

# **EFFECTIVE USE OF THE ESTRUS SYNCHRONIZATION PLANNER FOR AI MANAGEMENT**

Sandy Johnson and Garland Dahlke

Northwest Research and Extension Center, Kansas State University, Colby, KS  
Iowa Beef Center, Iowa State University, Ames, IA

## **Introduction**

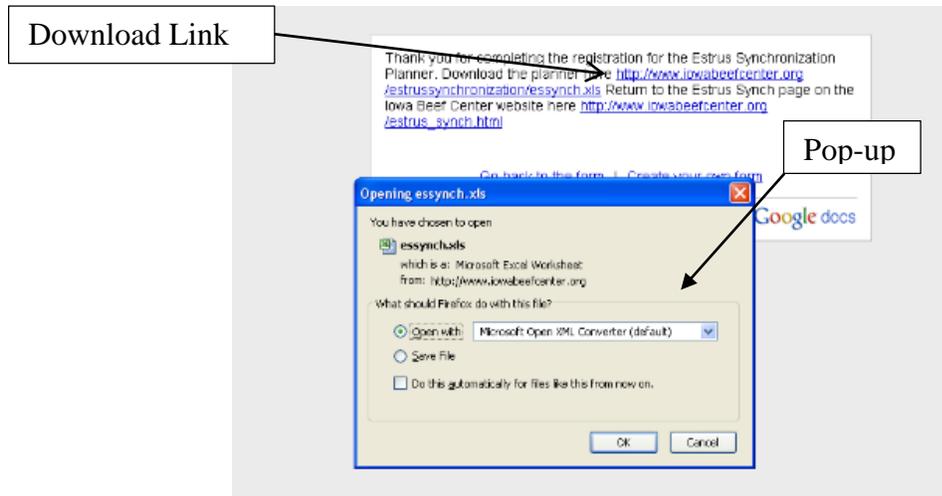
The process of selecting and implementing a program for synchronization of estrus and AI has become much easier. A short list of recommended protocols was developed by university personnel (Beef Reproduction Task Force) and a broader allied industry group (Beef Reproduction Leadership Team) to improve communication regarding synchronization systems and improve success when implemented. These protocols can be found in the catalogs of the major AI studs and at [www.BeefRepro.info](http://www.BeefRepro.info). Extensive research and field trial data support the use of these protocols as described. The recommendations are updated annually to incorporate the most recent research. For a majority of producers, selecting a protocol from this list should improve the chances of a good response. Other protocols may work, but often involve additional steps and costs with no improvement in response.

In 1998, an Excel-based planning tool was developed by Daryl Strohbehn, retired extension beef specialist at Iowa State University, known as the Estrus Synchronization Planner to help producers successfully implement synchronization programs. This was during an era of rapidly increasing knowledge on control of follicular growth and the incorporation of that knowledge into synchronization systems. The original planner had six basic synchronization systems and was available free upon request via e-mail or CD. Additional systems and program refinements were made when Mark Dikeman and later Garland Dahlke joined the Iowa Beef Center. It was available for free download on the web from about 2001 to 2004. Efforts to update the Estrus Synchronization Planner to reflect recommendations from the Beef Reproduction Task Force took place in 2004. This significantly revised version with extensive support material was available for \$25 and met goals from the Iowa State system to generate cost recovery funds. Yearly updates were made to the program and cost remained the same until 2011 at which time sufficient industry support had been developed to offer the program for free download on the web. Use of the planner increased significantly with this change. The planner guides users to appropriate protocols and based on user inputs, translates selections into dates and times on a calendar.

## **Program Basics**

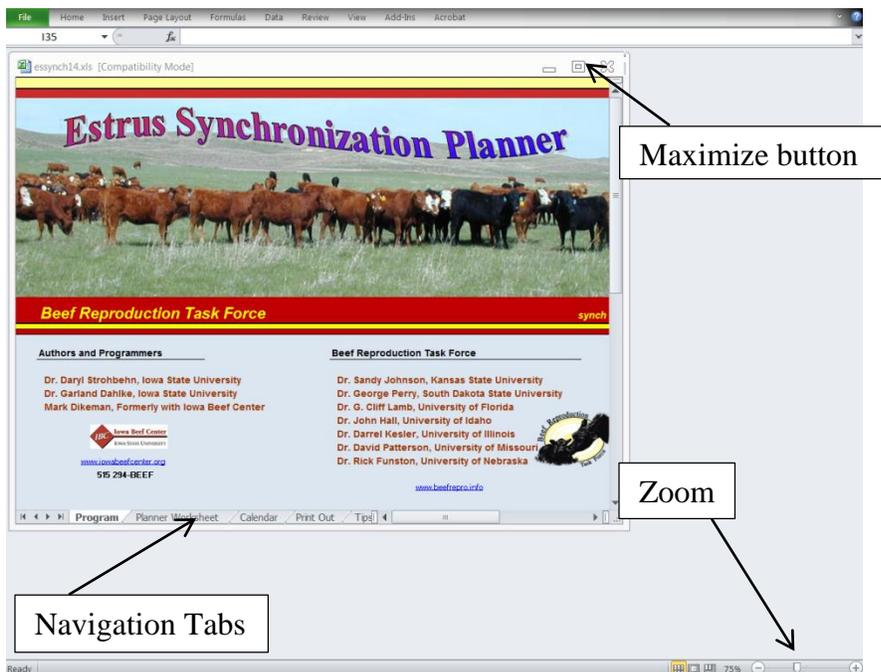
To use the Estrus Synchronization Planner you will need a copy of MS Excel or Open Office. The planner can be downloaded at no charge from the Iowa Beef Center at [http://www.iowabeefcenter.org/estrus\\_synch.html](http://www.iowabeefcenter.org/estrus_synch.html). This page also contains additional reference materials related to synchronization of estrus and AI. On this web page you will also find tips for downloading and saving your copy of the Estrus Synchronization Planner. Before you download the spreadsheet it will ask for your contact information. This is very important as we will contact you by e-mail when updates are made to the planner, generally on an annual basis. The current version is Synch 14, released in May of 2014 but enhancements are planned for

2015. After registering and submitting the registration, select the download link (Figure 1). A pop-up will then appear which allows you to open or save the file. Select “Open” followed by the “OK” button.



**Figure 1.** Downloading and opening the Estrus Synchronization Planner

After opening *essynch.xls*, you will see the Estrus Synchronization Planner program appear on your screen (Figure 2). This program will open in a compatibility mode which will allow it to run in either old or new versions of Excel. You may need to use the MAXIMIZE button (Figure 2) to see all the navigation tabs at the bottom of the program. The zoom features of Excel in the lower right hand portion of the screen can also be used to modify the size and amount of text shown on the screen.



**Figure 2.** Opening screen and basic navigation

Saving-  
The

Estrus Synchronization Planner is a formatted Excel sheet that should be saved to your computer after downloading and opening the program. Once saved to your computer you will not need to go to the download site to operate. Save the program in the desired folder on your computer (FILE- SAVE AS). You may wish to use “SAVE AS” and rename “*Essynch2014*” or rename the sheet after the protocol that you have just set up. For those that provide AI service to others,



the program can be further customized by adding your name and contact information on the top right hand side of the *Planner Worksheet*. Saving after this addition will avoid the need to re-enter each time you use the program. To save the program follow the normal save routine as you would for any spreadsheet developed with your version of Excel. To create and save a shortcut for this program on your desktop ‘right-click’ while the *Essynch.xls* file that you have downloaded is highlighted in File Explorer view and a menu will appear (Figure 3). Select ‘Create Shortcut’ from this menu and you will see a new icon appear that will be labeled as a shortcut. Drag this new icon on to your Desktop or where ever you would like to place the shortcut.

**Figure 3.** Creating a desktop shortcut.

*Basic Excel features* – The Estrus Synchronization Planner is made up of several worksheets whose names appear on navigation tabs (Figure 2) at the bottom of the screen: *Programs*, *Planner Worksheet*, *Calendar*, *Printout*, and *Tips & Overview*. Click on the appropriate tab to move throughout the program. The *Tips and Overview* section provides some basic definitions and guide to operation. In the *Planner Worksheet* you will see several small red triangles (Figure 4). As you move your mouse over each one, comment boxes will appear that provide definitions or explanations. To make or change an input (white boxes), click in the white box and begin typing. Default format for dates is MM/DD/YY and for times hh:mm am/pm. After you have clicked in an input box you can use the F2 key to edit the contents. This is helpful for the date and time cells.

## Use of the Planner

To begin using the planner, click on the *Planner Worksheet* (Figure 4) tab which guides users through a process of selecting an appropriate protocol for the females to be synchronized and the amount of heat detection desired. In the Input portion of the spreadsheet enter “1” for breed type for *Bos taurus* or “2” for *Bos indicus* (1/2 indicus breeding or greater).

Protocols are grouped based on how much if any heat detection is required; 1) AI after observed estrus (most heat detection), 2) AI after observed estrus followed by clean-up fixed-time AI or 3) strict fixed-time AI (no heat detection). Enter 1, 2, or 3 in the input box to make the appropriate selection. When the “detection-insemination type” is changed from 1 to 3, the recommended protocols listed below change based on that selection. Select a synchronization system by entering a number from the listed systems for cows or heifers. The short list of recommended protocols is different for cows (listed to the left) and heifers (listed to the right). The timing of insemination differs for comparable fixed-timed insemination protocols between cows and heifers. Other reasons for differences include that use of MGA (melengesterol acetate) is only approved for use in heifers. Additionally, heifers do not seem to respond as consistently to GnRH and some heat detection systems for heifers will not include GnRH where it is included for cows. Systems listed as “less preferred” generally require additional handlings and/or costs with no improvement in results, or do not work on non-cycling animals.

Entering the date to start breeding provides the expected calving date in the cells to the right (Figure 4). This is based on a 281 day gestation length. The time of day you want to breed becomes important for protocols that use fixed-time AI or clean-up fixed-timed AI. Entering the time of day that you want to breed then shows you the time of day prostaglandin and CIDR removal should occur to meet the specified interval prescribed for the protocol. Trial and error may be needed so that PG injection/CIDR removal and AI both occur at workable times. Or review Table 1 to see common times used. To get the best response from the selected protocol it is important to follow the schedule and timing of activities as described. Fixed-timed insemination systems require a precise interval between CIDR removal and timed AI. Never synchronize more animals for fixed-timed AI than you can inseminate in a 3 to 4 hour time period. By asking what day and time you want to begin breeding, the planner calculates the precise day and hour other treatments of the protocol should be administered. When working with groups of females that will require 3-4 hours to inseminate, the time you enter into the “time of day to inseminate” should represent the average time so that you actually start inseminating 1.5 – 2 hours sooner. If removing CIDRS and giving prostaglandin will take more than 1 hour, a similar approach should be taken to start that activity a half hour or more early.

For example let’s plan a fixed-timed AI program for 180 head of heifers using the 14 Day CIDR+PG system. Based on past experience in the given facilities and associated crew, it takes 3 hours to inseminate that many head. The heifers can be gathered and in the holding pen by 8 am. We put 9:30 am as the time we want to breed in the planner, which represents half of the total time for insemination (90 minutes) past our start time. The planner returns a time to give the prostaglandin (PG) injection of 3:30 pm. This would be our mid-point to give PG. If the estimated amount of time required to give PG is 1 hour, we would start giving PG at 3:00 pm. If a group of heifers consisted of 10 head with good facilities, then plan to start breeding at 8 am and start giving PG at 2:00 pm with no further adjustments.

**Table 1.** Common times for treatment and AI to achieve desired intervals for fixed-time AI

System	Interval	CIDR Removal/PG	Timed AI
cow- 7 Day CO-Synch+CIDR	66 hrs.	2 pm	8 am
cow – 5 Day CO-Synch+CIDR	72 hrs.	8 am	8 am
heifer – 7 Day CO-Synch+CIDR	54 hrs.	1 pm	7 am
heifer – MGA + PG	72 hrs.	7 am	7 am

heifer - 14 Day CIDR+PG	66 hrs.	2 pm	8 am
heifer - 5 Day CO-Synch+CIDR	60 hrs.	7 pm	1 pm
heifer - 5 Day CO-Synch+CIDR	60 hrs.	7am	7 pm

Enter inputs here. Notice the format for time.)

**Estrus Synchronization Planner**

synch 14

Producer Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Town: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Group: \_\_\_\_\_  
 Prepared by: Sandy Johnson  
 Phone Number: 785-462-6281

**Inputs**

Move your mouse over the red triangle to see helpful information

1	5/26/2014
Time of day you want to breed:	9:00 AM
Detection-Insemination type:	3
Estrus synchronization system:	38
Days from last AI to bull turn in:	26
Trips through the working facility:	4
Cost Comparison - Alternative 1:	16
optional Alternative 2:	19
Select GnRH product to be used:	0
Select PG product to be used:	0

1=Bos taurus, 2=Bos indicus influence  
 Expected Calving Date: 3/3/2015  
 CIDR removal: 5/23/14 9:00 PM  
 1 = Estrus AI, 2 = Estrus AI & Clean-up AI, 3 = Fixed-Time AI  
 Select number from list of systems below

Note the immediate outputs indicating expected calving date and CIDR removal or in some cases PG injection time.

Protocols to include in cost comparison

22 = 7 Day CO-Synch+CIDR with Fixed-Time AI - 66
29 = 5 Day CO-Synch+CIDR with Fixed-Time AI-72

**Fixed-Time AI**

23 = 7 Day CO-Synch+CIDR with Fixed-Time AI - 54
27=MGA + PG with Fixed-Time AI

**Figure 4.** Enter your values in the white input boxes.

If you would like the name of the specific GnRH or prostaglandin product you are using to show up on the calendar or other print outs, select the number of the appropriate product. If the specific product is unknown at the time, zero, the default, will return GnRH or prostaglandin on the output. The interval from the last AI to bull turn in can be indicated so it will be shown on the calendar. A cost comparison can be done on up to two alternative systems.

The lower portion of the *Planner Worksheet* has input areas to estimate costs (Figure 5). The feed/yardage costs are only figured into MGA programs. The default labor estimate is based on the number of working days in a particular system and the group size. This includes gathering, sorting, synchronization treatments, heat detection and AI service (Loeske, 1989). Users can override this value and enter their own estimate of total number of hours of labor for the cost analysis. User defined charges can be added. To complete the cost analysis, enter your own values for the cost of various inputs. If no cost information is needed, proceed directly to the program outputs. Updated cost information is not needed to continue.

**Cow Systems**  
 22 = 7 Day CO-Synch+CIDR with Fixed-Time AI - 66  
 29 = 5 Day CO-Synch+CIDR with Fixed-Time AI-72

**Less Preferred Systems**  
 10 = CO-Synch with Fixed-Time AI  
 13 = OvSynch  
 35 = PG 6 Day

**Fixed-Time AI**

**Heifer Systems**  
 23 = 7 Day CO-Synch+CIDR with Fixed-Time AI - 54  
 27=MGA + PG with Fixed-Time AI  
 32=14 Day CIDR+PG with Fixed- Time AI  
 38 = 5 Day CO-Synch+CIDR with Fixed-Time AI-60

**Less Preferred Systems**  
 28= CIDR Select with Fixed-Time AI  
 36 = PG 6 Day CIDR with Fixed- Time AI - 66

Note the associated costs of the synchronization protocol can be indicated here. The feed/yardage costs are only figured into the MGA programs. The labor (hours) required is estimated. These figures do not need to be updated to run the program.

Head in group:	100		Forage:	20	Daily Lbs./Hd.	Cost / Lb	PG (\$/dose):	\$2.80
Labor Estimate:	71.6	hours	Grain:	4			GnRH (\$/dose):	\$2.90
Labor Charge:	\$13.50	\$/hour	MGA:	1			CIDR (\$/insert):	\$11.00
Yardage:	\$0.30	\$/hd/day	Supplement:	0.25			Semen (\$/unit):	\$25.00

User Defined Charges:

Name of Item:		No.Units		Cost - \$ per Unit:	
Name of Item:		No.Units		Cost - \$ per Unit:	
Name of Item:		No.Units		Cost - \$ per Unit:	

**Figure 5.** Cost input section of *Planner Worksheet*.

### Program Output

Depending on the priority of the users, the next step would be to go to either the *Calendar* tab or the *Print Out* tab. The *Print Out* tab gives comments on using the selected synchronization system and then a written summary of what needs to occur each day (Figure 6). The next section of this worksheet (Figure 7) gives a summary of the immediate costs of using the system along with the costs of the alternative systems selected on the *Planner Worksheet*. Costs are broken down into synchronization cost, AI cost, total cost per synchronized female, feed and yardage cost (MGA systems only) and total cost. The bottom section (Figure 7) gives a cost per pregnancy based on the estrous response rate and conception rate.

To see how the selected synchronization system falls on the calendar (missing Grandma’s birthday party or when help will be home from school) go to the *Calendar* tab to see the agenda in a calendar format (Figure 8). If the system or the dates don’t work then go back to the *Planner Worksheet* to make the needed changes and re-evaluate. Select PRINT from your Excel menu to print the *Calendar* or *Print Out* output. To create a pdf version of the output to share, use the print command in Excel (FILE- PRINT-PRINTER) and change the printer to Adobe PDF or other pdf printer. It will ask you to name the file and where to save it. The PDF document can be printed to paper or attached and sent anywhere by attaching to an e-mail message.

### Estrus Synchronization Planner



Date to start breeding: 6/1/2014  
 Clean-up bull turn in date: 6/16/2014  
 Start of calving season: 3/9/2015

Producer Name: Shiloh Ranch  
 Address: \_\_\_\_\_  
 Town: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_  
 Group: \_\_\_\_\_  
 Prepared by: Sandy Johnson  
 Phone Number: \_\_\_\_\_

6 = MGA + Prostaglandin		
Comments		Estimated average number of times per head through the working facility: <u>2</u>
<p>This system is highly recommended for heifers and works effectively in postpartum cows.                      Estrus detection should begin at the time of PG administration.                      Majority will exhibit estrus between 48 and 96 hours after PG.                      Daily intake during MGA feeding is critical, may require drylot feeding.                      Deliver MGA in either a well mixed ration or a supplement with not less than 3-5 lbs fed per head per day.                      For either MGA feeding methodology provide adequate bunk space(12 in. for TMR, 18 in. for MGA + grain only).                      Immediate addition of clean-up bulls could lead to questions about parentage.</p>		
Date of Activity	Day of the Week	Description of Activity
04/30/14	Wednesday	Start feeding Melengestrol Acetate (MGA) at .5 mg/hd/day. Continue feeding until 5/13/2014.
05/13/14	Tuesday	Last day to feed MGA at .5 mg/hd/day.
05/15/14	Thursday	Large numbers of females will show heat the next 4 days - DO NOT BREED!
06/01/14	Sunday	Inject Prostaglandin (PG) to all females. Start heat detection. Breed females AI 10-14 hours after standing heat.
06/02/14	Monday	Continue heat detection. Breed females AI 10-14 hours after standing heat.
06/03/14	Tuesday	Peak heat at 60 - 72 hours after PG. Continue heat detection. Breed females AI 10-14 hours after standing heat.
06/07/14	Saturday	Last day of heat detection. Breed females AI 10-14 hours later if showing standing heat.
06/16/14	Monday	Turn clean up bulls in with females. Immediate addition of clean-up bulls could lead to questions about parentage.

**Figure 6.** Estrus Synchronization Planner spreadsheet, page 1 of *Print Out* worksheet. Information based on selections made in *Planner Worksheet*.

Cost Comparison of Three Selected Systems				6 = MGA + Prostaglandin	16 = Select Synch + CIDR with E-AI and Cleanup AI	31=14 Day CIDR+PG with E-AI and Cleanup AI	
Cost Analysis Item:	Units	Cost/Unit	Total Cost	vs.	Total Cost	vs.	Total Cost
PG Cost	100	\$2.80	\$280.00		\$280.00		\$280.00
GnRH Cost		\$2.90			\$391.50		\$101.50
MGA Supplement	1400	\$0.20	\$280.00				
CIDR Cost		\$11.00			\$1,100.00		\$1,100.00
<b>Synchronization Cost Subtotal</b>			<b>\$560.00</b>		<b>\$1,771.50</b>		<b>\$1,481.50</b>
Detect/Mgt.Labor	62.0	\$13.50	\$836.62		\$763.73		\$966.05
Semen	100	\$25.00	\$2,500.00		\$2,500.00		\$2,500.00
Estroject	100	\$1.10	\$110.00		\$110.00		\$110.00
<b>AI Cost Subtotal</b>			<b>\$3,446.62</b>		<b>\$3,373.73</b>		<b>\$3,576.05</b>
<b>Total Cost (not including feed &amp; yardage)</b>			<b>\$4,006.62</b>		<b>\$5,145.23</b>		<b>\$5,057.55</b>
<b>Cost / Female Synchronized</b>			<b>\$40.07</b>		<b>\$51.45</b>		<b>\$50.58</b>
Days in Drylot			39				
Forage (lbs)	78,000		\$4,680.00				
Grain (lbs)	15,600		\$1,716.00				
Yardage (hd-day)	3,900		\$1,170.00				
Supplement (lbs)	975		\$243.75				
<b>Feed &amp; Yardage Cost Subtotal</b>			<b>\$7,809.75</b>				
<b>Total Cost</b>			<b>\$11,816.37</b>		<b>\$5,145.23</b>		<b>\$5,057.55</b>

*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 - Response Analysis:		6 = MGA + Prostaglandin				
Estrous Response Rate		Conception Rate of those Responding to Synchronization				
		45%	55%	65%	75%	85%
75%	% AI Pregnant	33.8%	41.3%	48.8%	56.3%	63.8%
	\$/Synch AI preg.	\$100.20	\$81.98	\$69.37	\$60.12	\$53.05
80%	% AI Pregnant	36.0%	44.0%	52.0%	60.0%	68.0%
	\$/Synch AI preg.	\$97.41	\$79.70	\$67.44	\$58.44	\$51.57
85%	% AI Pregnant	38.3%	46.8%	55.3%	63.8%	72.3%
	\$/Synch AI preg.	\$94.94	\$77.68	\$65.73	\$56.97	\$50.26
90%	% AI Pregnant	40.5%	49.5%	58.5%	67.5%	76.5%
	\$/Synch AI preg.	\$92.76	\$75.89	\$64.22	\$55.65	\$49.11
95%	% AI Pregnant	42.8%	52.3%	61.8%	71.3%	80.8%
	\$/Synch AI preg.	\$90.80	\$74.29	\$62.86	\$54.48	\$48.07

\*\*This cost analysis does not include the feed & yardage cost subtotal which would be - \$78.10

**Figure 7.** Estrus Synchronization Planner spreadsheet, page 2 of *Print Out* worksheet. Information based on selections made in *Planner Worksheet*. Compares cost of the selected system to 2 alternatives. Cost response analysis shows costs based on varying conception and estrous response rates.

# Estrus Synchronization Planner

9/13/13

**6 = MGA + Prostaglandin**

**Producer Name:** Shiloh Ranch  
**Address:** \_\_\_\_\_  
**Town:** \_\_\_\_\_  
**Phone Number:** \_\_\_\_\_  
**Group:** \_\_\_\_\_  
**Prepared by:** Sandy Johnson  
**Phone Number:** \_\_\_\_\_

**Date to start breeding:** 6/1/2014  
**Clean-up bull turn in date:** 6/16/2014  
**Start of calving season:** 3/9/2015



Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
4/27/2014	4/28/2014	4/29/2014	4/30/2014	5/1/2014	5/2/2014	5/3/2014
			* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day
5/4/2014	5/5/2014	5/6/2014	5/7/2014	5/8/2014	5/9/2014	5/10/2014
* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day
5/11/2014	5/12/2014	5/13/2014	5/14/2014	5/15/2014	5/16/2014	5/17/2014
* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day	* MGA @ 0.5 mg/hd/day		* Many females in heat next 4 days. DO NOT BREED!		
5/18/2014	5/19/2014	5/20/2014	5/21/2014	5/22/2014	5/23/2014	5/24/2014
5/25/2014	5/26/2014	5/27/2014	5/28/2014	5/29/2014	5/30/2014	5/31/2014
6/1/2014	6/2/2014	6/3/2014	6/4/2014	6/5/2014	6/6/2014	6/7/2014
* Detect Estrus & Breed * Inject PG - all females	* Detect Estrus & Breed	* Detect Estrus & Breed * Peak Estrus	* Detect Estrus & Breed	* Detect Estrus & Breed	* Detect Estrus & Breed	* Detect Estrus & Breed
6/8/2014	6/9/2014	6/10/2014	6/11/2014	6/12/2014	6/13/2014	6/14/2014

**Figure 8.** Estrus Synchronization Planner spreadsheet, *Calendar* worksheet

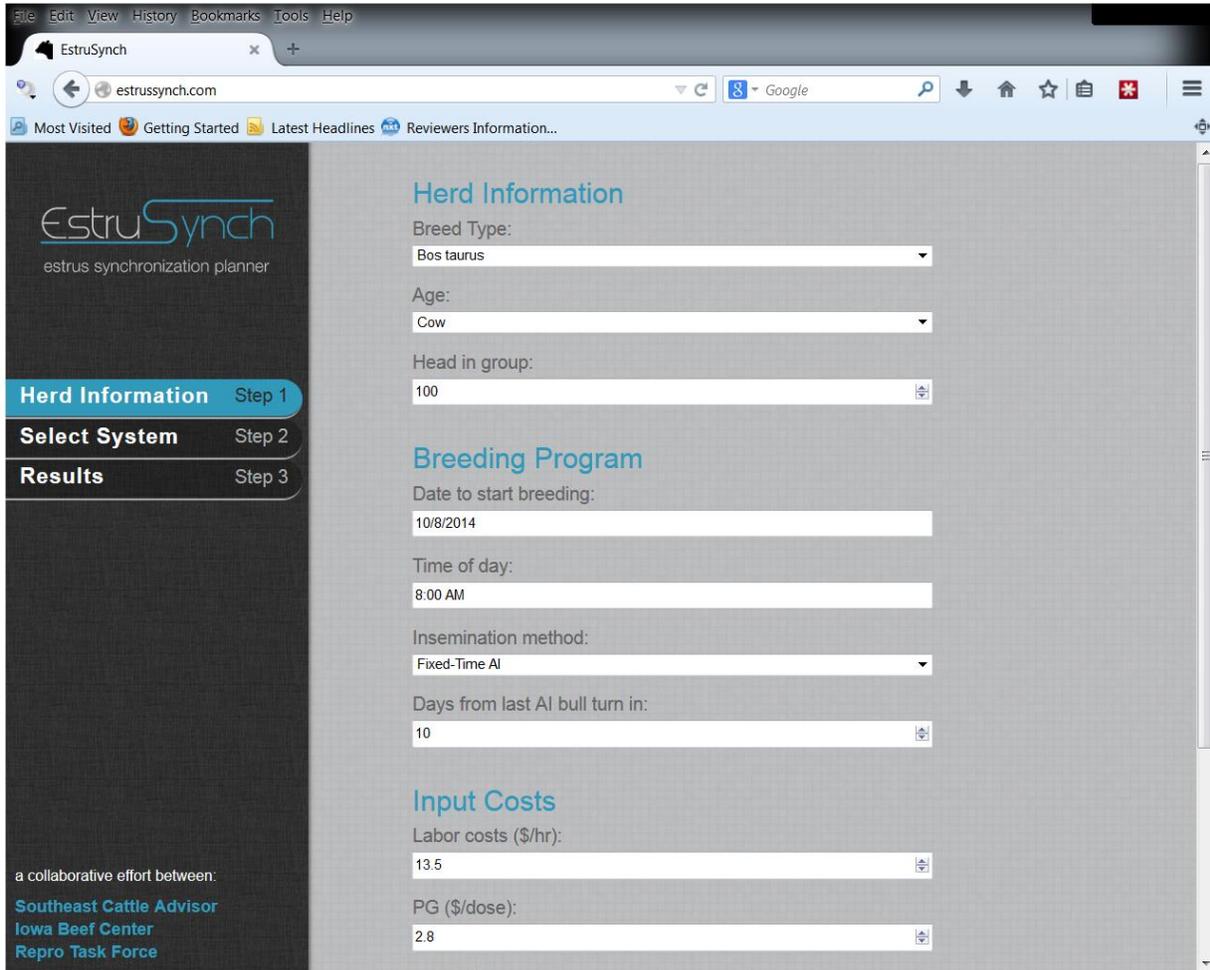
Once the output from the planner has been generated, a number of additional steps should be taken to help ensure a successful synchronization program. Share the output with everyone involved in the project (and your spouse even if they aren't directly involved) and double check for conflicts on their calendars. Post a copy of the calendar in the barn and or in the area where AI supplies are stored. Mark the synchronization products with date they will be used. Mistakenly administering GnRH rather than prostaglandin (or vice versa) is common problem.

Make sure necessary supplies are on hand including appropriately sized needles, syringes, gloves, AI sheaths, lube, paper towels and heat detection aids. Test temperature of automatic thaw units. Clean and check condition of insemination gun(s), tweezers and straw cutter. Review record keeping plans and methods. For timed-AI systems you may want to record how much time it took to inseminate, number of cows and number of people helping (perhaps names as that relates to level to experience/ability). This can be used to plan in subsequent years. Check facilities for any needed repairs.

### **Mobile version**

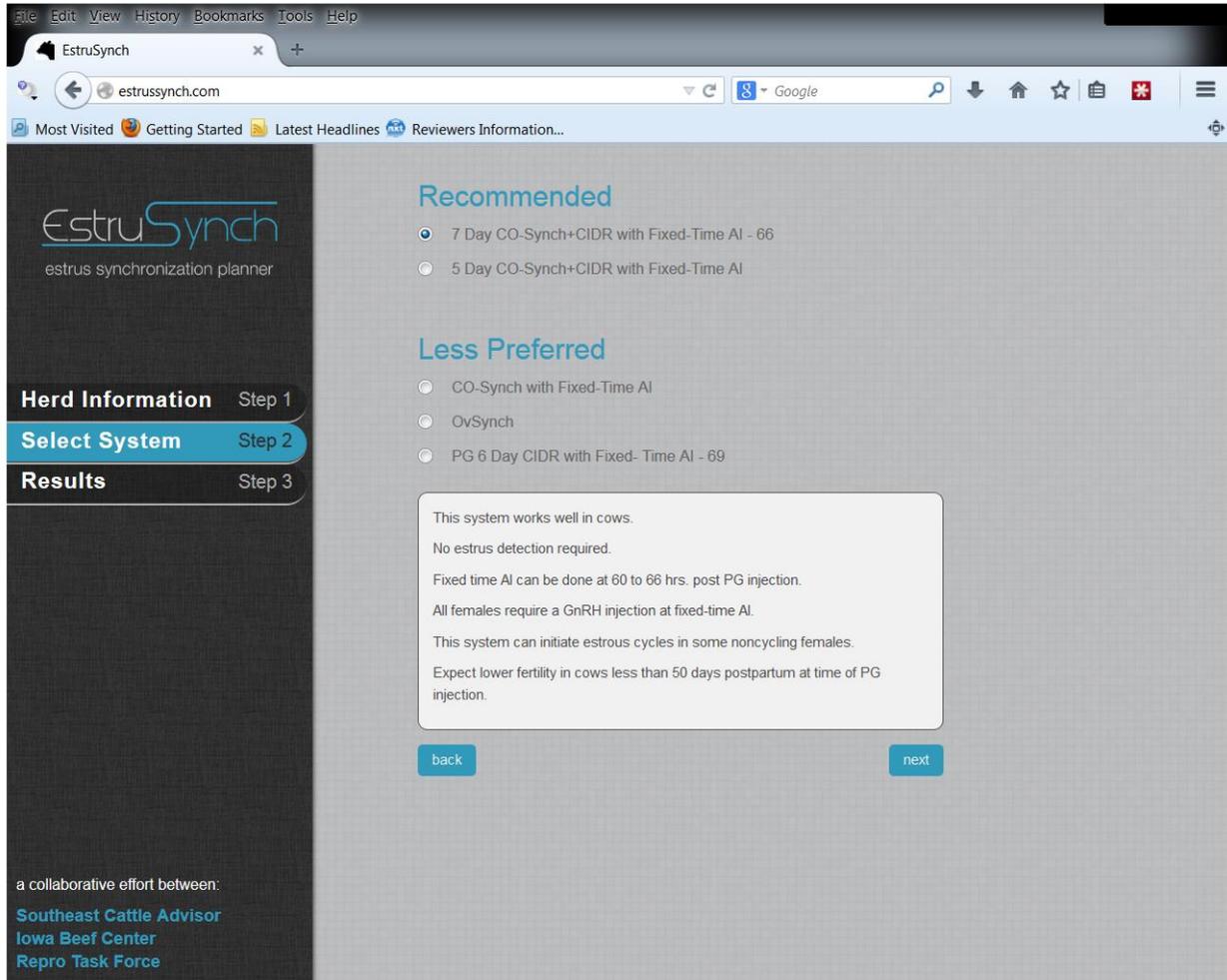
The Estrus Synchronization Planner is now available for use on your mobile device (EstruSynch). Direct your browser to [www.estrussync.com](http://www.estrussync.com) for this web-based application that requires a wireless signal or other internet connection to operate. Wireless coverage may limit use in some pasture settings. The program has the most critical but not all of the features of the full version. Protocol updates in the mobile version may lag behind the spreadsheet version.

Input your choices on the first page (Steps 1; Figure 9). Breed type, age, date to start breeding, time of day and insemination method are selected from drop down choices. You must enter a value into the "head in group" box and "days from last AI to bull turn in" to continue. The up and down arrow keys can be used to adjust up or down the number of "head in a group" or other numeric values or prices. When entries are complete, use the "next" button to continue.



**Figure 9.** Input screen, Step 1, of the Estrus Synchronization Planner App.

In Step 2 (Figure 10), select one of recommended protocols by clicking on the desired system. Comments related to the system selected appear in the lower portion of the screen. If the desired system is not shown, use the “back” button to change the “insemination method”. Return to Step 2 and look for desired system; hit “next” to move on.

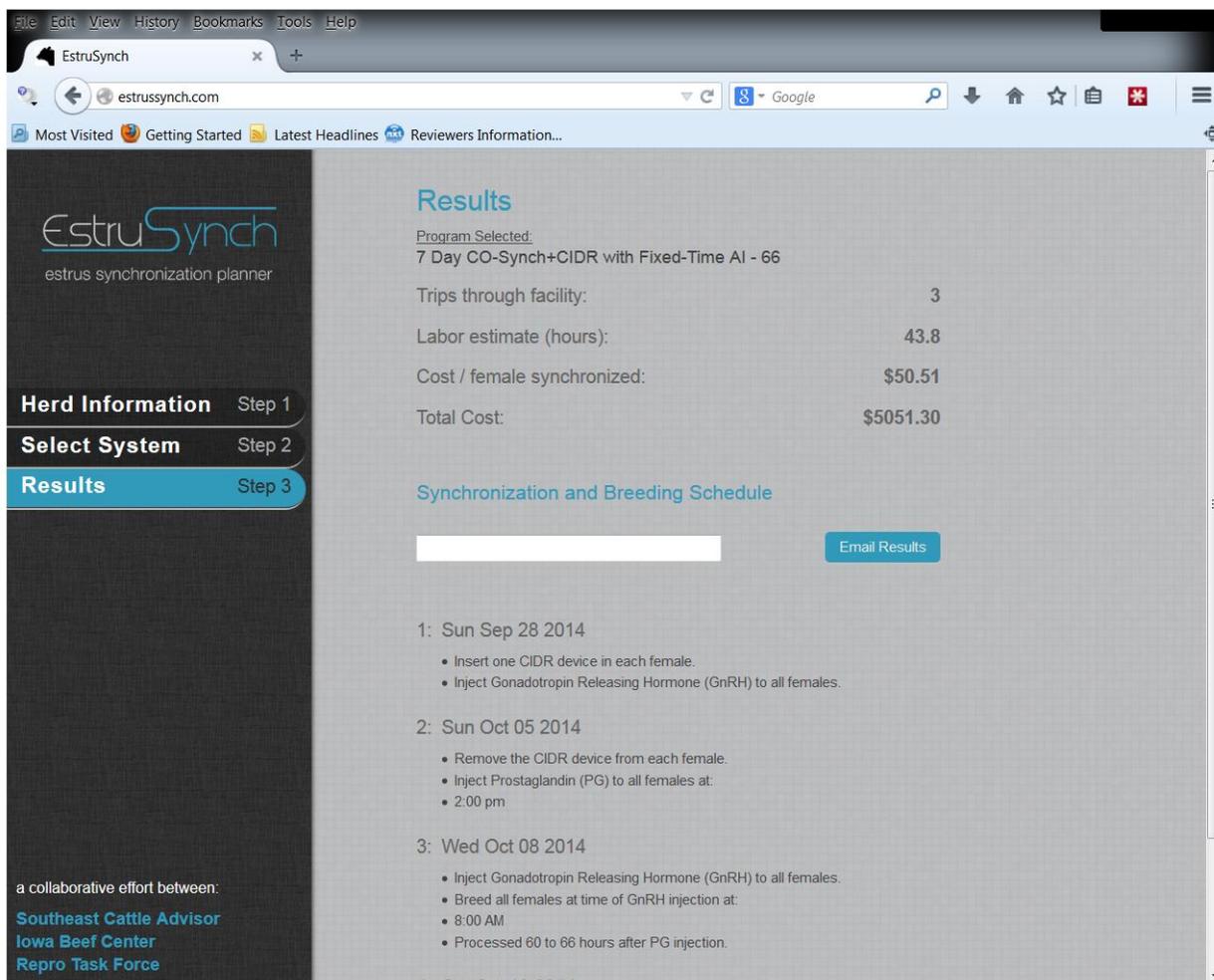


**Figure 10.** System selection input screen of Estrus Synchronization Planner App.

The results from the selections are shown in Step 3 (Figure 11). The labor hours estimated are calculated the same way as in the full version of the planner. Total cost reflects the number of animals entered in Step 1. The breeding schedule created can be shared via e-mail.

### Summary

The Estrus Synchronization Planner Spreadsheet and the associated version for hand held devices should help users select appropriate breeding systems and to deliver necessary treatments in a timely fashion. Follow these steps to use the planner successfully. 1) Download planner or check to see you have the latest version (synch 14, but expect 15). 2) Move to the *Planner Worksheet* and determine insemination type (AI after observed estrus, AI after observed estrus and cleanup timed AI, or fixed-time AI). 3) Enter breed type, date to start breeding and time of day to breed (for fixed-time AI systems). 4) Select protocol from list. 5) Review *Calendar* and *Print Out* output and adjust as needed. Use output to communicate with your team members. With these details covered, producers can focus on other aspects of animal nutrition and management, semen handling and insemination technique to further improve AI pregnancy rates.



**Figure 11.** Results screen of Estrus Synchronization Planner App.

## References

Loseke, G. L. 1989. A cost analysis of artificial insemination breeding systems as compared to natural service for Nebraska cow-calf producers. Masters Thesis. University of Nebraska.