PROTOCOLS FOR SYNCHRONIZATION OF ESTRUS AND OVULATION

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Introduction

The potential for genetic improvement in beef herds in the US through advances in biotechnology has never been greater. Recent improvements in our understanding of methods of inducing and synchronizing estrus and ovulation in postpartum beef cows and replacement beef heifers creates the opportunity to significantly expand the use of artificial insemination in both purebred and commercial herds. Technology now exists to successfully inseminate beef cows at predetermined fixed times with pregnancy rates comparable to those achieved with heat detection.

While many options exist for synchronization of estrus and ovulation, this short list of protocols was developed based on available research data and field use by the Beef Cattle Reproduction Leadership Team. This group is composed of representatives from the AI and pharmaceutical industries, veterinarians, and reproductive physiologists from the Beef Reproduction Task Force with active research programs in this area.

Selecting a synchronization protocol

Each producer should evaluate available resources and assess the cows or heifers intended for synchronization before selecting a protocol. Key considerations should include time and skill available for heat detection, body condition of the cows or heifers, days postpartum in cows, facilities, experience, and cost.

Amount of Heat Detection

The first step in selecting a synchronization protocol is to determine how much, if any, heat detection is feasible or desired. Some management systems make heat detection and the sorting of animals very simple and effective. In other cases, heat detection can be very difficult. Poor detection efficiency can result in a low AI pregnancy rate. The recommended protocols are divided into three groups based on amount of heat detection required; 1) heat detection for 7 to 8 days, 2) heat detection for 3 days followed by fixed-time AI of all remaining animals not previously detected in heat (clean-up timed AI) or 3) strict fixed-time AI.

Cow factors

Any of the synchronization protocols are recommended for mature cows with a body condition score of 5 or greater that are 50 days or more since calving at the time of AI. Young, thin, and late calving cows are all less likely to have resumed their estrous cycles at the beginning of the breeding season. If a high percentage of cattle are in these categories, consideration should be given to protocols that include a progestin such as a CIDR. The progestin will induce some non-cycling cows to cycle and improve their chance of conceiving to

AI. If cows are too thin or have calved too recently, the investment in synchronization of estrus may not be cost effective.

Heifer factors

Age and weight are key factors that influence time of puberty in heifers. Heifers should attain 60% of their mature weight prior to breeding. Because selection pressure on growth has increased mature cow size, producers may tend to underestimate future mature size. Producers that score heifer reproductive tracts at 50 to 60 days prior to breeding have a true measure of physiological maturity and time to adjust rations prior to breeding. If 50% of heifers have a tract score of 3 or greater 50 to 60 days prior to breeding, estrous synchronization programs tend to be more successful. Protocols including a progestin such as MGA or CIDR will induce some prepubertal heifers to cycle.

Other

Length of the protocol, number of times handled, and the ability to successfully deliver treatments such as MGA are other factors that must be considered when choosing a synchronization protocol. Management system, feed resource flexibility, and facilities will play a role in which protocol works best in each particular environment. Success of any protocol is dependent on the proper administration and timing of treatments. For help see the Estrus Synchronization Planner at
http://www.iowabeefcenter.org/content/software_software_estrus.html

Cost

If labor is available or can be hired, protocols using heat detection are generally lower cost than fixed-timed AI. Treatments, semen and number of handlings will contribute to cash costs of synchronization. Estimated savings from fewer bulls needed for natural service and increased returns from age and weight of AI sired calves should be considered. Producers that find AI most cost effective are those that capture additional returns from AI sired calves.

Which animals should I synchronize?

When starting an AI program for the first time, replacement heifers probably are the easiest group of animals to work with and first calf heifers the most difficult group to achieve success. Start simple and add more animals as you gain experience.

PRODUCTS USED

Hormones common to many protocols are prostaglandin $F_{2\alpha}$ (**PG**), gonadotropin releasing hormone (**GnRH**) and progestins. They are available in the following commercial products. Follow label directions for dose and route of administration.

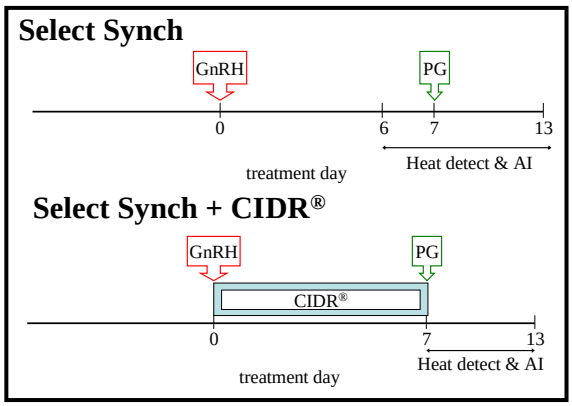
Type	Commercial Names
GnRH	Cystorelin®, Factrel®, Fertagyl®, OvaCyst®
PG	estroPLAN®, Estrumate®, In-Synch®, Lutalyse®, ProstaMate®
Progestin	MGA® (melengesterol acetate) CIDR® (progesterone)

PROTOCOLS

Heat Detection Protocols

Animals in these protocols should be inseminated 6 to 12 hours after the first observation of standing heat. During peak activity (48 to 72 hours after PG for most systems), heat detection for a total of three hours per day at three or more times would be a minimum and a total of 5 to 6 hours better.

Figure 1. Heat detection only protocols for cows; Select Synch and Select Synch + CIDR.



Select Synch and **Select Synch + CIDR®** (Figure 1) are protocols for use in cows. Including the CIDR is recommended when more cows are likely to be anestrus and/or when heat detection prior to PG is not feasible. With Select Synch, 5 to 20% of the animals may show heat 1.5 to 2 days before PG. Both protocols could be applied to the same group of cows, with CIDRs selectively placed in young, thin, and/or late calving cows.

The **7-day CIDR®-PG** protocol (Figure 2**)** is recommended in heifers in contrast to the Select Synch + CIDR® protocol in cows. The difference is that heifers do not require the GnRH injection at the beginning of the treatment. Research has shown pregnancy rates from the 7-day CIDR®-PG protocol similar to those from the Select Synch + CIDR® protocol in heifers. Select Synch is not preferred for heifers because a wider range in responses to Select Synch has been reported in heifers perhaps due to inconsistent response to GnRH.

Figure 2. Heat detection only protocol for heifers, 7-day CIDR-PG.

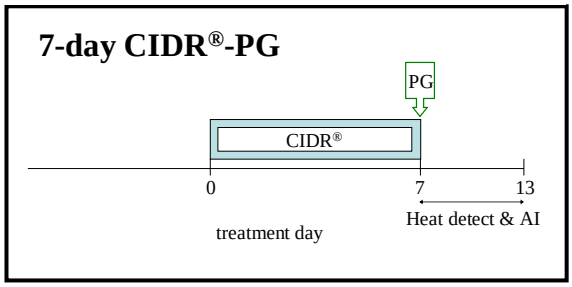
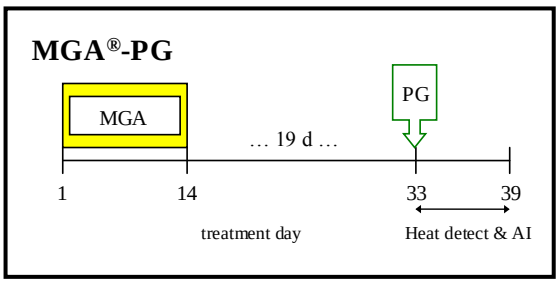
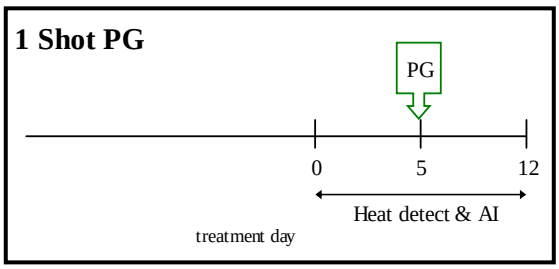


Figure 3. Heat detection only protocol for heifers, MGA-PG.



Feeding of MGA is specifically approved for estrus suppression in heifers only. The MGA-based protocol recommended for heifers is **MGA®-PG** (Figure 3). More advance planning is needed as this protocol begins with feeding MGA for 14 days starting 33 days before injection of PG. If MGA can be delivered accurately on a daily basis; this is a very effective protocol in beef heifers. The original recommendation for the interval between the last feeding of MGA and PG injection was 17 days. Delaying this interval to 19 days improves synchrony of estrus.

Figure 4. Heat detection only protocol for heifers, single shot PG.



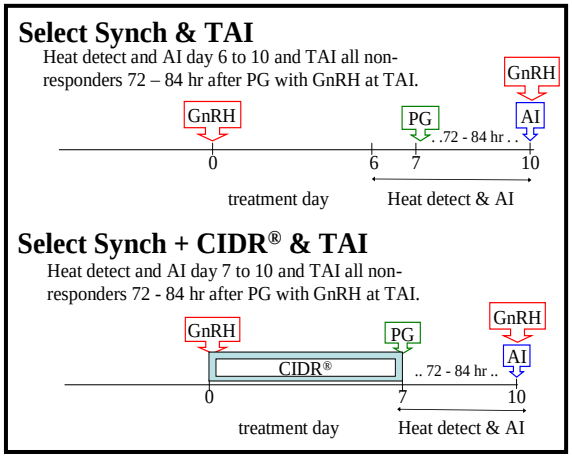
A single injection of PG (Figure 4) can be used on heifers. This protocol does not provide the degree of synchrony of others and the heat detection period is twice as long. Nevertheless, it is a low cost method that often works well for those just starting to use AI. It could be used on cows but because sorting and heat detection are more complex when the calf is present, other options should be strongly considered. Heifers that have not reached puberty or cows that have not initiated estrous cycles do not have a corpus luteum (CL) and **will not** respond to this treatment. Heifers observed in heat and inseminated before the time of PG injection do not require PG.

Heat Detection & Timed AI (TAI) Protocols

Heat detection and timed AI protocols involve AI 6 to 12 hours after observed estrus for 3 days then timed AI of all non-responders 72 to 84 hours after PG with GnRH given at TAI. The amount of time spent on heat detection is reduced and early responders have a better chance of conceiving compared to a single fixed-timed AI.

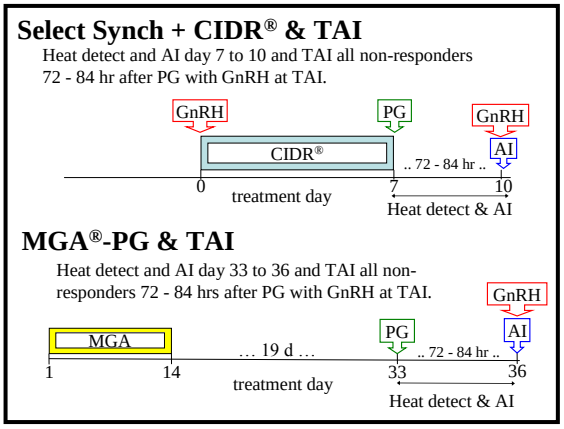
The same protocols recommended for heat detection are also recommended for the combination of heat detection and timed AI in cows (Figure 5). The success of these protocols is still dependent on good heat detection, particularly for early heats in the Select Synch protocol.

Figure 5. Heat detection and clean-up timed AI protocols for cows, Select Synch & TAI and Select Synch + CIDR & TAI.



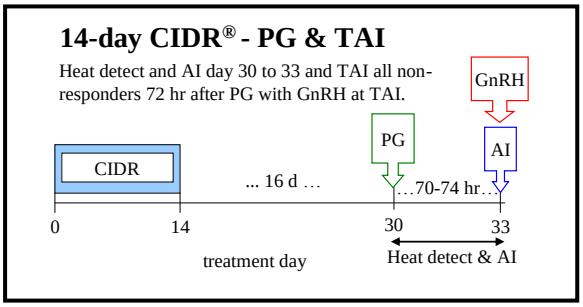
In heifers, the MGA®-PG (Figure 6) protocol can be used combining heat detection and timed AI. A second protocol recommended for use in heifers is Select Synch + CIDR® (Figure 6). GnRH is recommended in this protocol as it adds little additional cost and heifers that do respond with a new follicular wave are more likely to conceive at the clean-up timed AI.

Figure 6. Heat detection and clean-up timed AI protocols for heifers, Select Synch + CIDR & TAI and MGA-PG & TAI.



The third option for combination heat detection and TAI in heifers is **14-day CIDR® – PG** (Figure 7). This protocol appears similar to MGA-PG but the interval between CIDR removal and PG is reduced to 16 days. This is because the progesterone in CIDR treated animals is cleared from the body much faster than melengesterol acetate in MGA-treated animals.

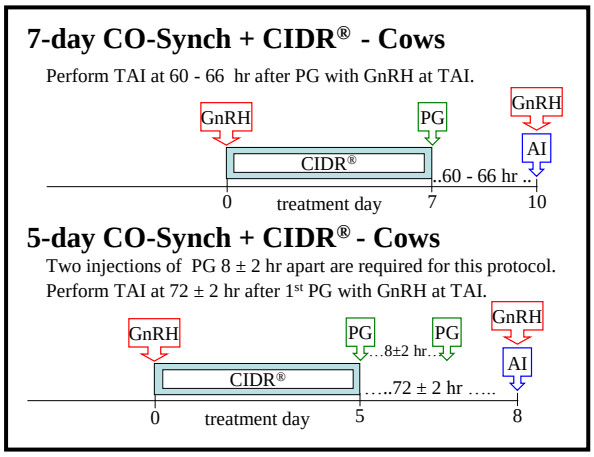
Figure 7. Heat detection and timed AI protocols for heifers, 14-day CIDR-PG & TAI.



Fixed-Time AI protocols

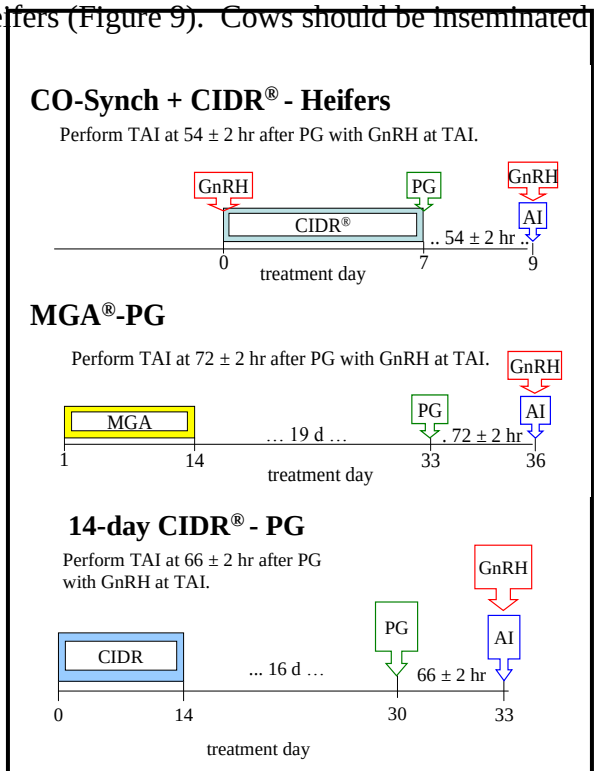
In fixed-time AI protocols, all animals are inseminated at a predetermined time. For cows, fixed-timed AI can produce similar pregnancy rates as protocols that require 5 to 7 days of heat detection. For heifers, pregnancy rates from current TAI protocols tend to be 5 to 10% lower than using heat detection alone. The times listed for fixed-time AI should be considered as the approximate average time of insemination. This should be based on the number of females to inseminate, labor and facilities.

Figure 8. Fixed time AI protocols for cows, 7-day CO-Synch + CIDR and 5-day CO-Synch + CIDR.



The **7-day CO-Synch + CIDR®** protocol is recommended for both cows (Figure 8) and heifers (Figure 9). Cows should be inseminated between 60 and 66 hours after CIDR removal. Insemination time for heifers is recommended at 52 to 56 hours after CIDR removal. A shortened **5-day CO-Synch + CIDR®** protocol (Figure 8) is another option for cows. Two full doses of PG given 8 hours apart are critical for success in the shortened protocol.

Figure 9. Fixed time AI protocols for heifers, CO-Synch + CIDR, MGA-PG and 14-day CIDR-PG.



MGA®-PG (Figure 9) can be used with fixed-timed AI in heifers; however, pregnancy rate will likely be lower than with the CO-Synch + CIDR® protocol or 14-day CIDR®-PG.

For many producers a CIDR-based protocol would be lower risk for fixed-timed AI than MGA®-PG as they are not reliant on accurate, daily MGA consumption and control of follicular growth should be better. The 14-day CIDR-PG is the most recent fixed-timed AI protocol for heifers. It is 3 days shorter than MGA-PG and requires one more handling than CO-Synch +CIDR.

Planning and Logistics

Developing technologies continue to provide more tools for planning and implementing synchronization protocols. One of the first such tools was the "Estrus Synchronization Planner" from the Iowa Beef Center. This is a spreadsheet based planning tool where the user answers questions regarding their desired breeding/calving date, the type of females being subjected to the protocol, the synchronization system they plan to use and the cost of their materials and labor. The software then creates a printable calendar with all the important dates and times for injections and insemination. Furthermore, it generates a detailed economic analysis of the protocol based on the cost of materials and labor for that individual user.

While the Iowa Beef Center's "Estrus Synchronization Planner" remains the prominent planning tool, other spreadsheet based tools are available. For example, Mississippi State University Extension has published a downloadable spreadsheet that generates a planning calendar with injection, breeding and calving days (http://msucares.com/livestock/beef/beefpubs.html). This tool does not include a financial analysis component.

The advent of "smartphones" and other mobile electronic devices has yielded another set of decision making and planning tools referred to as applications (apps). Mississippi State University Extension has developed an estrus synchronization smartphone application base on their previously described downloadable spreadsheet. Many beef cattle producers who already use these devices for record keeping and data management could use these applications to make reproductive management decisions in the field or in situations where expedient decisions are necessary.

Concluding Comments

Considerable research and field data support the use of these protocols as described. General comparisons of the protocols are found in Tables 1 and 2. Other protocols should only be considered in unique situations and with the advice of someone with extensive experience with synchronization protocols. Alterations of any protocol should be supported with sound research data

COMPARISON OF PROTOCOLS

Table 1. Beef Cows

Heat Detection	Cost	Labor	Reports[a]	No. of cows	Pregnancy Rate[b]	
					Range	Avg.
Select Synch	Low	Medium/High	4	678	38-70	46
Select Synch + CIDR®	High	Medium	8	595	42-85	51
Heat Detect & TAI						
Select Synch	Low	Medium/High	6	2048	31-89	51
Select Synch + CIDR®	High	Medium	8	1596	36-77	56
Fixed-time AI						
7-day CO-Synch + CIDR®	High	Medium	23	10,701[c]	32-79	58
5-day CO-Synch + CIDR®	High	Medium	13	3921	49-80	60

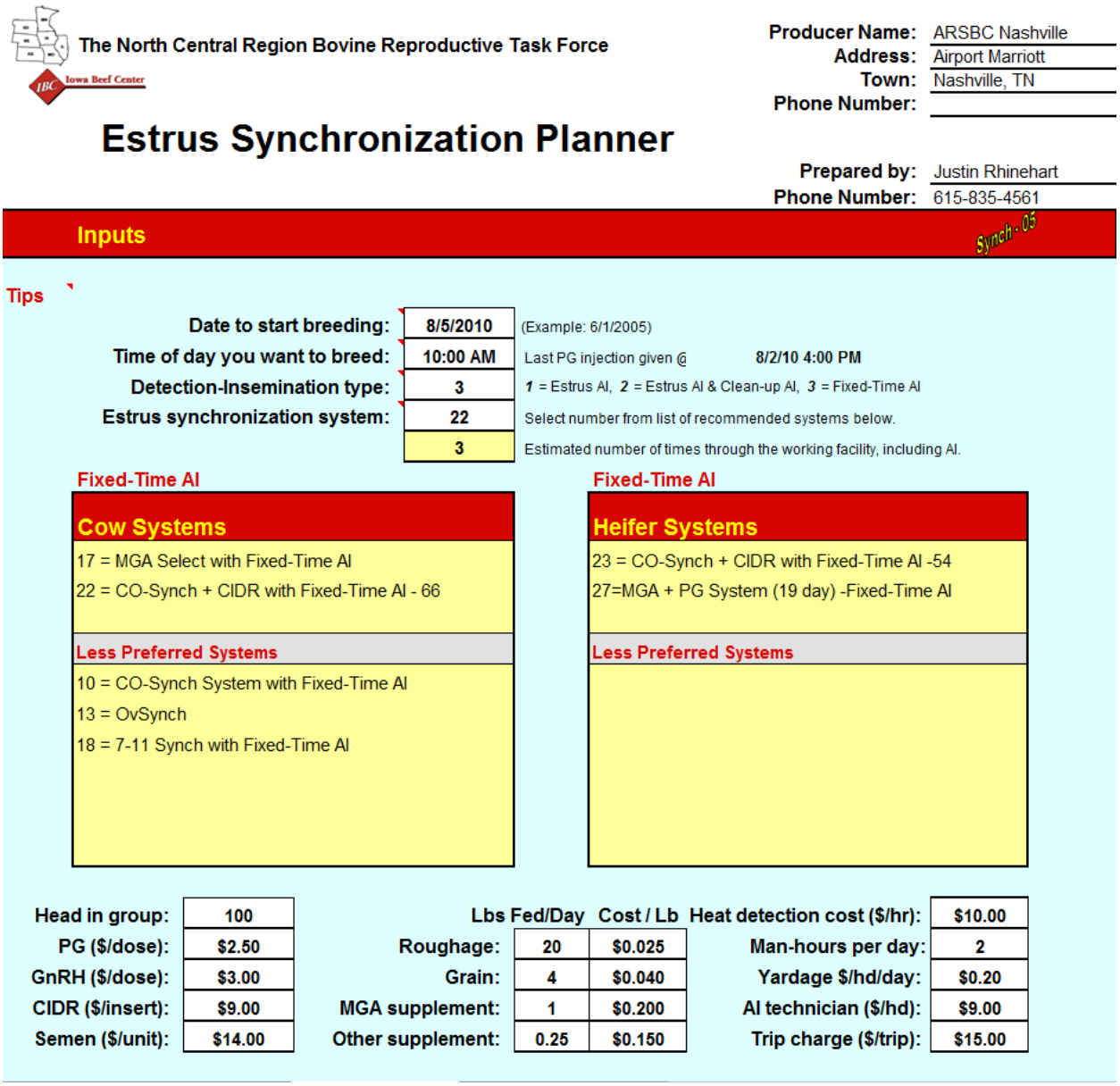
[a]Number of reports in published literature
[b]Number pregnant to AI / total number treated
[c]Includes field data from 35 herds (3015 head) in Missouri

Table 2. Beef Heifers

Heat Detection	Cost	Labor	Reports[a]	No. of heifers	Pregnancy Rate[b]	
					Range	Avg.
1 Shot PG	Low	High	1(18 herds)	2700		45
7-day CIDR® - PG	Medium	Medium	1	147	41-59	51
CIDR® - PG (3 days of heat detection)			2	745	33-61	46
MGA® - PG	Low	Low/Medium	6	2746	40-71	60
Heat Detect & TAI						
Select Synch + CIDR®	High	Medium	3	1044	31-67	55
MGA® - PG	Medium	Medium	5	1905	48-64	56
14-day CIDR®-PG	Medium	Medium	4	539	50-62	55
Fixed-time AI						
CO-Synch + CIDR®	High	Medium	11	1495	24-68	50
MGA® - PG	Medium	Medium	5	831	36-62	46
14-day CIDR®-PG	Medium	Medium	3	1168[c]	58-69	61

[a]Number of reports in published literature
[b]Number pregnant to AI / total number treated
[c]Includes field data from 534 head in Missouri

Image 1: Data input screenshot from the Iowa Beef Center's "Estrus Synchronization Planner"



The North Central Region Bovine Reproductive Task Force

Iowa Beef Center

Producer Name:	ARSBC Nashville
Address:	Airport Marriott
Town:	Nashville, TN
Phone Number:	

Estrus Synchronization Planner

Prepared by:	Justin Rhinehart
Phone Number:	615-835-4561

Inputs

Synch - 05

Tips

Date to start breeding:	8/5/2010	(Example: 6/1/2005)
Time of day you want to breed:	10:00 AM	Last PG injection given @ 8/2/10 4:00 PM
Detection-Insemination type:	3	*1* = Estrus AI, *2* = Estrus AI & Clean-up AI, *3* = Fixed-Time AI
Estrus synchronization system:	22	Select number from list of recommended systems below.
	3	Estimated number of times through the working facility, including AI.

Fixed-Time AI

Cow Systems

17 = MGA Select with Fixed-Time AI

22 = CO-Synch + CIDR with Fixed-Time AI - 66

Less Preferred Systems

10 = CO-Synch System with Fixed-Time AI

13 = OvSynch

18 = 7-11 Synch with Fixed-Time AI

Fixed-Time AI

Heifer Systems

23 = CO-Synch + CIDR with Fixed-Time AI -54

27=MGA + PG System (19 day) -Fixed-Time AI

Less Preferred Systems

Head in group:	100		Lbs Fed/Day	Cost / Lb	Heat detection cost ($/hr):	$10.00
PG ($/dose):	$2.50	Roughage:	20	$0.025	Man-hours per day:	2
GnRH ($/dose):	$3.00	Grain:	4	$0.040	Yardage $/hd/day:	$0.20
CIDR ($/insert):	$9.00	MGA supplement:	1	$0.200	AI technician ($/hd):	$9.00
Semen ($/unit):	$14.00	Other supplement:	0.25	$0.150	Trip charge ($/trip):	$15.00

Image 2: Activity printout screenshot from the Iowa Beef Center's "Estrus Synchronization Planner"

7/12/2010 10:11

Estrus Synchronization Planner

Producer Name: ARSBC Nashville
Address: Airport Marriott
Town: Nashville, TN
Phone Number:

Date to start breeding: 8/5/2010
Start of Calving Season: 5/13/2011

Prepared by: Justin Rhinehart
Phone Number: 615-835-4561

22 = CO-Synch + CIDR with Fixed-Time AI - 66

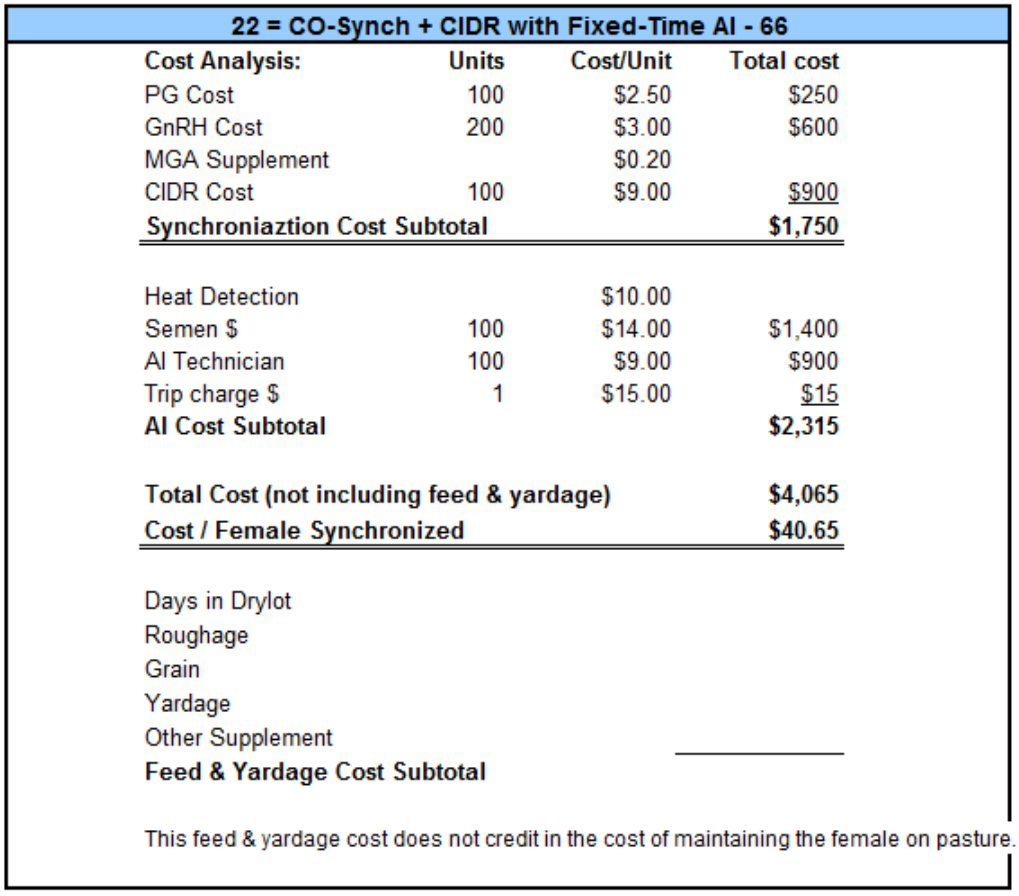
Estimated average number of times per head through the working facility = 3

Comments

This system works well in cows.
No estrus detection required.
Fixed time AI can be done between 60 and 66 hours post PG injection.
All females require a GnRH injection at fixed-time AI.
This system can initiate estrous cycles in some noncycling females.
Expect lower fertility in cows less than 50 days postpartum at time of PG injection.
Immediate addition of clean-up bulls could lead to questions about parentage.

Date of Activity	Day of the Week	Description of Activity
07/26/10	Monday	Insert one CIDR device in each female. Inject Gonadotropin Releasing Hormone (GnRH) to all females.
08/02/10	Monday	Remove the CIDR device from each female. Inject Prostaglandin (PG) to all females at: 4:00 PM
08/05/10	Thursday	Inject Gonadotropin Releasing Hormone (GnRH) to all females. Breed all females at time of GnRH injection at: 10:00 AM
08/06/10	Friday	Turn clean up bulls in with females. Immediate addition of clean-up bulls could lead to questions about parentage.

Image 3: Cost analysis screenshot from the Iowa Beef Center's "Estrus Synchronization Planner"



22 = CO-Synch + CIDR with Fixed-Time AI - 66			
Cost Analysis:	**Units**	**Cost/Unit**	**Total cost**
PG Cost	100	$2.50	$250
GnRH Cost	200	$3.00	$600
MGA Supplement		$0.20	
CIDR Cost	100	$9.00	$900
Synchroniaztion Cost Subtotal			**$1,750**
Heat Detection		$10.00	
Semen $	100	$14.00	$1,400
AI Technician	100	$9.00	$900
Trip charge $	1	$15.00	$15
AI Cost Subtotal			**$2,315**
Total Cost (not including feed & yardage)			**$4,065**
Cost / Female Synchronized			**$40.65**
Days in Drylot			
Roughage			
Grain			
Yardage			
Other Supplement			
Feed & Yardage Cost Subtotal			
This feed & yardage cost does not credit in the cost of maintaining the female on pasture.			

$/Synch AI = cost per successful AI pregnancy for the selected system under the given success rate.

Cost Analysis with Varying Estrous Response and Conception Rates						
Estrous Response Rate		**Conception Rate of those Responding to Synchronization**				
		35%	**45%**	**55%**	**65%**	**75%**
100%	% AI Pregnant	35.0%	45.0%	55.0%	65.0%	75.0%
	$/ Synch AI preg.	$116.14	$90.33	$73.91	$62.54	$54.20
	% AI Pregnant					
	$/ Synch AI preg.					
	% AI Pregnant					
	$/ Synch AI preg.					
	% AI Pregnant					
	$/ Synch AI preg.					
	% AI Pregnant					
	$/ Synch AI preg.					

Image 4: Calendar screenshot from the Iowa Beef Center's "Estrus Synchronization Planner"

7/12/2010 10:11

Estrus Synchronization Planner

Producer Name: ARSBC Nashville
Address: Airport Marriott
Town: Nashville, TN
Phone Number:

22 = CO-Synch + CIDR with Fixed-Time AI - 66

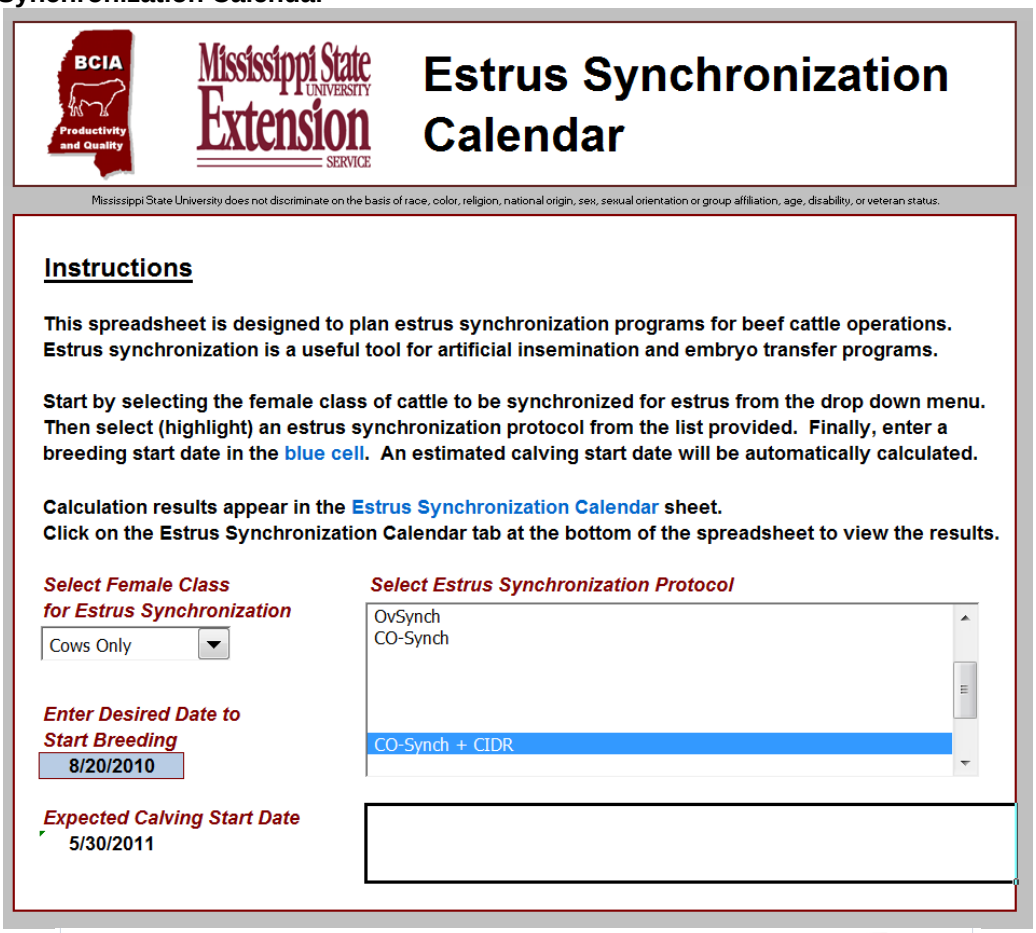
Date to start breeding: 8/5/2010
Start of Calving Season: 5/13/2011

Prepared by: Justin Rhinehart
Phone Number: 615-835-4561

Last PG injection given @ 4:00 PM on 8/2/2010
Fixed time AI done @ 10:00 AM on 8/5/2010

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7/25/2010	7/26/2010	7/27/2010	7/28/2010	7/29/2010	7/30/2010	7/31/2010
	* Insert CIDR device in all females * Inject GnRH - all females					
8/1/2010	8/2/2010	8/3/2010	8/4/2010	8/5/2010	8/6/2010	8/7/2010
	* Remove CIDRs * Inject PG - all females			* GnRH injection & Fixed time AI (66 hrs after PG)	* Turn in Bull Power	

Image 5: Data input and calendar screenshots from the Mississippi State University Extension "Estrus Synchronization Calendar"



BCIA Productivity and Quality

Mississippi State University Extension Service

Estrus Synchronization Calendar

Mississippi State University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation or group affiliation, age, disability, or veteran status.

Instructions

This spreadsheet is designed to plan estrus synchronization programs for beef cattle operations. Estrus synchronization is a useful tool for artificial insemination and embryo transfer programs.

Start by selecting the female class of cattle to be synchronized for estrus from the drop down menu. Then select (highlight) an estrus synchronization protocol from the list provided. Finally, enter a breeding start date in the blue cell. An estimated calving start date will be automatically calculated.

Calculation results appear in the Estrus Synchronization Calendar sheet.
Click on the Estrus Synchronization Calendar tab at the bottom of the spreadsheet to view the results.

Select Female Class for Estrus Synchronization

Cows Only

Select Estrus Synchronization Protocol

OvSynch
CO-Synch
CO-Synch + CIDR

Enter Desired Date to Start Breeding

8/20/2010

Expected Calving Start Date

5/30/2011

August 2010

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10 GnRH injection; insert CIDR	11	12	13	14
15	16	17 Remove CIDR; PGF injection	18	19	20 GnRH injection; time breed 66 hours after PGF	21
22	23	24	25	26	27	28
29	30	31				