Comparison of long-term progestin-based protocols to synchronize estrus prior to fixed-time artificial insemination or natural service in *Bos indicus*-influenced beef heifers

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Abstract

An experiment was designed to evaluate breeding strategies for *Bos indicus*-influenced beef heifers. Treatments were designed to compare natural service (NS) and fixed-time artificial insemination (FTAI) as well as evaluate the effect of estrus synchronization with melengestrol acetate (MGA; 0.5 mg·animal^{-1}·d^{-1}) or a controlled internal drug release (CIDR; 1.38 g progesterone). Weights and reproductive tract scores (RTS; Scale 1-5) were obtained for heifers (n = 1,456) within a single location prior to assignment of one of five treatments: NS with no estrus synchronization (NS); NS beginning 10 days after a 14 d feeding of MGA (MGA + NS); natural-service beginning 10 days after treatment with a CIDR for 14 d (CIDR + NS); FTAI following the 14-d MGA-PG protocol (MGA + FTAI); or FTAI following 14-d CIDR-PG protocol (CIDR + FTAI). Heifers in FTAI treatments were administered $PGF_{2\alpha}$ (PG; 25 mg, IM) 19 or 16 d following MGA or CIDR removal, respectively. For MGA-PG and CIDR-PG treatments, FTAI was performed 72 and 66 h after PG, respectively. Gonadotropin-releasing hormone (GnRH; 100µg, IM) was administered concurrent with FTAI. Estrus detection aids were applied at PG to heifers in FTAI treatments and evaluated at AI to determine estrous response. Blood samples were collected and ovarian ultrasounds were performed at PG and FTAI to compare serum concentrations of estradiol, progesterone, and follicular dynamics between the two FTAI treatments. Heifers in FTAI treatments were exposed to fertile bulls 12 d following FTAI. Heifers in the three NS treatments were exposed to fertile bulls for 60 d, beginning 10 d after progestin removal for MGA + NS and CIDR + NS groups. Pubertal status was based on reproductive tract score and outcomes were evaluated within three groups: prepubertal RTS = 1-2; peripubertal RTS = 3; pubertal RTS = 4-5. Pregnancy status was determined at the end of a 60 d breeding period. Data were analyzed using PROC FREQ, GLM, and GLIMMIX procedures of SAS. Heifers that exhibited estrus by FTAI had higher serum concentrations of progesterone (P = 0.006; 8.6 versus 4.5 ng/ml) and larger dominant follicle diameter (LFD; P = 0.01; 9.2 versus 7.5 mm) at PG administration. At FTAI, LFD was influenced by pretreatment pubertal status (P = 0.02). Females assigned to the MGA + FTAI treatment had higher serum concentrations of progesterone at PG (P = 0.04; 8.1 versus 5.0 ng/ml) than CIDR + FTAI treated heifers. Serum concentrations of estradiol at FTAI were higher among CIDR- versus MGA-treated heifers (P = 0.04; 8.2 versus 6.4 pg/ml); however, estrous response after PG (53%) and pregnancy rates after FTAI (40%) did not differ between MGA- and CIDR-PG treatments. Across all treatments, pregnancy rates were compared on 21, 30 and 60 d of the breeding period based on pretreatment weight, pubertal status, and treatment. Pregnancy rate was influenced by pretreatment pubertal status (P ≤ 0.03) and weight (P ≤ 0.057) at all three time points, with higher pregnancy rates observed among heifers that weighed more and were pubertal prior to treatment initiation. By day 30, the CIDR + NS treatment resulted in higher pregnancy rates as compared to both FTAI treatments (P ≤ 0.02), while there were no differences among the three natural service treatments. There was no difference, however, among treatments with regard to pregnancy rate at day 21 or day 60 of the breeding season. These data can be used as a basis for considering various breeding management strategies for *Bos indicus*-influenced beef heifers, and highlight the importance of prebreeding evaluations to ensure adequate heifer growth and pubertal status prior to the start of the breeding period.

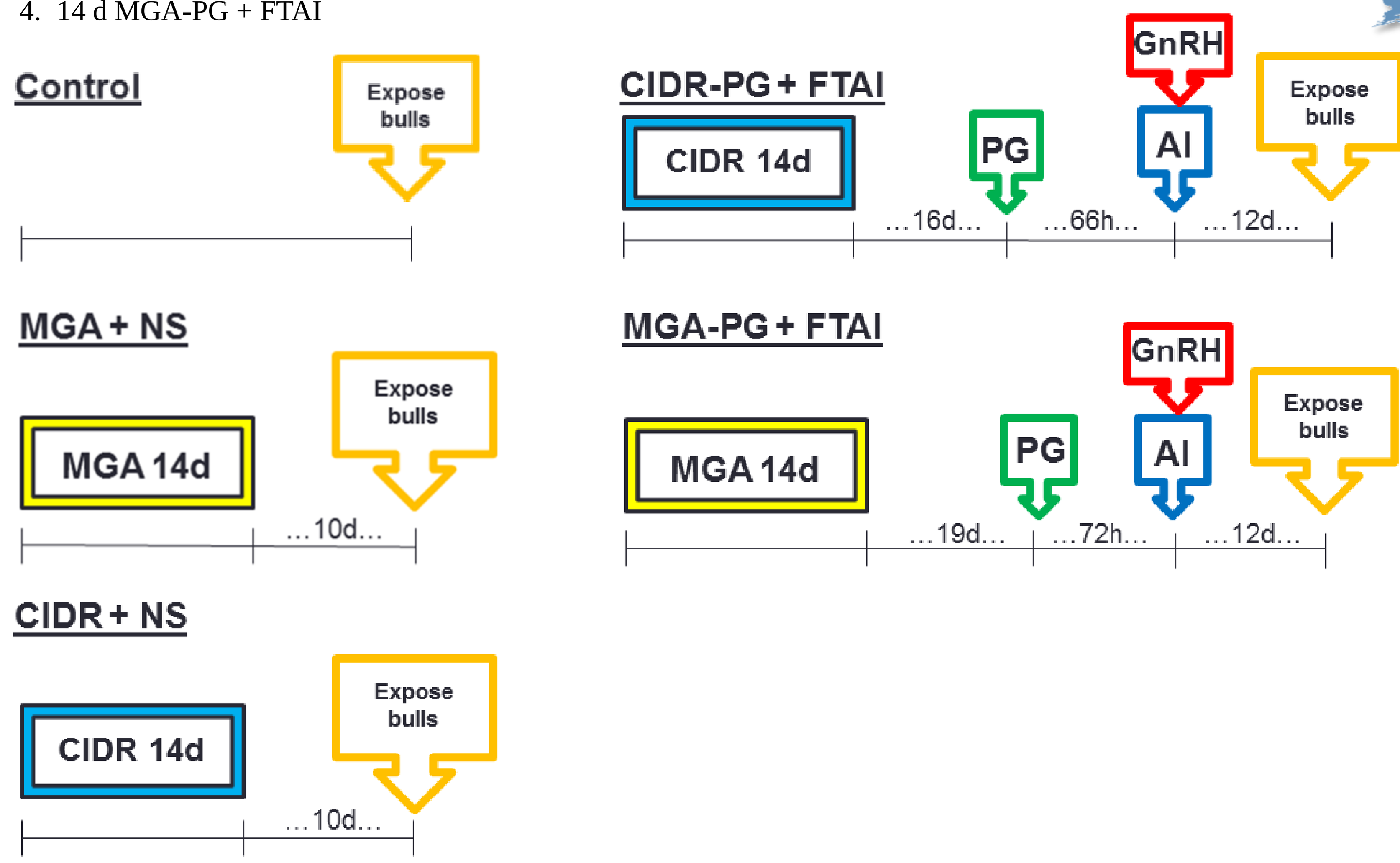
Introduction

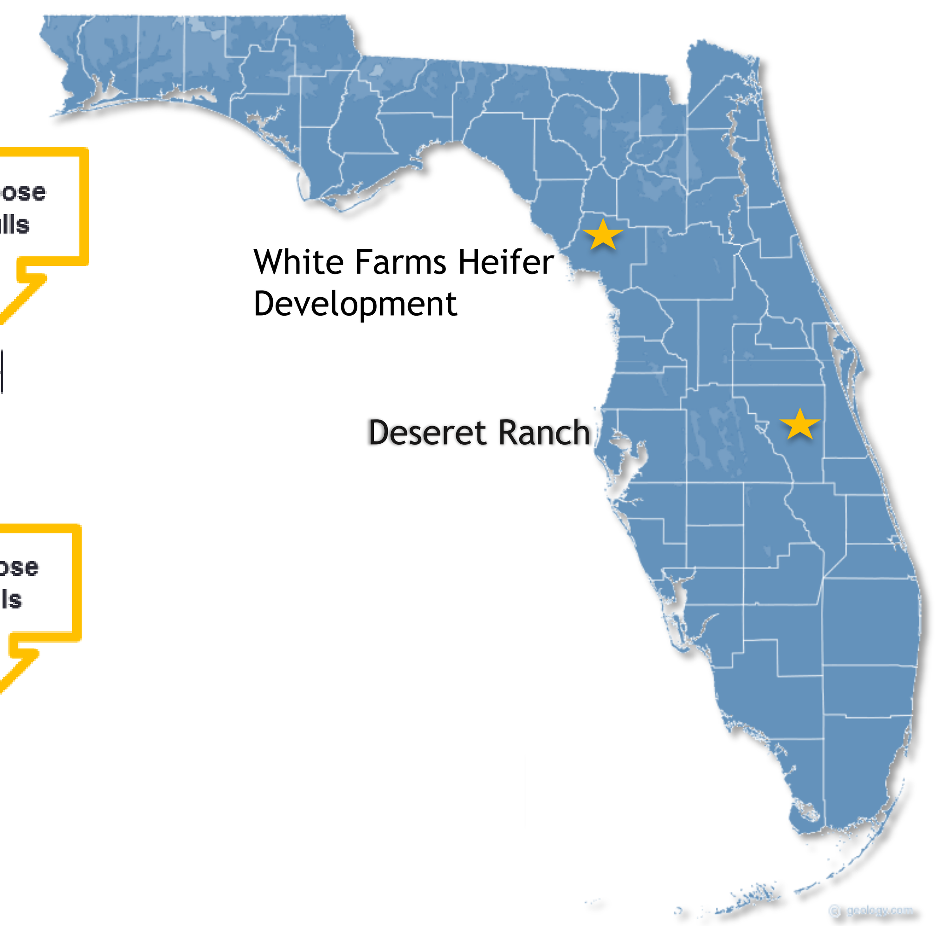
- *Bos indicus*-influenced beef heifers (Sartori, et al, 2010; Yelich and Bridges, 2012)
  - Thrive in Subtropical environments
  - Delayed Puberty
  - Differing response to synchronization drugs
  - Limited research using FDA-approved pharmaceuticals
- Long-term estrus synchronization protocols
  - Well-understood in *Bos taurus* heifers
  - Efficacy in *Bos indicus*-influenced heifers is not characterized

Materials and Methods

Pretreatment reproductive tract scores (RTS) and weights were recorded for 1456 heifers prior to assignment to one of five treatments:

1. Natural Service (NS) with no estrus synchronization
2. 14 d MGA + NS
3. 14 d CIDR + NS
4. 14 d MGA-PG + FTAI





Results

- Differences between FTAI treatments exist relative to follicular dynamics and mean progesterone and estradiol concentrations (Table 1).
- Pregnancy rate was significantly influenced by pretreatment pubertal status (P ≤ 0.03) and weight (P ≤ 0.057) at 21, 30, and 60 days of the breeding season (Table 2).
- No difference among treatments by Day 60 of the breeding season
- FTAI treatments resulted in a significantly lower mean day of conception compared to all three natural service groups (Table 3).

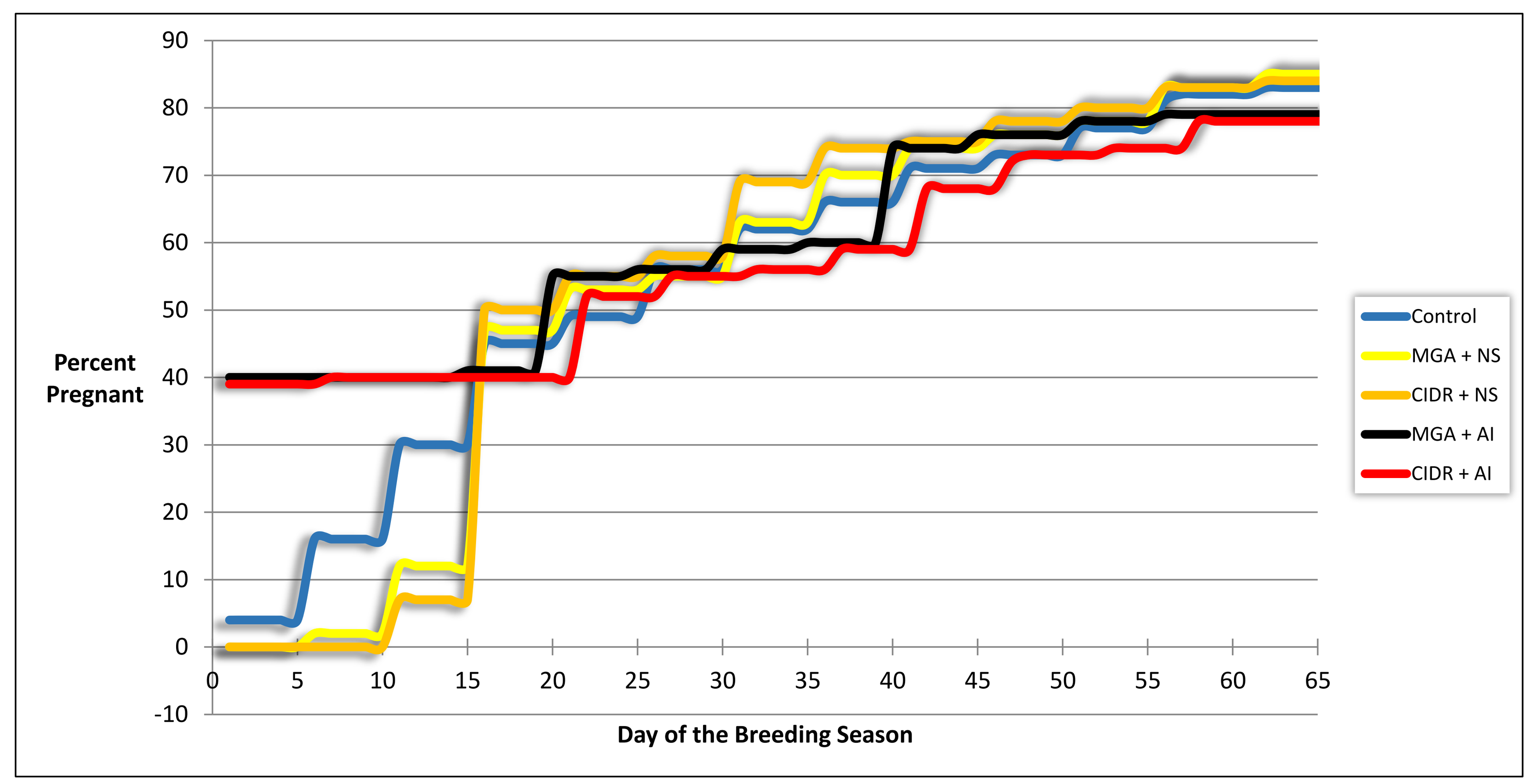


Table 1. Mean Progesterone (ng/ml), Estradiol (pg/ml) concentration, and Largest Follicle (mm) at PG administration and AI

Pubertal status	FTAI Treatment	P4 at PG	P4 at AI	E2 at PG	E2 at AI	LFD at PG	LFD at AI
Prepubertal	MGA	6.4	0.4	5.9	9.1	8.3	8.3[a]
	CIDR	4.4	0.8	7.4	6.2	8.4[a]	9.3
Peripubertal	MGA	7.8	0.8	6.5	6.6	7.7	8.5[a]
	CIDR	4.7	0.7	6.3	7.0	7.3[a]	10.4
Pubertal	MGA	8.3	1.0	6.4	8.5	8.1	11.4[b]
	CIDR	6.9	0.7	6.2	7.2	10.1[b]	10.4
Total	MGA	7.9[a]	0.7	6.3	8.2[a]	8.0	9.4
	CIDR	5.3[b]	0.7	6.8	6.4[b]	8.6	10.0

[ab]Values within column with different superscripts differ (P ≤ 0.05).

Table 2. Percent pregnant by days 21, 30, and 60 of the breeding season

Pubertal status	Breeding period	Control + NS No.	%	MGA + NS No.	%	CIDR + NS No.	%	MGA-PG + FTAI No.	%	CIDR-PG + FTAI No.	%	Total No.	%
	Day 21	45/117	38[a]	42/81	52	60/121	50	48/102	47[a]	29/81	36[a]	224/502	45[a]
Prepubertal	Day 30	64/117	55[c]	50/81	62	78/121	64	52/102	51[c]	30/81	37[c]	274/502	55[d]
	Day 60	92/117	79	69/81	85	89/121	74	73/102	72	54/81	67[f]	377/502	75[g]
	Day 21	44/91	48[ab]	51/97	53	51/89	57	53/98	54[ab]	45/92	49[ab]	244/467	52[b]
Peripubertal	Day 30	55/91	60[cd]	61/97	63	63/89	71	58/98	59[cd]	50/92	54[d]	287/467	61[e]
	Day 60	73/91	80	83/97	86	79/89	89	81/98	83	72/92	78[fg]	388/467	83[gh]
	Day 21	57/91	63[b]	64/117	55	47/79	59	61/95	64[b]	71/105	68[b]	300/487	62[c]
Pubertal	Day 30	67/91	74[d]	74/117	63	58/79	73	64/95	67[d]	73/105	70[e]	336/487	69[f]
	Day 60	81/91	89	94/117	80	71/79	90	79/95	83	91/105	87[g]	416/487	85[h]
Total		246/299	82	246/295	83	239/289	83	233/295	79	217/278	78	1181/1456	81

[abcdefg]Pregnancy rates at each time point within column with different superscripts differ (P ≤ 0.05).

Table 3. Mean day of conception within the 60d breeding season

Pubertal status	Control	MGA + NS	CIDR + NS	MGA-PG + FTAI	CIDR-PG + FTAI	Total
	(Days)	(Days)	(Days)	(Days)	(Days)	(Days)
Prepubertal	25[1a]	24[13]	23[13]	18[2a]	18[23a]	22[a]
Peripubertal	23[13ab]	25[1]	24[1]	17[2a]	18[23a]	21[a]
Pubertal	18[14b]	24[1]	22[13]	12[2b]	13[24'b]	18[b]
Total	22[1]	24[1]	23[1]	16[2]	17[2]	21

Day 0 corresponds to introduction of bulls in natural service treatments or performance of FTAI. [ab]Pubertal status within column with different superscripts differ (P ≤ 0.05). [1234]Treatment comparison within row with different superscripts differ (P ≤ 0.05). 4' denotes tendency (P = 0.07).

Discussion

Pubertal status prior to the start of the breeding season was the largest factor in predicting breeding success. Heifers that were prepubertal prior to the onset of the breeding season achieved lower pregnancy rates by the end of the breeding season than those heifers that were ≤ 30d from puberty (P =0.05).

Pregnancy rates to FTAI could be improved by utilizing a bull that is known to work well in a FTAI approach. Appropriate bull:heifer ratio following tightly synchronized FTAI protocols is necessary in order to cover a large number of repeat cycling heifers that failed to conceive to AI.

Delayed LH peak has been observed in *Bos indicus* heifers with low concentrations of circulating progesterone (Batista et. al, 2017). This might help explain suboptimal FTAI pregnancy rates observed in this study where GnRH is utilized.

Split-time AI (STAI) could be used to increase the number of females that conceive to AI (Thomas et. al, 2014b, Bishop et. Al, 2017), by optimizing insemination time and decreasing GnRH administration, thereby eliminating concern of delayed LH surge.

Conclusion

- Established long-term estrus synchronization protocols are effective in *Bos indicus*-influenced beef heifers
- Estrus synchronization results in a greater number of heifers that become pregnant early in the breeding season
- Endocrine differences are apparent between MGA and CIDR treatments
  - No difference in estrous response or pregnancy rate to FTAI
- Prebreeding evaluations provide an opportunity to assess growth and pubertal status prior to breeding

References

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Acknowledgements

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BUDGET FOR FLORIDA CATTLE ENHANCEMENT FUND- BUDGET JUSTIFICATION					
PROJECT TITLE: Developing precise methods of estrous cycle control for Bos indicus influenced heifers and cows.					
DETAILED LINE ITEM DESCRIPTION	QTY	% Complete	TOTAL	EXPLANATION/JUSTIFICATION OF DELIVERABLE	COMPLETION DATE
Animals	N/A	100%	$ 25,724.37	Animals and supplies	9/1/2017
Consultant Services	N/A	100%	$ 26,301.23	Material for soil and forage analysis	9/1/2017
Final research project report	N/A			Project report detailing research, which may include, findings, future needs, results, conclusions, issues, risks, assessments and all other pertinent information.	9/1/2017
Indirect Cost	N/A		$ 6,243.08		N/A
GRAND TOTAL: (equal to percentage of completion)			**$ 58,268.68**		