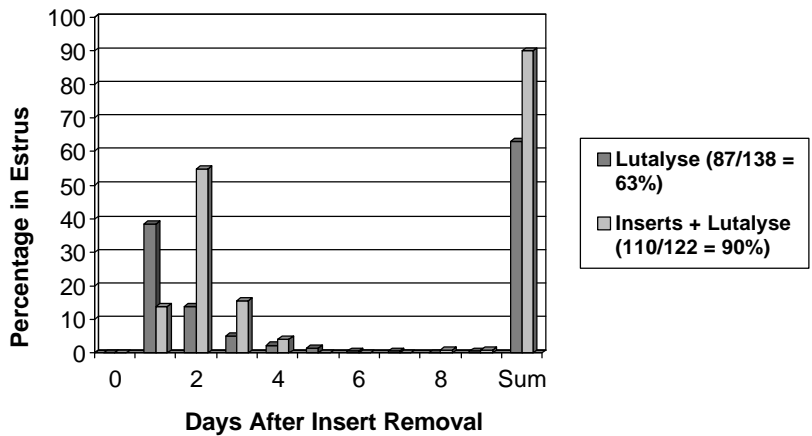


Figure 4

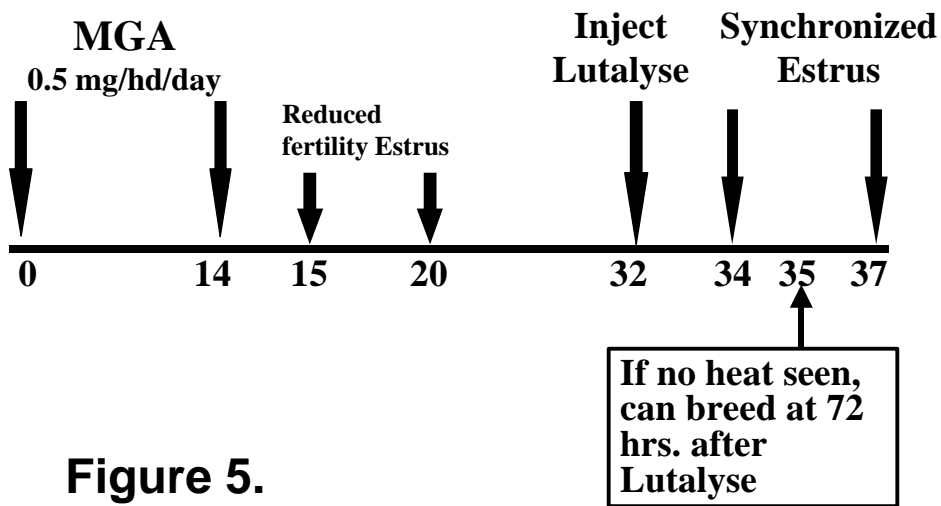


Figure 5.

Schedule for MGA Synchronization Program

Wk 1	M	T	W	Th	F	S	S
Wk 2	M	T	W	Th	F	S	S
Wk 3	M	T	W	Th	F	S	S
Wk 4	M	T	W	Th	F	S	S
Wk 5	M	T	W	Th	F	S	S
Wk 6	M	T	W	Th	F	S	S

MGA

PGF_{2a} Heat Detection Heat Detection

Timed AI b

Figure 6

Table 1. Reproductive performance of cows inseminated at specific intervals after a timed insemination following the second GnRH injection

	Time from second GnRH to AI				
	0 h	8 h	16 h	24 h	32 h
Cows, no.	149	148	149	143	143
PR/AI, %	37	41	45	41	32
Pregnancy Loss, %	9	21	21	21	21
Calving rate, %	32	34	36	32	23
Female:male ratio (%)	61:39	54:55	54:46	54:46	65:35
% Breedings w/ heifer calf	19	14	18	16	13

Adapted: Pursley, et al., 1998. JDS 81:2139

Table 2. Effect of interval from calving to insemination on pregnancy rate

	Early Insemination		Late Insemination	
	DIM	Pregnancy Rate	DIM	Pregnancy Rate
Pursley, et al., 1998	50-75	36	76-100	47
Pursley & Wiltbank, 1997	60-75	26	>75	43.4