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Comparison of three CIDR based fixed-time AI protocols for beef heifers[1]

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SUMMARY

Several effective fixed-time AI (FTAI) protocols have been developed to facilitate AI while eliminating the need for estrus detection. Among these are the 5-d CO-Synch+CIDR (5d), PG 6-d CIDR (PG-CIDR), and 14-d CIDR-PG (CIDR-PG) protocols. While each of these protocols varies in duration and approach to synchronizing estrus and ovulation, each has been reported as an effective method to facilitate FTAI in beef heifers. Therefore, the objective of this study was to compare FTAI pregnancy rates in beef heifers synchronized with these three CIDR based protocols. Virgin beef heifers (n = 801) at four locations were synchronized with one of three protocols: 1) (**5-day CO-Synch + CIDR**) an injection of GnRH (100 µg; i.m.) and insertion of a CIDR on d -5, PG (25 mg; i.m.) and CIDR removal on d 0 with a second injection of PG (>4 h after CIDR removal) on d 0 and FTAI at 72 h after CIDR removal, 2) (**PG 6-day CIDR**) PG (25 mg; i.m.) on d -9, GnRH (100 µg; i.m.) and insertion of a CIDR on d -6, PG and CIDR removal on d 0, and FTAI at 66 h after CIDR removal, or 3) (**14-day CIDR-PG**) a 14-day CIDR insert from d -30 to -16, PG (25 mg; i.m.) on d 0, and FTAI at 66 h after PG. All heifers received an injection of GnRH (100 µg; i.m.) concurrent with FTAI. Timing of treatment initiation was offset to allow all heifers to receive FTAI concomitantly and at random. Pregnancy success was determined between 35 and 40 d after FTAI by transrectal ultrasonography. Blood samples were collected approximately 12 d before the beginning of each protocol and at the initiation of each protocol to determine estrous cycling status (77%). Data were analyzed using the GLIMMIX procedures of SAS. Fixed-time AI pregnancy success did not differ between treatments ($P = 0.13$; 62.5%, 56.9%, and 53.3%, for 5-day CO-Synch + CIDR, PG 6-day CIDR, and 14-day CIDR-PG; respectively) or location ($P = 0.16$; 51.5%, 62.7%, 56.1%, and 58.6% for location 1, 2, 3, and 4; respectively). However, heifers that had reached puberty by initiation of synchronization had greater ($P < 0.01$) pregnancy success compared to heifers that were prepubertal (60.7% and 47.3%; respectively). In summary, all three protocols had similar FTAI pregnancy success, and puberty status had the greatest impact on pregnancy success.

INTRODUCTION

Numerous estrous synchronization protocols are available for facilitating artificial insemination (AI) in cattle. While some of these protocols rely on estrous detection, recently several protocols have been developed to facilitate the mass breeding of all females at a predetermined time. These “fixed-time AI” (FTAI) programs forgo estrous detection but rather synchronize ovulation. Such an approach eliminates the time and labor involved in estrous detection and allows females to be worked as a herd rather than individually. Recently, several FTAI approaches have been developed for beef heifers. Among these

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include the 5 day CO-Synch + CIDR, PG 6-day CIDR, and the 14-day CIDR-PG protocols. While each of these protocols vary in their duration and approach to synchronizing estrus and ovulation, each have been proven effective methods to facilitate FTAI in beef heifers. Therefore, the objective of this experiment was to compare FTAI pregnancy rates between the 5 day CO-Synch + CIDR, PG 6-day CIDR, and the 14 day CIDR-PG protocols.

METHODS AND MATERIALS

Eight hundred and one virgin beef heifers (approximately 15 months of age) located at 4 locations (WY n= 116, SD n= 157, MN n=233, and UT n=295) were randomly allotted to 1 of 3 FTAI protocols (Figure 1): 1) (**5-day CO-Synch + CIDR**) an injection of GnRH (100 μg; i.m.) and insertion of a CIDR on d -5, PG (25 mg; i.m.) and CIDR removal on d 0 with a second injection of PG > 4 h after the 1st on d 0, and FTAI at 72 h after CIDR removal concurrent with GnRH administration, or 2) (**PG 6-day CIDR**) PG (25 mg; i.m.) on d -9, GnRH (100 μg; i.m.) and insertion of a CIDR on d -6, PG (25 mg; i.m.) and CIDR removal on d 0, and FTAI at 66 h after CIDR removal concurrent with GnRH administration; 3) (**14-day CIDR-PG**) a 14-day CIDR insert from d -30 to -16, PG on d 0, and FTAI at 66 h after PG concurrent with GnRH administration. Treatment initiation was offset to allow all heifers to be FTAI at the same time and at random across treatments.

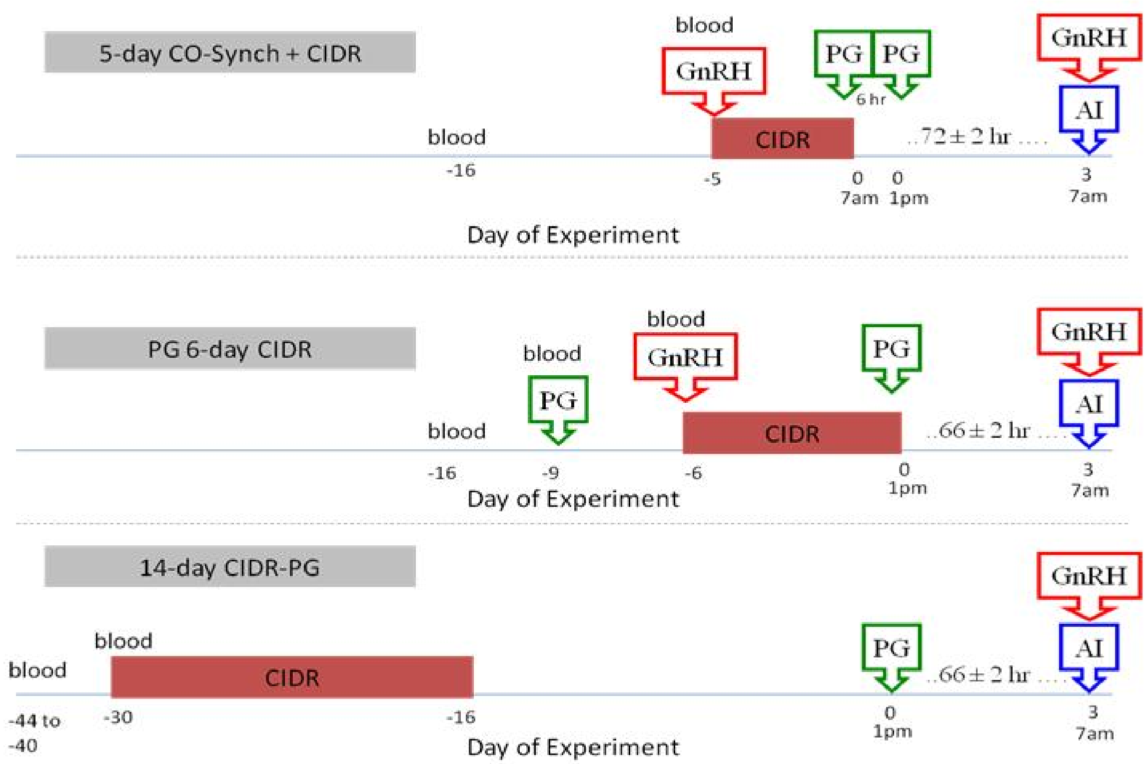

Figure 1. Heifers were allotted to 1 of 3 protocols: 1) (**5-day CO-Synch + CIDR**) an injection of GnRH (100 μg; i.m.) and insertion of a CIDR on d -5, PG (25 mg; i.m.) and CIDR removal on d 0 with a second injection of PG >4 h after the 1st on d 0, and FTAI at 72 h after CIDR removal concurrent with GnRH administration, or 2) (**PG 6-day CIDR**) PG (25 mg; i.m.) on d -9, GnRH (100 μg; i.m.) and insertion of a CIDR on d -6, PG (25 mg; i.m.) and CIDR removal on d 0, and FTAI at 66 h after CIDR removal concurrent

with GnRH administration; 3) (**14-day CIDR-PG**) a 14-day CIDR insert from d -30 to -16, PG on d 0, and FTAI at 66 h after PG concurrent with GnRH administration.

At the final PG administration all heifers at locations 2 and 3 (SD and MN) were marked with tail paint. At FTAI, tail paint scores were assessed (1 = tail paint completely gone; 2 = tail paint partially gone, obvious signs of mounting; 3 = no signs of mounting, tail paint undisturbed). Pregnancy success was determined in all heifers 35 to 40 d after insemination using transrectal ultrasonography. Blood samples were collected 10 to 12 d before the beginning of each synchronization protocol and on the day the synchronization protocol was initiated to determine cycling status. Heifers with > 1.0 ng/mL of progesterone in at least one of the two blood samples were considered pubertal. Heifers that failed to have progesterone concentrations > 1.0 ng/mL in either blood sample were considered prepubertal at protocol initiation.

Sire and technician were unique to each herd. Therefore, the effect of sire and technician within each herd was analyzed separately using the GLIMMIX procedure of SAS. There was no treatment x sire or treatment x technician interactions so data was combined. Fixed-time AI pregnancy rates were analyzed using the GLIMMIX procedure of SAS with herd included as a random effect. None of the main effect interactions were significant; therefore, all interactions were removed from the model. Main effects were removed in a stepwise reducing method, and the final model included treatment and puberty status. In herds 2 and 3 where tail paint scores were used, impact of tail paint score on fixed-time AI pregnancy success was determined using the GLIMMIX procedure of SAS.

RESULTS AND DISCUSSION

All three of the implemented protocols have been previously determined to be effective and deliver satisfactory FTAI pregnancy rates (42 to 64%) when conducted in independent research trials (Mallory et al., 2010; Perry et al., 2011). However, these protocols have never been tested against each other in a controlled research trial. In the present study, FTAI pregnancy success did not differ between treatments (P = 0.13; Table 1) and ranged from 53% to 63%.

Table 1. Impact of treatment, puberty status, and estrus activity on fixed-time AI pregnancy success.

Treatment	**5-day CO-Synch + CIDR**	**PG 6-day CIDR**	**14-day CIDR-PG**
	62.5%	56.9%	53.3%
Pubertal status	**Pubertal**	**Prepubertal**	
	60.7%[a]	47.3%[b]	
Tail paint score[c]	**1**	**2**	**3**
	64%[a]	58%[a]	43%[b]

[ab]Means within a row having different superscripts are different (P < 0.05)
[c]Tail paint scores 1 = tail paint completely gone; 2 = tail paint partially gone, obvious signs of mounting; 3 = no signs of mounting, tail paint undisturbed.

Previous studies have reported differences in response to synchronization between pubertal and prepubertal heifers (Wood-Follis et al. 2004, Leitman et al. 2008). In the present study there was no difference in the percent of heifers that had reached puberty prior to the initiation of the synchronization protocol (73.3%, 79.2%, and 77.1% for the 14-day CIDR-PG, 5-day CO-Synch + CIDR, and the PG 6-day CIDR, respectively). However, there was an effect of puberty status on fixed-time AI pregnancy success (P = 0.004). Heifers that had reached puberty prior to the start of synchronization had greater fixed-time AI pregnancies compared to heifers that were prepubertal at protocol initiation (60.7% vs. 47.3%, respectively). However, there was no treatment by puberty status interaction (P = 0.87). Among all three treatments fixed-time AI pregnancy rates were greater among heifers that had reached puberty prior to the start of the synchronization protocol compared to heifers that were prepubertal at the start of the synchronization protocol (Figure 2).

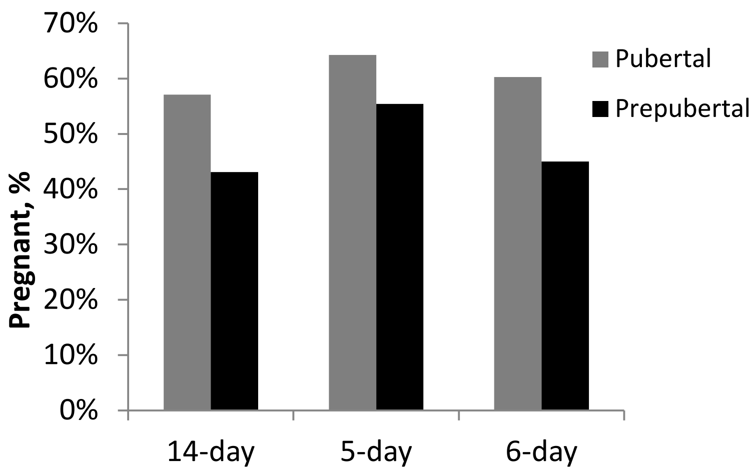

Figure 2. Effect of pubertal status within each treatment on FTAI pregnancy success.

At locations 2 and 3 where estrus activity at fixed-time AI was determined by tail paint scores there was an effect of tail paint score on fixed-time AI pregnancy success (P < 0.01). Heifers that had a tail paint score of 1 (all tail paint removed; 64%) or 2 (tail paint partially removed; 58%) had greater fixed-time AI pregnancy rates compare to heifers that had a tail paint score of 3 (no tail paint removed; 43%). In addition, there tended to be a tail paint score by puberty status interaction (P = 0.057). Among heifers that had reached puberty prior to the initiation of the synchronization protocol there was no effect of tail paint score on fixed-time AI pregnancy success (64%, 58%, and 51% for score 1, 2, and 3, respectively), but among heifers that were prepubertal, heifers with a tail paint score of 1 or 2 had greater (P < 0.05) pregnancy success compared to heifers with a tail paint score of 3 (63%, 57%, and 26% for score 1, 2, and 3, respectively).

CONCLUSION

All three protocols delivered acceptable (> 50%) fixed-time AI pregnancy rates in beef heifers, thus allowing beef producers the option of using a long or short protocol when breeding heifers by fixed-time AI. Pubertal status had the greatest impact on fixed-time AI pregnancy success, with heifers that had reached puberty prior to synchronization having greater fixed-time AI pregnancy rates compared to heifers that were prepubertal. In addition estrus activity as determined by tail paint score had a significant impact on fixed-time AI pregnancy success. In summary, this research demonstrates that beef producers have options when synchronizing estrus in beef heifers and it is critical that heifer development strategies are in place to ensure that heifers are pubertal at the initiation of synchronization to maximize pregnancy success with FTAI.

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