Estrus Synchronization in Dairy Cattle

Reproduction is one of the most important aspects of a successful dairy operation but is often overlooked. Most dairy operations focus on increasing milk production to increase profit, and reproduction directly impacts milk production. Cows reach peak milk production in their first 120 days of lactation. The more lactations a cow has, the more time she spends producing at her peak, making her more efficient and more profitable. Therefore, achieving pregnancy in females as quickly as possible after their voluntary waiting period (VWP) maximizes profit. The VWP is the time defined by the producer, often 60 days, during which an early lactation cow will not be inseminated, even if she displays signs of estrus (heat). An estrus synchronization program can ensure that cows are being inseminated as soon as possible after the VWP.

Why synchronize?

Estrus synchronization can be a very beneficial tool for dairy producers. First, synchronization facilitates artificial insemination (AI). Artificial insemination is a great opportunity to advance the genetics of any herd. The use of AI helps eliminate the spread of sexually transmitted diseases, may decrease dystocia by allowing for the selection of sires chosen for calving ease, allows for a known date of conception and thus accurate dry-off dates, and reduces the risk of injury to employees from dangerous bulls (Vishwanath, 2003). The use of a synchronization program can also improve the reproductive performance of the herd. A proper synchronization program ensures animals are inseminated until they conceive or are culled. A synchronization program will help decrease the average days in milk (DIM) of the herd, decrease the DIM at first service, and decrease the calving interval. These are all factors that increase profitability.

The average value of a new pregnancy is $278 (De Vries, 2006). The value increases when conception takes place early in lactation, as well as in both first lactation animals and in cows that produce more milk (De Vries, 2006). For every day past 150 DIM, production decreases an average of 0.2 pounds per day. A herd with an average DIM of 200 days is losing approximately five to ten pounds of milk per cow per day. The optimum calving interval (time between calves) is 13 months (Hilty, 2008). Calving interval and average DIM are correlated; that is, one decreases when the other decreases. It is clear that improved fertility and management of reproduction will increase milk production and overall farm profitability.

Estrous cycle and hormones

The estrous cycle is a series of events that allows multiple opportunities for a female to become pregnant. The cycle starts with estrus and ends with the subsequent estrus. The time between these two estrus events averages 21 days but can vary between 17 to 24 days. The estrous cycle has four stages: estrus, metestrus, diestrus, and proestrus. The most obvious and visual of these stages is estrus. During estrus, the female is in standing heat, which means she is visually receptive to the male and stands still to be mounted. Ovulation follows the start of standing estrus by approximately 27 hours (Walker et al., 1996); therefore, standing estrus is

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Table 1. Hormones involved in reproduction and commonly used in estrus synchronization protocols.

Hormone	Origin	Function	Products*	Approximate cost per dose
Estrogen	Dominant follicle	Induces behavioral estrus	Not FDA approved for use	–
Progesterone	Corpus luteum	Maintains pregnancy and suppresses ovulation	Eazi-breed CIDR[1]	$10
Prostaglandin $F_{2\alpha}$	Uterus	Regresses the corpus luteum	Lutalyse[1] Estrumate[2]	$3
Gonadotropin releasing hormone	Hypothalamus	Indirectly stimulates ovulation	Factrel[1] Fertagyl[2] Cystorelin[3] OvaCyst[4]	$5

* Always consult with herd veterinarian and refer to label for dosage and use.
[1] Zoetis; Kalamazoo, MI.
[2] Merk Animal Health; Summit, NJ.
[3] Merial; Duluth, GA.
[4] Butler Schein Animal Health; Dublin, OH.

used to identify animals in estrus and to establish the proper time for insemination.

Several hormones control the estrous cycle (Table 1). These hormones occur naturally in the female and orchestrate ovulation as well as behavior during standing estrus. You can manipulate the estrous cycle and ovulation to fit your schedule by administering these same hormones (except for estrogen). The result is a predictable timing of estrus and ovulation that results in more cows being inseminated than estrus detection alone.

Protocols to synchronize estrus or ovulation

Many protocols can be used to synchronize the estrous cycle and ovulation. So many exist, in fact, that choosing a protocol may be the most difficult part of synchronizing the herd. To make the decision easier, the Dairy Cattle Reproduction Council, a group of university researchers from across the U.S., assembles a dairy reproduction protocol sheet. There is a protocol sheet for heifers, one for cows, and a Spanish translation. The protocols included in the sheets have been researched extensively and selected because they help achieve consistent, satisfactory conception rates. They are simple to use, which decreases the burden of choosing a protocol. The most current protocol sheets can be accessed at www.dcrcouncil.org/protocols.aspx. The protocols described below are all included in the protocol sheets from the Dairy Cattle Reproduction Council.

These are some of the hormone abbreviations used used in the protocols:

- Prostaglandin F2alpha = PGF
- Gonadotropin releasing hormone = GnRH

Presynchronization

Cows respond better to estrus synchronization protocols if they are presynchronized first. Presynchronization gets cows to a point in their estrous cycle when they respond best to estrus synchronization. Many producers feel the better response rate is worth the time and money to presynchronize. One of the two common presynchronization (Presynch) protocols is called 2xPGF. This protocol involves two injections of PGF2α, 14 days apart, followed by an Ovsynch protocol (see below) 12 days later.

The second Presynch protocol is GnRH-PGF-GnRH. This protocol requires GnRH on day 0, PGF2α on day 7, and GnRH on day 10 followed by an Ovsynch protocol 7 days later. Presynch is used only for the first postpartum AI after calving and is a great way to ensure that all animals will be inseminated early in their lactation, which will decrease DIM at first service.

Ovsynch

The Ovsynch protocol was the first synchronization protocol developed for the use of timed artificial insimination (TAI). TAI has two major advantages:

- it does not require detection of estrus, which decreases labor needed, and
- it ensures all females are inseminated, which increases the total number of cows that become pregnant.

There are two main variations of Ovsynch; they differ only in the timing of the final injection. The first, Ovsynch48, requires an injection of GnRH on day 0 and an injection of PGF2α 7 days later. A second injection of GnRH is administered 48 hours later, and the cow is inseminated 8 to 24 hours after the final injection of GnRH.

The second Ovsynch protocol is Ovsynch56. This protocol also starts with an injection of GnRH on day 0 and an injection of PGF2α on day 7. The difference is the timing of the last injection of GnRH. In Ovsynch56, the GnRH is administered 56 hours after the PGF2α and TAI is performed 16 hours later. These are both great protocols for synchronizing large groups of animals at a minimal cost.

CIDR Synch

A CIDR is a vaginal insert that releases progesterone and can be used with either of these Ovsynch protocols. The CIDR is inserted at the time of the first injection of GnRH and is removed at the time of the injection of PGF2α . The use of a CIDR can increase conception rates but will also increase the cost of the protocol.

Resynchronization

Resynchronization (Resynch) sets up cows that did not conceive to the first AI. In a Resynch protocol, cows should be checked for pregnancy by a veterinarian 32 ± 3 days after AI. Cows that are diagnosed not pregnant are administered GnRH, beginning the Ovsynch48 or Ovsynch56 protocol. On day 40 after initial AI, the cow receives an injection of PGF2α and then an additional injection of GnRH on day 42. The cow is inseminated 16 to 24 hours later, depending on the Ovsynch protocol chosen.

A more aggressive resynchronization protocol is available and lessens the time between two inseminations. Resynchronization begins before pregnancy diagnosis. The first injection of GnRH of the Ovsynch protocol is given on day 26 after initial AI instead of day 33. Pregnancy diagnosis is still conducted on day 33, but if the cow is not pregnant, she receives an injection of PGF2α and continues the Ovsynch protocol. If pregnant, she receives no further injections. On day 35, the cows that received PGF2α also receive an injection of GnRH and are inseminated based on TAI of the chosen Ovsynch protocol. This use of resynchronization shortens the interval between inseminations by seven days. To be successful, both Resynch protocols require early pregnancy diagnosis and a great management system.

Which protocol is right for your operation?

Choosing which protocol is right for your operation can be very difficult. Facilities, labor, and cost can act as limiting factors.

Synchronization protocols require handling animals many times. Having adequate facilities, such as headlocks or a palpation rail, makes applying a protocol much easier. Proper facilities for handling cows can greatly reduce the amount of labor and time required to carry out a protocol.

An effective synchronization program also requires labor. The protocols require injections, heat detection, and AI. Hormones must be administered to the correct animals at the correct times. Failure to do so will lead to poor conception rates. Other points to keep in mind are the amount of time required to heat detect and the number of animals being synchronized at one time. A protocol that uses TAI instead of heat detection can reduce the amount of time required. Furthermore, excellent record keeping is essential to success.

Estrus synchronization can be a very valuable tool for a dairy producer. Getting cows pregnant is a vital part of any operation. A synchronization program can help make your dairy business more efficient. In the end, the goal of any business is to make a profit, and a synchronization program may help accomplish that goal.

References

De Vries, A. 2006. Economic Value of Pregnancy in Dairy Cattle. J. Dairy Sci. 89:3876-3885.

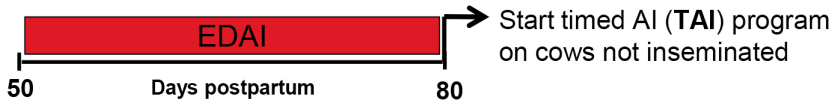
Vishwanath, R. 2003. Artificial insemination: the state of the art. Theriogenology 59:571-584.

Walker, W. L., R. L. Nebel, and M. L. McGillard. 1996. Time of ovulation relative to mounting activity in dairy cattle. J. Dairy Sci. 79:1555-1561.

Dairy Cow Synchronization Protocols - 2013

Timed AI after detection of estrus

For herds with efficient and accurate estrus-detection systems in place.

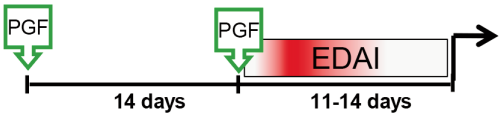


Definitions and comments:
EDAI = estrous detection and AI after detection of estrus.
Start and stop dates for EDAI depend on the voluntary waiting period (VWP) and the reproductive goals of the individual herd.

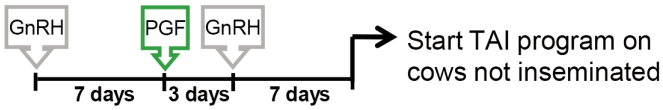
Presynch methods used before Ovsynch

*Used with Ovsynch programs (listed below) to increase pregnancies per AI (**P/AI**). Programs can be used with or without estrous detection and AI (**EDAI**).*

A. 2xPGF



B. GnRH-PGF-GnRH

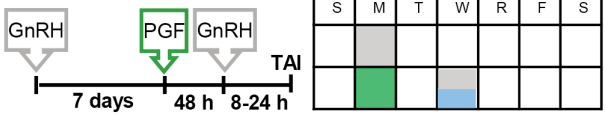


Definitions and comments:
PGF = prostaglandin $F_{2\alpha}$
GnRH = gonadotropin-releasing hormone
Intensity of red color within EDAI denotes periods to expect most cows in estrus. Most cows come into estrus 2 to 7 d after PGF.

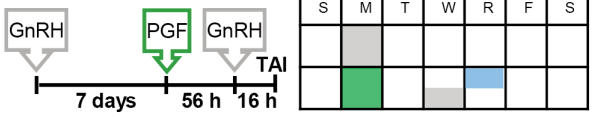
Ovsynch methods used for TAI

Can be used alone or with presynch methods (see above). Programs can be used with or without EDAI.

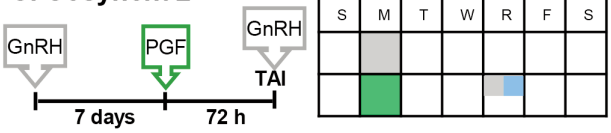
A. Ovsynch48



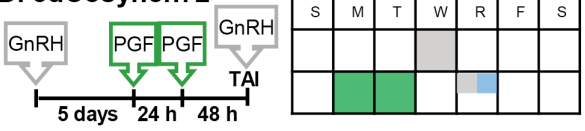
B. Ovsynch56



C. Cosynch72



D. 5dCosynch72



PGF | GnRH | TAI

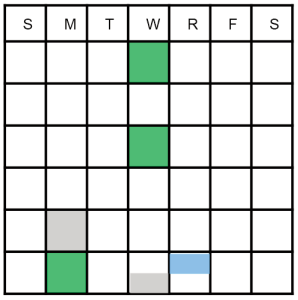
Afternoon GnRH, morning TAI
Morning GnRH, morning TAI
Morning GnRH, afternoon TAI

A CIDR can be used with any of these programs (CIDR_Ovsynch). The CIDR is inserted at first GnRH and removed at PGF. An example would be CIDR_Ovsynch56.

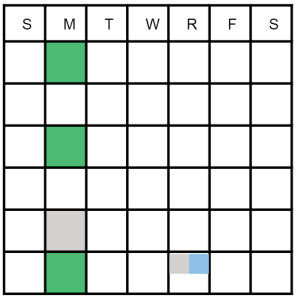
Presynch-Ovsynch Calendars

Calendars are examples of presynch-ovsynch combinations that are used for insemination. Any presynch program can be combined with any Ovsynch program. Any cow observed in estrus after the VWP can be inseminated. Cows will often show estrus 2 to 7 d after PGF .

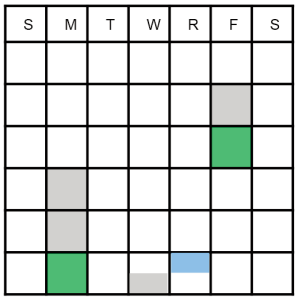
2xPGF/Ovsynch56
(12 day interval to start of TAI program)



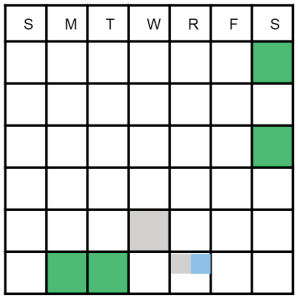
2xPGF/Cosynch72
(14 day interval to start of TAI program)



GnRH-PGF-GnRH/Ovsynch56
(Double Ovsynch)



2xPGF/5dCosynch72
(14 day interval to start of TAI program)



The synchronization efficiency and fertility may differ among the listed programs. Specific research data should be evaluated to determine the program that is optimal for use on a particular dairy.

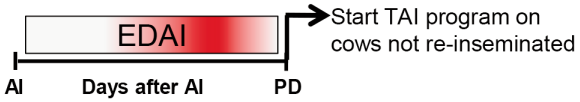
January 2011

Dairy Cow Synchronization Protocols - 2011

Resynch methods

Any cow that is diagnosed open at pregnancy diagnosis (**PD**) can be resynchronized.
Methods can be used with or without estrous detection and AI after observed estrus (**EDAI**).

A. Start Ovsynch method after PD.



Example: Ovsynch56 Starting after PD

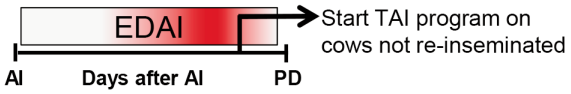
PGF GnRH TAI PD

S	M	T	W	R	F	S
	■					
	▒					
	■			▒		

The black rectangle denotes PD. PGF is administered to cows diagnosed open (not pregnant). Pregnant cows are not treated. A CIDR can be used in a resynch program according to the instructions on page 1.

Intensity of red color within EDAI denotes periods to expect most cows in estrus during EDAI. Open cows are typically observed in estrus on days 20 to 25 after AI. Nomenclature: The interval in days from first AI to the start of the resynch program (first GnRH) is denoted in front of the program (d32Ovsynch56, etc.).

B. Start Ovsynch method before PD.



Example: Ovsynch56 Starting before PD

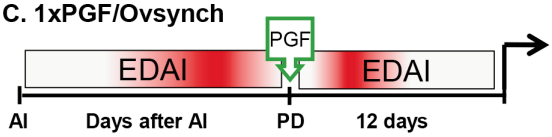
S	M	T	W	R	F	S
	▒					
	■			▒		
	■		▒			

Example: 5dCosynch72 Starting before PD

S	M	T	W	R	F	S
			▒			
	■	■		▒		
	■					

PGF is given to open cows (not pregnant). Pregnant cows are not treated after PD.

C. 1xPGF/Ovsynch



PGF is administered to cows that have not been inseminated and are diagnosed open at PD (32 +/- 3 d after AI).

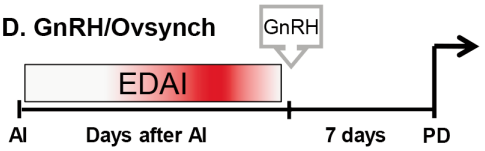
The intensity of red color within EDAI denotes periods to expect most cows in estrus during EDAI. Open cows are typically observed in estrus on days 20 to 25 after AI or 2 to 7 d after PGF.

Example: 1XPGF/Ovsynch56

S	M	T	W	R	F	S
				■		
				▒		
		▒				
		■			▒	

The 1XPGF/Ovsynch program can be used with any Ovsynch method.

D. GnRH/Ovsynch



GnRH is administered to cows that have not been re-inseminated at 32 +/- 3 d after previous AI. Cows do not usually come into estrus within one week after a GnRH injection.

Example: GnRH/Ovsynch56

S	M	T	W	R	F	S
		▒				
		■				
		■			▒	

The GnRH/Ovsynch program can be used with any Ovsynch method.

Sample Calendars for Resynch Programs

Calendars are examples of resynch programs. Any resynch program can be used after an initial AI. Any cow observed in estrus before or during the resynch can be inseminated.

Example: d32 Ovsynch56 Starting after PD

	S	M	T	W	R	F	S
Initial AI					■		
Resynch and AI		■			▒		
		■		▒	▒		

Example: d32 Ovsynch56 Starting before PD

S	M	T	W	R	F	S
				■		
	▒					
	■		▒	▒		

The synchronization efficiency and fertility may differ among the listed programs. Specific research data should be evaluated to determine the program that is optimal for use on a particular dairy.

Compliance table

The following table is provided for reference. It shows the percentage of cows that receive all injections (yellow boxes) as a function of compliance at an individual injection. As an example, if 95 out of 100 cows receive their injection on any given day then the herd has 95% compliance. The greatest P/AI are achieved with 100% compliance so that all cows receive every injection. Farms should have a method to monitor compliance before they start a program.

Compliance	3 injection program	5 injection program
100%	100%	100%
95%	86%	77%
90%	73%	59%

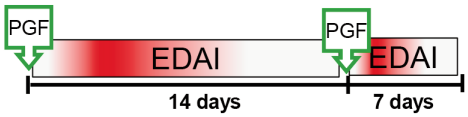
This protocol sheet was assembled by members of the Dairy Cattle Reproduction Council (DCRC). Programs are intended to promote sustainable food production by the dairy industry through sound reproductive management practices. The DCRC recommends working with a licensed veterinarian for proper use and administration of all reproductive hormones.

June 2013

Dairy Heifer Synchronization Protocols - 2013

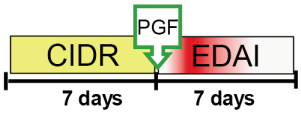
AI after detection of estrus

2xPGF

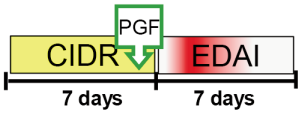


Comments: 2XPGF
70% of heifers should be in estrus after the first PGF. Remaining heifers in estrus after the second PGF. Non-responding heifers may be prepubertal. This program typically yields greatest conception rates to AI at estrus.

CIDR-PGF Option 1
(PGF at CIDR removal)



CIDR-PGF Option 2
(PGF at 1 day before CIDR removal)



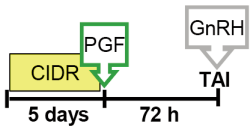
Comments: CIDR-PGF
All heifers should be in estrus after CIDR removal. Non-responding heifers may be prepubertal. Option 2 improves the synchrony of estrus. These programs typically yield slightly lower conception rates when compared with 2XPGF. CIDR-based programs will induce fertile estrus in some heifers that are prepubertal at start of treatment.

Definitions and comments:
EDAI = estrous detection and AI after detection of estrus.
PGF = prostaglandin $F_{2\alpha}$.
CIDR = Controlled internal drug release intravaginal insert containing progesterone.
GnRH = gonadotropin-releasing hormone.
Intensity of red color within EDAI denotes periods to expect most heifers in estrus. Most heifers come into estrus 2 to 5 days after PGF.

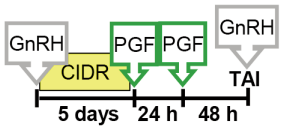
Programs for Timed AI (TAI)

Comments: 5dCIDR_Cosynch72
Option 2 yields slightly greater conception rate to TAI than option 1.

5dCIDR_Cosynch72 Option 1



5dCIDR_Cosynch72 Option 2

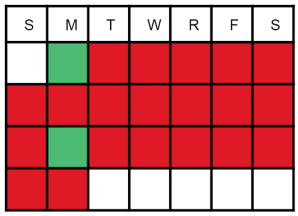


Calendars

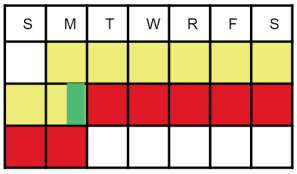
PGF | CIDR | EDAI | GnRH | TAI

AI after detection of estrus

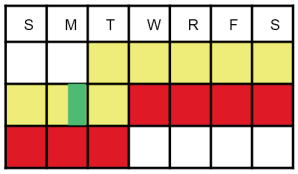
2xPGF



CIDR-PGF - Option 1

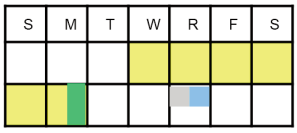


CIDR-PGF - Option 2



Timed AI (TAI)

5dCIDR_Cosynch72 Option 1



5dCIDR_Cosynch72 Option 2

This protocol sheet was assembled by members of the Dairy Cattle Reproduction Council (DCRC). Programs are intended to promote sustainable food production by the dairy industry through sound reproductive management practices. The DCRC recommends working with a licensed veterinarian for proper use and administration of all reproductive hormones. June 2013

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By **Jamie E. Larson,** Assistant Professor, Department of Animal and Dairy Sciences, and Benjamin E. Voelz, Graduate Research Assistant, Department of Animal and Dairy Sciences.

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