Synchronization response: *Bos taurus* vs. *Bos indicus* cattle

Joel. V. Yelich[1], and G. Allen Bridges[2]

[1]University of Florida, Gainesville and [2]University of Minnesota, North Central Research & Outreach Center, Grand Rapids.

Introduction

Approximately 30% of cattle in the United States (US) contain some percentage of *Bos indicus* genetics (Chase et al., 2005). Additionally, it is estimated that 42% of beef cows and 50% of cow-calf producers are located in the southern US, and cattle that contain some *Bos indicus* breeding dominate these areas (Morrison, 2005). The reason these cattle contain some *Bos indicus* breeding is because of their superior ability to deal with heat-stress, capacity to utilize low quality forages, and increased parasite tolerance. However, cattle of *Bos indicus* breeding also have some negative attributes including older at onset of puberty, longer postpartum anestrous period, and carcasses that produce a less tender product compared to cattle of *Bos taurus* breeding. Therefore, it is imperative for producers in these areas of the US to use superior genetics that not only take advantage of the positive attributes of *Bos indicus* cattle but assist in improving genetically on those negative traits.

One of the most effective ways to improve genetic performance is utilizing superior sires through artificial insemination (AI) combined with estrous synchronization. **T**he primary goal of any estrous synchronization protocol is to induce a compact estrous response so cattle can be inseminated at a predetermined time period with acceptable fertility. Protocols are designed to allow for AI following either a detected estrus or at an induced ovulation and timed-AI (TAI). From the producers' perspective, these synchronization protocols must be cost effective, easy to implement, require minimal cattle

workings, and yield consistent and acceptable AI pregnancy rates in either yearling heifers or suckled cows.

It should be noted that in the US there are a limited number of products available for use as estrous synchronization agents and they include GnRH, prostaglandins, and progestogens. The trade names for these products are listed in Table 1.

Table 1. Commonly used hormones in estrous synchronization and their trade names[a].

Hormone (Abbreviation)	**Commercial Products[b]**
Gonadotropin Hormone Releasing Hormone (GnRH)	Cystorelin®, Factrel®, Fertagyl®, OvaCyst®
Progestins	
Progesterone	CIDR®, Intravaginal progesterone-releasing insert
Synthetic progestin	Melengestrol acetate (MGA®), Orally-active feed additive
Prostaglandin F_{2a} (PGF)	Lutalyse®, Estrumate®, ProstaMate®, estroPLAN™, In-Synch™

[a] Table adapted from M.L. Day and D.E. Grum, The Ohio State University

[b] The commercial products often do not have the same chemical composition as the hormone produced by the animal's body. In many cases, these compounds have similar effects on the reproductive system as the native hormone. Please read and follow label instructions when using these products.

The primary functions of GnRH are to initiate follicle turnover at the start of a synchronization protocol and to synchronize ovulation with delivery of semen during a TAI protocol. The primary function of the prostaglandins (PG) is to regress the corpus luteum resulting in the animal to come into estrus followed by ovulation. The primary functions of the progestogens are to prevent the expression of estrus during their duration of administration and in induce estrous cycles in prepubertal heifers and anestrous suckled cows. There are numerous synchronization systems that use a combination of the

previously mentioned pharmaceuticals with different degrees of effectiveness and they are available for review at the Beef Reproduction Task Force website (http://beefrepro.unl.edu/resources.html). Commonly used estrous synchronization protocols and those being discussed in this paper are presented in Figure 1. Common terms used when describing estrous synchronization responses are presented in Table 2.

Table 2. Definitions of estrous synchronization terms

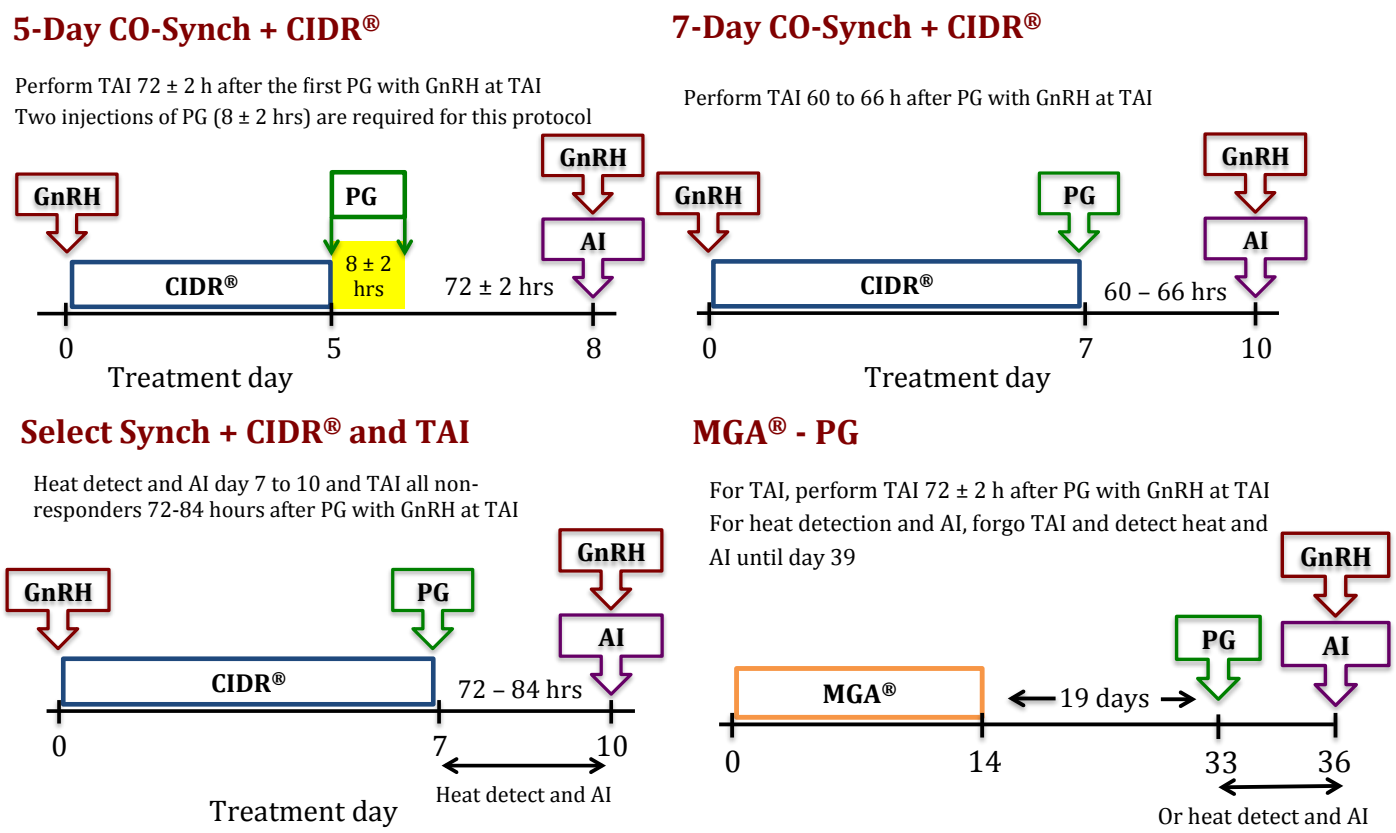
Term	Definition
Prepubertal	Failing to have reached sexual maturity and not having estrous cycles
Anestrus	Failing to have estrous cycles following calving
Synchronized Period	Period of time which estrus is expressed after treatment
Estrous Response	Percentage of females that exhibit estrus during synchronized period
Conception Rate	Percentage of females that conceived to AI of those that exhibited estrus
Timed-AI Pregnancy Rate	Percentage of females that became pregnant following timed-AI
AI Pregnancy Rate	Percentage of females that became pregnant to AI of the total that were inseminated

For brevity, this article and presentation will focus on estrous synchronization protocol that only use the products available in the US and several additional estrous synchronization protocols that included estrous detection, timed-AI, or a combination of estrous detection and timed-AI are available for beef producers. This review will only focus on those protocols that have been dually investigated in cattle of *Bos indicus and Bos taurus* breeding. Recognize that when comparisons are made between independent research studies within this paper, these comparisons have not been statistically evaluated, but rather are being used as examples to demonstrate differences in AI pregnancy rates reported when similar estrous synchronization protocols were used in *Bos indicus* and *Bos*

taurus cattle. Most estrous synchronization protocols have been developed in cattle of *Bos taurus* breeding and these proven synchronization protocols yield acceptable AI pregnancy rates in yearling heifers and suckled cows of *Bos taurus* breeding. In yearling heifers these protocols include the 7- and 5-Day CO-Synch + CIDR and Select Synch + CIDR and timed-AI (TAI), and the MGA-PG protocol either with or without a timed-AI (Figure 1). Whereas, protocols used in suckled beef cows include the 7- and 5-Day CO-Synch + CIDR and the Select Synch + CIDR and TAI (Figure 1). However, in cattle of *Bos indicus* breeding, utilization of these same synchronization protocols yields AI pregnancy rates that are inconsistent and usually unacceptable for producers. There are several physiological reasons for the different responses to the synchronization protocols between *Bos taurus* and *Bos indicus* cattle; although, a full review of these effects cannot be given complete justice in this paper and presentation, a small summary will be provided.

As previously mentioned, heifers of *Bos indicus* breeding attain puberty at older ages compared to *Bos taurus* heifers (Reynolds, 1967; Wiltbank et al., 1966; Plasse et al., 1968). Differences exist between *Bos indicus* and *Bos taurus* cattle in concentrations of and sensitivities to reproductive hormones such as LH (Griffen and Randel, 1978), estradiol (Segerson et al., 1984), and progesterone (Rhodes et al., 1982;). There are also differences in characteristics associated with the expression of estrus. Estrus is more difficult to detect in cattle of *Bos indicus* breeding (Galina et al., 1982) primarily due to decreased estrus duration (Rae et al., 1999) and increased incidence of silent heats (Lamothe-Zavaleta et al., 1991). It is also suggested that cattle of *Bos indicus* breeding are more excitable and susceptible to the negative effects of handling and management stress and/or understated differences in timing of hypothalamic-pituitary-ovarian events related to expression of

Figure 1. Common estrous synchronization protocols used in yearling beef heifers and suckled beef cows. More information on available estrous synchronization protocols for beef cows and heifers can be found at: http://beefrepro.unl.edu/resources.html



estrus and ovulation (Bo et al., 2003). And finally, there are considerable differences in characteristics associated with follicle wave development in *Bos taurus* compared to *Bos indicus* cattle (Bo et al., 2003). All of these factors either alone, or in combination, may result in differences in reproductive physiology between *Bos taurus* and *Bos indicus* cattle and impact how these cattle respond to estrous synchronization protocols that were mostly developed in *Bos taurus* breeds of cattle.

Discussion

Heifers Due to typical managerial practices, yearling heifers are one of the easier groups of cattle to implement estrous synchronization protocols. As previously discussed, yearling heifers of *Bos indicus* breeding reach puberty at older ages compared to *Bos tauurs* heifers, which in itself can be a limiting factor in the effectiveness of an estrous synchronization system in heifers of *Bos indicus* breeding. Therefore, it is imperative that a majority of yearling heifers of either *Bos taurus* or *Bos indicus* breeding attain puberty before the start of the breeding season as pregnancy success to AI can be greatly influenced by pubertal status in both breeds of heifers.

Until recently, the primary estrous synchronization protocol for synchronizing yearling beef heifers was the MGA-PG system (Figure 1). Heifers of *Bos taurus* breeding respond very well to the MGA-PG synchronization protocol, with AI pregnancy rates that are consistently greater than 50% (Table 3; Lamb et al., 2000); which is primarily due to a high estrous response as well as excellent conception rates. In contrast, AI pregnancy rates for heifers of *Bos indicus* breeding are decreased by over 20% compared to the *Bos taurus* heifers. This decrease in pregnancy rates is due to both a decreased estrous response and conception rates in the *Bos indicus* heifers. However, Bridges et al., (2005; Table 3) showed

that estrous response and AI pregnancy rates could be enhanced by providing a second PG treatment 24 hours after the first. The researchers concluded that the increased estrus response and subsequent AI pregnancy rate was due to an increase in luteal regression due to the second PGF treatment. With that said, the AI pregnancy rates are still considerably decreased in the heifers of *Bos indicus* breeding compared to the *Bos taurus* heifers with the MGA-PG protocol.

Table 3. Reproductive performance of yearling *Bos taurus* heifers synchronized with MGA-PG_{α} (PG either 17 or 19 days after MGA; Lamb et al., 2000) and yearling heifers of *Bos indicus* breeding synchronized with MGA-PG_{α} with clean-up timed-AI with either a single PG or two consecutive PG treatments started 19 days after MGA (Bridges et al., 2005)

Treatment	n	Estrous response, %[b]	Conception rate, %[c]	Timed-AI pregnancy rate, %[d]	Synchronized pregnancy rate, %[e]
Lamb et al., 2000					
17 days	249	68.3	75.9	-	51.8
19 days	260	68.1	75.9	-	55.4
Bridges et al., 2005					
Single PGF	354	43.2[a]	48.8	23.9[a]	34.5[a]
Split PGF	341	50.1[b]	51.5	33.5[b]	42.5[b]

[a, b] Means without a common superscript within an author and column differ ($P < 0.05$).

For producers that do not want to deal with the long term planning required for the MGA-PG system and when they cannot assure adequate MGA consumption, shorter estrous synchronization protocols have been devised that incorporate the use of a CIDR as the progestogen source. These shorter, CIDR-based protocols include the 7-Day Select Synch/CO-Synch + CIDR protocol and the 5-Day Select Synch/CO-Synch + CIDR protocols (Figure 1). Both of these approaches to estrous synchronization involve CIDR insertion and

GnRH administration at treatment initiation followed by CIDR removal and PG delivery either 5 (5-Day approach) or 7 (7-Day approach) days later. With the 5-Day approach, an additional administration of PG is needed. Recent research in beef cows has demonstrated that this second PG can be given from 0 to 12 h after the initial administration (Bridges et al., 2011). Following CIDR removal, females can receive timed-AI (referred to as a "CO-Synch" approach) 60 to 66 (7-Day) or 72 (5-Day) hours later or estrus can be detected using the AM/PM rule followed later by timed-AI in non-responding heifers (referred to as a "Select Synch and TAI" approach). The 5-Day CIDR approach to estrous synchronization was originally developed by Bridges and co-workers (2008) and has been demonstrated deliver greater AI pregnancy rates in *Bos taurus* beef cows (Bridges et al., 2008) and heifers (Wilson et al., 2007; Sparks et al., 2010) compared to the 7-Day approach (Summarized in Table 4).

Although the 5-Day CIDR approach has delivered acceptable and consistent results in *Bos taurus* heifers, researchers continue to investigate approaches to further increase AI pregnancy rates. Recent research in *Bos indicus* breeds of heifers (Dias et al., 2009; Peres et al., 2009; Claro et al., 2010; SáFilho and Vasconcelos, 2010) suggests that reducing progesterone concentrations during the development of the follicular wave for a finite period of time may improve pregnancy success to AI in beef heifers. Therefore, Sparks and coworkers (2010) investigated if PGF at the onset of a CIDR-based estrous synchronization protocol would result in improved estrous response and greater AI pregnancy rates in *Bos taurus* beef heifers. Thus, they developed the Modified 7 day Select Synch + CIDR + TAI protocol (Figure 2). The AI pregnancy rates were similar between the 5 day Select Synch + CIDR + TAI and Modified 7 day Select Synch + CIDR + TAI protocol, which were both

greater than the 7 day Select Synch + CIDR + TAI protocol. Hence, in *Bos taurus* beef heifers, administering PGF prior to the onset of a 7-Day Select Synch + CIDR approach did not improve pregnancy success (Table 5) compared to the 5-Day approach.

Table 4. Comparison of AI pregnancy rates between the 7-Day and 5-Day approaches to estrous synchronization in *Bos taurus* beef cows and heifers.

		AI pregnancy rate		
	Reference	**7-Day**	**5-Day**	***P* - value**
CO-Synch + CIDR				
Cows	Bridges et al., 2008, Year 1	66.7% (n = 111)	80.0% (n = 105)	< 0.05
	Bridges et al., 2008, Year 2	56.2% (n = 201)	65.3% (n = 199)	< 0.05
Heifers	Wilson et al., 2007	49.0% (n = 204)	59.7% (n = 201)	< 0.05
Select Synch + CIDR and TAI				
Heifers	Sparks et al., 2010	47.3% (n = 298)	57.1% (n = 367)	< 0.05

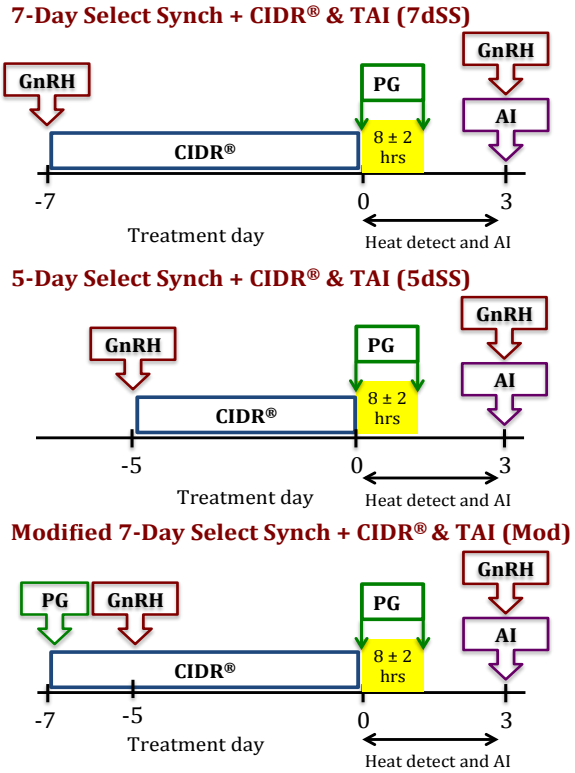


Figure 2. Illustration of the 7-Day Select Synch + CIDR and TAI, 5-Day Select Synch + CIDR and TAI, and Modified 7-Day Select Synch + CIDR and TAI treatments used in experiments described in Tables 4, 5, 6, and 7. In all treatments, two doses (25 mg) of $PGF_{2\alpha}$ (Lutalyse) were administered 8 h apart, with the initial dose given at CIDR withdrawal. Females were detected for estrus for 60 h following CIDR insert removal and AI based on the AM/PM rule. Females failing to exhibit estrus within 60 h received timed-AI at 72 h after CIDR insert removal, concurrent with GnRH administration.

Table 5. Reproductive performance of yearling beef heifers of *Bos taurus* breeding synchronized with the 7-Day Select Synch + CIDR and TAI (7dSS), 5-Day Select Synch + CIDR and TAI (5dSS), and Modified 7-Day Select Synch + CIDR and TAI (Mod) treatments described in Figure 2 (Sparks et al., 2010).

Treatment	n	Estrous Response, %	Estrous AI Conception Rate, %	Timed-AI Conception Rate, %	AI Pregnancy Rate, %
5dSS[1]	367	56.1[a]	62.0[c]	50.9	57.1[a]
7dSS[2]	298	67.1[b]	50.0[d]	41.8	47.3[b]
Mod[3]	374	69.3[b]	65.6[c]	42.1	58.4[a]

[1] 5-Day Select Synch + CIDR & TAI (Figure 2)
[2] 7-Day Select Synch + CIDR & TAI (Figure 2)
[3] Modified 7-Day Select Synch & CIDR + TAI (Figure 2)
[a,b] $P < 0.05$
[c,d] $P < 0.01$

Although the 5-Day approach to estrous synchronization appears affective in cattle of *Bos taurus* breeding, results in *Bos indicus* breeds of cattle are not as promising. In contrast to the high AI pregnancy rates of the 5-Day Select Synch + CIDR and TAI in *Bos taurus* cattle, the AI pregnancy rates for heifers of *Bos indicus* breeding synchronized with the 5-Day Select Synch + CIDR and TAI were only 19.5%, which were also similar to AI pregnancy rates (23.0%) for the 7-Day Select Synch + CIDR and TAI (Table 6). Heifers of *Bos indicus* breeding synchronized with the Modified 7-Day Select Synch + CIDR and TAI protocol had greater AI pregnancy rates compared to both the 5-Day and 7-Day Select Synch + CIDR and TAI protocols (Table 6). What was surprising in the *Bos indicus* heifers synchronized with the 5-Day Select Synch + CIDR and TAI protocol was that they had significantly decreased conception rates (33.3%; Table 6) compared to the *Bos taurus* heifers (62.0%; Table 5). It should be noted that the conception rate (62%; Table 6) for the *Bos indicus* heifers synchronized with the Modified 7-Day Select Synch + CIDR and TAI

protocol are similar to those observed for the both the 5- and 7-Day Select Synch + CIDR and TAI protocols in *Bos taurus* heifers (Table 5). In addition, one of the reasons for this significant decrease in AI pregnancy rates, regardless of estrous synchronization protocol, for the *Bos indicus* heifers was the low percentage of heifers that were pubertal at the start of the synchronization trial. Approximately 2/3 of the heifers (Table 7) had reproductive tract scores < 3 at the start of the breeding season (< 3 is an indication of being prepubertal). The RTS (Anderson et al., 1991) is an excellent indicator of pubertal status of heifers at the start of the breeding season as heifers with RTS of > 3 typically response well to a synchronization protocol. Therefore it is imperative that heifers of *Bos indicus* breeding have attained puberty before the start of a synchronization protocol.

Table 6. Reproductive performance of yearling beef heifers of *Bos indicus* breeding synchronized with the 7-Day Select Synch + CIDR and TAI (7dSS), 5-Day Select Synch + CIDR and TAI (5dSS), and Modified 7-Day Select Synch + CIDR and TAI (Mod) treatments described in Figure 2.

Treatments [a]	N	Estrous Response, %	Conception Rate, %	Timed-AI pregnancy rate, %	AI pregnancy rate, %
5dSS[1]	113	21.2[a]	33.3[a]	15.7	19.5[a]
7dSS[2]	113	34.5[b]	38.5[a]	14.9	23.0[a]
Mod[3]	117	42.7[b]	62.0[b]	19.4	37.6[b]

[1] 5-day Select Synch + CIDR + TAI (Figure 2)
[2] 7-day Select Synch + CIDR + TAI (Figure 2)
[3] Modified 7-day Select Synch + CIDR + TAI (Figure 2)
[a, b] Means without a common superscript within a column differ (P < 0.05).

Table 7. Reproductive tract score (RTS) effects on reproductive performance of yearling beef heifers of *Bos indicus* breeding synchronized with the 7-Day Select Synch + CIDR and TAI, 5-Day Select Synch + CIDR and TAI, and Modified 7-Day Select Synch + CIDR and TAI treatments described in Figure 2.

RTS	N	Estrous Response, %	Conception Rate, %	Timed-AI pregnancy rate, %	Synchronized pregnancy rate, %	Thirty-day pregnancy rate, %
1	51	13.7[a]	14.3	9.1	9.8[a]	31.4[a]
2	74	10.8 [a]	50.0	12.1	16.2[a]	44.6[a]
3	76	39.5[b]	50.0	23.9	34.2[b]	59.2[b]
4	98	49.0[b]	54.2	18.0	35.7[b]	68.4[b]
5	44	45.5[b]	40.0	25.0	31.8[b]	72.7[b]
P-value		P < 0.05	P > 0.05	P > 0.05	P < 0.05	P < 0.05

[a],[b] Means without a common superscript within a column differ (P < 0.05).

A recent report by Williams et al., (2012) also confirmed the poor AI pregnancy rates of the 5-Day CIDR protocol in heifers of *Bos indicus* breeding. Therefore, it does not appear that 5-Day Select Synch + CIDR and TAI is a recommended system for use in heifers of *Bos indicus* breeding. However, the Modified 7-Day Select Synch + CIDR +and TAI protocol (Figure 2) appears to have some promise for heifers of *Bos indicus* breeding and additional research is needed to confirm these results. In addition, Gary Williams at Texas A & M University has reported that a modified 5-Day CO-Synch + CIDR protocol they have named "Bee Synch" also has some promise in cattle of *Bos indicus* breeding. In this system both PG and GnRH are administered at CIDR insertion and all cattle receive timed-AI 66 hours after CIDR removal. The Bee Synch protocol along with the Modified 7-Day Select Synch + CIDR and TAI take advantage of decreased progesterone concentrations during the

CIDR treatment which appear to result in follicles that are very fertile after CIDR removal. Other researchers in Brazil with Nelore cattle have also reported that decreased progesterone concentrations during a synchronization treatment may result in significantly improved AI pregnancy rates in *Bos indicus* breeds of cattle. In summary, when modification were made to the 5-Day and 7-Day Select Synch + CIDR protocols in an attempt to decrease progesterone concentrations during estrous synchronization, AI pregnancy rates appear to be improved. Therefore, these protocols appear to have promise in yearling heifers of *Bos indicus* breeding and additional research will need to be conducted to confirm these results.

Suckled Cows Postpartum beef cows are more of a challenge to synchronize estrus since a majority of cows are anestrous at the start of a synchronized breeding season. To reduce the proportion of anestrus cows at the start of the breeding season, beef cows must be of adequate body condition (BCS; Scale 1-9) at calving. Failing to have cows in proper BCS (ideal 5 to 6) will result in reduced reproductive performance during the subsequent breeding season and decreased profits (Kunkle et al., 1998). Furthermore, BCS can have significant effects on synchronized AI pregnancy rates. Cattle that are to thin at the start of a synchronization period will have decreased AI pregnancy rates compared to cattle in adequate BCS (Stevenson et al., 2000; DeJarnette et al., 2004; Larson et al., 2006). Providing progesterone supplementation can stimulate some anestrous cows to resume having normal estrous cycles. Therefore, most of the recent estrous synchronization research in suckled cows of *Bos taurus* and *Bos indicus* breeding has focused on estrous synchronization protocols that incorporate the use of a CIDR as a progesterone source. Administration of a CIDR is an effective method to induce estrus in anestrous postpartum beef cows (Lucy et

al., 2001). The most commonly used CIDR-based protocols include the CO-Synch + CIDR and Select Synch + CIDR and TAI protocols of either the 5-Day or 7-Day variety (Figure 1).

The CO-Synch protocols require the least amount of cattle handlings, as cattle must only be handled three times. Also, timed-AI approaches reduce the labor of estrous detection since all cows are AI at a predetermined time. With the 7-Day CO-Synch + CIDR, initially cows were TAI from 48 to 54 hours after CIDR removal but most recent research suggest that timed-AI at 60 to 66 hours is the best. A recent study by Larsen et al., (2006) reported an AI pregnancy rate of 54% for the 7-Day Co-Synch + CIDR protocol in *Bos taurus* cows, which agrees with numerous other reports in the literature. In contrast, cattle of *Bos indicus* breeding synchronized with a similar protocol with TAI at 48 hours only reported AI pregnancy rates of 33.3% (Saldarriaga et al., 2004; Yelich, 2000; Summarized in Figure 3). However, a recent report by Esterman. (2011; Figure 4) in suckled *Bos indicus* cows synchronized with an Extended 7-Day CO-Synch + CIDR with the CIDR left in for 7.5 days and TAI conducted at 60 hours post CIDR removal reported AI pregnancy rates of 47%, which was considerably greater than previous reports in *Bos indicus* cattle. So it appears that leaving the CIDR in for an additional 12 hours and conducting TAI at 60 hours after CIDR removal may be advantageous in *Bos indicus* cattle and warrants further research, but it still does not provide results to what is observed in *Bos taurus* cows.

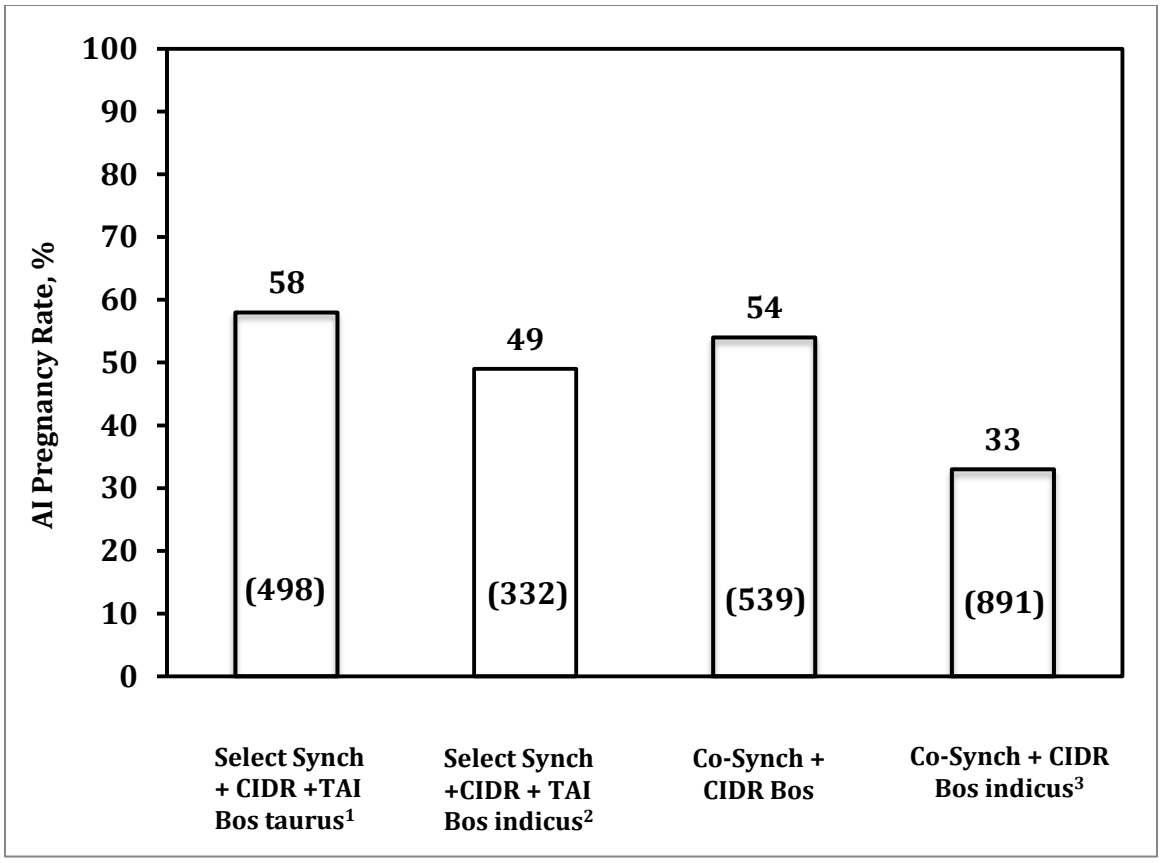


Figure 3. Summary of data taken from literature of AI pregnancy rates of suckled *Bos taurus* and *Bos indicus* × *Bos taurus* cows synchronized with 7-Day Select Synch + CIDR + TAI and 7-Day CO-Synch + CIDR protocol. Timed-AI for CO-Synch in *Bos taurs* cattle was performed between 54 to 66 hours after CIDR removal; whereas, timed-AI was performed at 48 hours in the *Bos indicus* × *Bos taurus* cattle. Numbers in parenthesis are the numbers of animals synchronized (Larsen et al., 2006[1]; Saldarriaga et al., 2004[3]; Yelich, 2000[3], Esterman, 2011[2]).

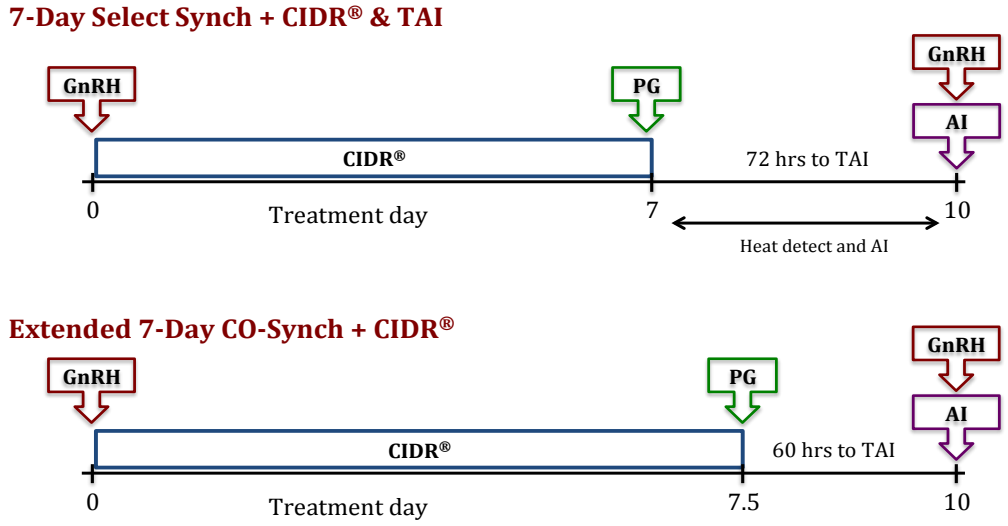


Figure 4. Description of the 7-Day Select Synch + CIDR and TAI and the Extended 7-Day CO-Synch + CIDR treatments used to synchronize suckled *Bos indicus* x *Bos taurus* beef cows. Blood samples were collected at and 10 days prior to CIDR insertion to determine estrous cycling status of cows (Esterman, 2011)

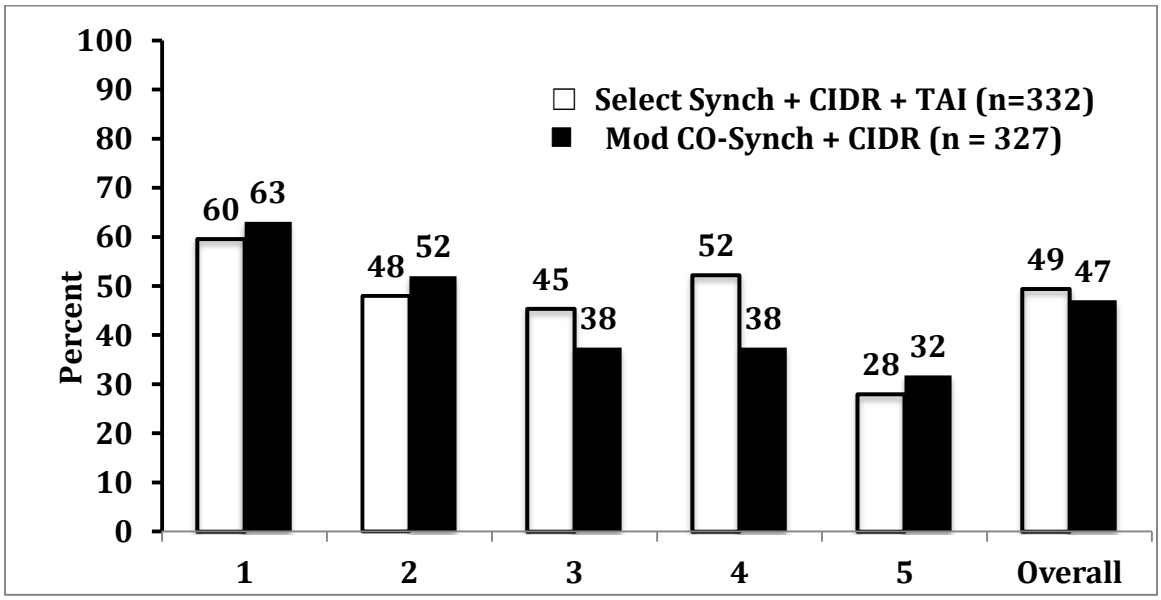


Figure 5. AI pregnancy rates of suckled *Bos indicus* × *Bos taurus* cows synchronized at five locations with either a Select Synch + CIDR + TAI or an Extended 7-Day CO-Synch + CIDR protocol. See Figure 4 for description of treatments. Synchronized pregnancy rates were similar ($P > 0.05$) between treatments, but differed ($P < 0.05$) between groups. There was no ($P > 0.05$) estrous cycling status and treatment × group effects on AI pregnancy rates (Esterman, 2011).

In *Bos taurus* cattle the 5-Day CO-Synch + CIDR protocol has been reported as an effective method to facilitate timed-AI in cows (Bridges et al., 2008). However, Williams et al., (2012) reported AI pregnancy rates of 36% in *Bos indicus* cattle synchronized with the 5-Day Co-Synch + CIDR protocol. Yelich J. (Table 6: Unpublished data) reported AI pregnancy rate of 42% in Brangus cows synchronized with a 5-Day Select Synch + CIDR and TAI (Figure 2) while the AI pregnancy rates of the Angus cows was 59.8%. Therefore, the 5-Day Co-Synch and 5-Day Select Synch + CIDR + TAI are very effective synchronization protocols in suckled *Bos taurus* cows but they do not provide a similar response in suckled cows of *Bos indicus* breeding.

The other short term CIDR protocol that provide effective synchronized pregnancy rates in suckled *Bos taurus* cows is the 7 day Select Synch + CIDR + TAI (Figure 1). This protocol is a little more labor intensive since it does require a couple of days of estrus detection in combination with TAI for cows that do not exhibit estrus within 72 hours after CIDR removal. Larson et al., (2006; Figure 3) reported AI pregnancy rates of 58% in suckled *Bos taurus* cows; whereas, Esterman (2011) reported AI pregnancy rates of only 49% in suckled *Bos indicus* cows (Figure 3). Furthermore, there is considerable variation in AI pregnancy rates in suckled *Bos indicus* cattle synchronized with the 7-Day Select Synch + CIDR + TAI, where the AI pregnancy rates ranges from the 28 to 60% (Figure 5).

As previously discussed with heifers of *Bos indicus* breeding, there appears to be some promising results using the modified 5-Day ("Bee Synch") and modified 7-Day CIDR protocols, that include PG at CIDR insertion, in suckled *Bos indicus* type cows. Williams et al. (2012) reported AI pregnancy rates of 52.1% with the "Bee Synch" protocol where PG was administered concurrently with GnRH CIDR insertion to assist in decreasing the

circulating concentrations of progesterone in the animal. Furthermore, Yelich, J. (Unpublished data) utilized the Modified 7 day Select Synch + CIDR and TAI approach described in Figure 3 and reported AI pregnancy rates of 54.1% in Brangus cows. Therefore, it does appear that using either 5-Day or 7-Day CIDR approaches that utilize PG at CIDR insertion to decrease the circulating concentrations of progesterone may benefit fertility in *Bos indicus* cattle.

Table 8. Reproductive performance of suckled Angus (AN) and Brangus (BN) cows synchronized with the 5-Day Select Synch + CIDR and TAI (5dSS) and Modified 7-Day Select Synch + CIDR and TAI (Mod) treatments described in Figure 2 (Yelich, J. Unpublished).

Breed x Treatment		n	Estrous response, %[b]	Conception rate, %[c]	Timed-AI pregnancy rate, %[d]	Synchronized pregnancy rate, %[e]
Angus	5dSS	87	71.2	67.7	40.0	59.8
	Mod	90	70.0	71.4	51.9	65.6
Brangus	5dSS	74	51.4	57.9	33.3	41.9
	Mod	74	75.7	60.7	26.1	54.1

Summary

Estrous synchronization protocols designed in *Bos taurus* cattle do not result in the same AI pregnancy rates when administered to cattle of *Bos indicus* breeding. Although the reasons for the discrepancies in AI pregnancy rates and inconsistent results when these protocols are applied to *Bos indicus* females are not completely clear, *Bos indicus* females do have subtle difference in endocrine responses and follicular dynamics that may be to blame. Given the importance of AI at facilitating the incorporation of improved genetics in

Bos indicus cattle, developing effective methods to synchronize estrus in these breed types is critical. Recently investigated protocols specifically designed for *Bos indicus* females show promise. These advances and improved results warrant continued research in this area towards the development of consistently effective estrous synchronization protocols in *Bos indicus* cattle.

References

Anderson, K.J., D. G. LeFever, J. S. Brinks, and K. G. Odde. 1991. The use of reproductive tract score in beef heifers. Agri-practice 12 (4):19-26.

Bo, G. A., Baruselli, P. S., and M. F. Martinez, M. F. 2003 Pattern and manipulation of follicular development in Bos indicus cattle. Anim. Repro. Sci, 78(3-4):307-26.

Bridges, G.A., G.E. Portillo, J.W. de Araujo, W.W. Thatcher, and J.V. Yelich. 2005. Efficacy of either a single or split treatment of $PGF_{2\alpha}$ after a 14 day melengestrol acetate treatment to synchronize estrus and induce luteolysis in *Bos indicus* x *Bos taurus* heifers. Theriogenology 64:344-362.

Bridges, G. A., L. A. Helser, D. E. Grum, M. L. Mussard, C. L. Gasser and M. L. Day. 2008. Decreasing the interval between GnRH and $PGF_{2\alpha}$ from 7 to 5 days and lengthening proestrus increases timed-AI pregnancy rates in beef cows. Theriogenology 69:843–851.

Bridges, G.A, Cruppe, L.H.,Currin, J. F., Day, M. L., Gunn, P. J., Jaeger, J.R., Lamb, G. C., Radunz,, A. E., Repenning, P, Stevenson, J. S., Whittier, J. C. and W.D. Whittier. 2011. Determination of appropriate delivery of $PGF_{2\alpha}$ in the 5-day CO-Synch + CIDR protocol in lactating beef cows. J. Anim. Sci. 89 (Suppl. 1): 265.

Chase, C., S. Coleman, and D. Riley. 2005. Evaluation of beef cattle germplasm for the subtropics of the United States. Research Report, USDA-ARS. http://www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=405830. Accessed Feb. 17, 2012.

Claro, I. Jr., O. G. SáFilho, R. F. Peres, F. H. Aono, M. L. Day, and J. L. Vasconcelos. 2010. Reproductive performance of prepubertal Bos indicus heifers after progesterone-based treatments. Theriogenology 74:903-911.

DeJarnette, J.M., R.B. House, W.H. Ayars, R.A. Wallace, and C.E. Marshall. 2004. Synchronization of estrus in postpartum beef cows and virgin heifers using combinations of melengestrol acetate, GnRH, and $PGF_{2\alpha}$. J. Anim. Sci. 82:867-877.

Dias, C. C., F. S. Wechester, M. L. Day, and J. L. Vasconcelos. 2009. Progesterone concentrations, exogenous equine gonadotropin, and timing of prostaglandin $F_{2\alpha}$ treatment affects fertility in postpubertal Nelore heifers. Theriogenology 72:378-385.

Esterman, R. 2011. Evaluation of follicle development and pregnancy rates in tearling heifers and lactating cows of Bos indicus x Bos taurus breeding that were synchronized with progestogen based protocols. Dissertation University of Florida.

Galina, C. S., A. Calderon, and M. McCloskey. 1982. Detection of signs of estrus in the Charolais cow and its Brahman cross under continuous observation. Theriogenology 17:485-498.

Griffin, J. L. and R. D. Randel. 1978. Reproductive studies of Brahman cattle II. Luteinizing hormone patterns in ovariectomized Brahman and Hereford cows before and after injection of gonadotropin releasing hormone. Theriogenology 9:437-443.

Kunkle, W.E., R.S. Sand, and D.O. Rae. 1997. Effects of body condition of productivity in beef cattle. UF-IFAS EDIS Pub. SP144.

Lamb, G.C., D.W. Nix., J.S. Stevenson, and L.R. Corah. 2000. Prolonging the MGA prostaglandin F2 alpha interval from 17 to 19 days in an estrous synchronization system for heifers. Theriogenology 53:691-698.

Larson, J. E., G. C. Lamb, J. S. Stevenson, S. K. Johnson, M. L. Day, T. W. Geary, D. J. Kesler, J. M. DeJarnette, F. N. Schrick, A. DiCostanzo, and J. D. Arseneau. 2006. Synchronization of estrus in suckled beef cows for detected estrus and artificial insemination and timed artificial insemination using gonadotropin-releasing hormone, prostaglandin $F_{2\alpha,}$ and progesterone. J. Anim. Sci. 84:332-342.

Lamothe-Zavaleta, C., G. Fredricksson, and H. Kindahl. 1991. Reproductive performance of Zebu cattle in Mexico. Part 1. Sexual behavior and seasonal influence on estrous cyclicity. Theriogenology 36:887-896.

Lucy, M.C., H.J. Billings, W.R. Butler, L.R. Ehnis, M.J. Fields, D.J. Kesler, J.E. Kinder, R.C. Mattos, R.E. Short, W.W. Thatcher, R.P. Wettemann, J.V. Yelich, and H.D. Hafs. 2001. Efficacy of an intravaginal progesterone insert and an injection of $PGF_{2\alpha}$ for synchronizing estrus and shortening the interval to pregnancy in postpartum beef cows, peripubertal beef heifers, and dairy heifers. J. Anim. Sci. 79:982-995.

Morrison, D. G. 2005. A compilation of research results involving tropically adapted beef cattle breeds. Southern Cooperative Series Bulletin 405.

http://www.lsuagcenter.com/en/crops_livestock/beef_cattle/breeding_genetics/tropical_br eeds.htm. Accessed Feb. 23, 2007.

Peres, R. F., I. Claro Jr., O. G. SáFilho, G. P. Nogueira, and J. L. Vasconcelos. 2009. Strategies to improve fertility in Bos indicus postpubertal heifers and nonlactating cows submitted to fixed-time artificial insemination. Theriogenology 72:681-689.

Plasse, D., A.C., Warnick, and M. Kogar. 1968. Reproductive behavior of Bos indicus females in a subtropical environment. I. Puberty and ovulation frequency in Brahman and Brahman x British heifers. J. Anim. Sci. 27:94-100.

Rae, D. O., P. J. Chenoweth, M. A. Giangreco, P. W. Dixon, and F. L. Bennett. 1999. Assessment of estrus detection by visual observation and electronic detection methods and characterization of factors associated with estrus and pregnancy in beef heifers. Theriogenology 51:1121-1132

Reynolds, W. L. 1967. Breeds and reproduction. In: T. J. Cunha, A. C. Warnick, and M. Koger. (Ed.). Factors Affecting Calf Crop. pp. 244-259. Univ. Florida Press, Gainesville.

Rhodes, R. C. III, R. D. Randel, and C. R. Long. 1982. Corpus luteum function in the bovine: in vivo and in vitro evidence for both a seasonal and breedtype effect. J. Anim. Sci. 55:159- 167.

SáFilho, O. G. and J. L. Vasconcelos. 2010. Treatments to optimize the use of artificial insemination and reproductive efficiency in beef cattle under tropical environments. Vet. Med. Int. 2011;923053.

Segerson, E. C., T. R. Hansen, D. W. Libby, R. D. Randel, and W. R. Getz. 1984. Ovarian and uterine morphology and function in Angus and Brahman cows. J. Anim. Sci. 59:1026-1046.

Sparks, B.L., S.L. Lake, J. Berry, K. Heaton, R.P. Lemenager, L.A. Horstman, K.S. Fisher, P.J. Gunn, and G.A. Bridges. 2010. Effect of $PGF_{2\alpha}$ administration at CIDR insertion on AI pregnancy rates in beef heifers. J. Anim. Sci. 88 (Suppl. 1):845.

Stevenson, J. S., K. E. Thompson, W. L. Forbes, G. C. Lamb, D. M. Grieger, and L. R. Corah. 2000. Synchronizing estrus and (or) ovulation in beef cows after combinations of GnRH, norgestomet, and prostaglandin $F_{2\alpha}$ with or without timed insemination. J. Anim. Sci. 78:1747–1758.

Wiltbank, J. N., K. E. Gregory, L. A. Swiger, J. E. Ingalls, J.A. Rothlisherger and R. M. Koch. 1966. Effects of heterosis on age and weight at puberty in beef heifers. J. Anim. Sci. 25:744-751.

Williams, G, Stanko, R., Allen, C., Cardoso, R., Prezotto, L., Thorson, J., and M. Amstalden. 2012. Evidence that prostaglandin administration at the onset of a 5-day CO-Synch +

CIDR synchronization protocol markedly improves fixed-time AI pregnancy rates in *Bos indicus*-influenced cattle. J. Anim. Sci. 89 (E-Suppl. 1):264. (Abstr.)

Wilson, K. N., M. L. Day, W. D. Whittier, R. Kasimanickam, and J.B. Hall. 2007. Comparison of 5-day or 7-day CIDR-based estrous synchronization systems for fixed-time AI in beef heifers. J. Anim. Sci. 85 (Suppl 2):43. (Abstr.)

Yelich, J. V. A vaginal insert (CIDR) to synchronize estrus and timed-AI. 2002. In: Fields, M J, Yelich, J. V., and Sand R.S. (ed) Factors Affecting Calf Crop. CRC Press, Boca Raton, USA p 87-100.