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D.M. Larson
West Central Research and Extension Center

Richard N. Funston
University of Nebraska - Lincoln, rfunston2@unl.edu

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ESTROUS SYNCHRONIZATION INCREASES EARLY CALVING FREQUENCY, WHICH ENHANCES STEER PROGENY VALUE

D.M. Larson* and R.N. Funston
West Central Research and Extension Center, North Platte, NE

ABSTRACT: Calving records collected between 2000 and 2008 at the Gudmundsen Sandhills Laboratory, Whitman, NE, were used to determine the effect of estrous synchronization on calving distribution and the impact of time of calving on carcass characteristics. Calves born between 2000 and 2006 resulted from non-synchronized 60 d breeding seasons between 1999 and 2005 (n = 2075). Calves born in 2007 and 2008 resulted from synchronized 45 d breeding seasons in 2006 and 2007 (n = 521). Estrus was synchronized with a single injection of prostaglandin $F_{2\alpha}$ administered 108 h after bulls were turned in with cows. Cow pregnancy rate after synchronized or non-synchronized breeding seasons was similar (P = 0.48). Twelve percent more (P < 0.001) synchronized cows calved during the first 21 d compared to non-synchronized cows. Average calving date and percentage of male calves were similar ($P \geq$ 0.23). The weaning BW of calves born to synchronized dams was 9 kg greater (P < 0.001) than calves from non-synchronized dams. The effect of calving distribution, defined as percentage calving in the 1st, 2nd or 3rd 21 d of the season was evaluated in the steer progeny born between 2001 and 2007 (n = 659). Steers were fed in the feedlot and slaughtered after 218 d on feed. As the time of calving increased, male calf birth weaning BW decreased (P < 0.001). Time of calving did not affect feedlot ADG (P = 0.90). As time of calving increased, HCW, marbling score and yield grade decreased (P < 0.001). Although the percentage of steers achieving USDA small grade was not affected (P = 0.17) by time of calving, the percentage of steers receiving a USDA quality grade of modest or greater and the total carcass value declined ($P \leq$ 0.001) as time of calving increased. Estrous synchronization with a single injection of prostaglandin $F_{2\alpha}$ resulted in more cows giving birth earlier, even though the breeding season was 15 d shorter. Calves born earlier in the season are heavier at weaning and produce a heavier, more valuable carcass.

Key Words: Calving distribution, Carcass quality, Estrous synchronization, Weaning weight

Introduction

Estrous synchronization is utilized primarily in conjunction with artificial insemination. However, estrous synchronization is potentially beneficial to cattle producers using natural mating. A primary obstacle to increased usage of estrous synchronization is the labor associated with applying a synchronization protocol. Thus, a successful system will be easy to implement and cost effective. Prostaglandin $F_{2\alpha}$ (**PGF**) causes lysis of the corpus luteum (**CL**) when administered at least 96 h after ovulation; however, the corpus luteum is not responsive to PGF prior to this time. Standing estrus will occur between 48 and 96 h after PGF in cyclic females. Whittier et al. (1991) demonstrated a single PGF injection administered 96 h after bull turn-in increased the percentage of cows calving in the first 50 d of the calving season. However, they did not detect a difference in the percentage calving in the first 21 d, nor did they measure weaning BW or carcass characteristics of the resulting calf crop. Data from our group (Larson et al., in press) indicate more heifers given PGF 96 h after bull turn-in calved in the first 21 d of the calving season. Further research is needed to evaluate the effect of this system in mature, lactating cows. Thus, data from eight production yr were summarized to determine the effect of estrous synchronization on time of calving and subsequent effects of time of calving on carcass characteristics.

Materials and Methods

The University of Nebraska-Lincoln Institutional Animal Care and Use Committee approved the procedures and facilities used in this experiment.

Breeding, calving, weaning, and carcass data were collected from the research herd at the Gudmundsen Sandhills Laboratory (**GSL**) near Whitman, NE. The data for the spring calving herd, collected between 2000 and 2008, were used for the purposes of this analysis. Calves born between 2000 and 2006 resulted from non-synchronized 60 d breeding seasons between 1999 and 2005 (n = 2075). Calves born in 2007 and 2008 resulted from estrous synchronized 45 d breeding seasons in 2006 and 2007 (n = 521). The exception was a subset of cows used in a nutritional experiment exposed to bulls for 60 d during the estrous synchronized spring breeding season in 2007 (118 cows). The breeding season begins on approximately June 15. Estrus was synchronized using a single injection of PGF administered 108 h after fertile, mixed age bulls were turned in with the cowherd. The bull to cow ratio was at least 1:25 in all years. Pregnancy was diagnosed via rectal palpation approximately 45 d following bull removal. As varying nutritional and breeding treatments are applied to the yearling heifers during breeding, two year-old cows were removed from this analysis to avoid confounding the results. Weaning data were analyzed for the 2007 and 2008 weaned calves (408 individual records) and compared to calves weaned between 2000 and 2006 (1790 individual records).

Weaned steers (n = 659) in each yr were transported to the West Central Research and Extension Center in North Platte, NE. The data from these steers were used to determine the effect of early calving frequency on feedlot performance and carcass quality. Steers were fed a common diet, within yr, in the feedlot for approximately 218 d. Steers were slaughtered at a commercial abattoir when 12^{th} rib fat cover was visually assessed to be approximately 1 cm. Routine carcass data were collected after slaughter. Carcass characteristics were evaluated by period of calf birth the first, second, or third 21 d period of the calving season. The continuous data were analyzed using the MIXED procedure of SAS and binomial data with the GLIMMIX procedure of SAS. The model included the fixed effect of estrous synchronization and the age of the dam. The model also included the random effects of year and any treatments imposed on each particular herd within each year.

Results and Discussion

The data demonstrating the effect of estrous synchronization on reproduction and calf production are displayed in Table 1. The estrous synchronized subset of data was generated for the 2007 and 2008 calving seasons and the non-synchronized subset was generated for the years between 2000 and 2006.

Calf birth date was similar (P = 0.23) between estrous synchronized and non-synchronized cows however, calf birth BW (P < 0.001) and the incidence of dystocia (P < 0.001) were lower if from synchronized dams. The percentage of male calves was unaffected (P = 0.62) by estrous synchronization. Perhaps most interesting, estrous synchronization increased (P < 0.001) the percentage of cows giving birth in the first 21 d by 12% (73 vs. 61%; estrous synchronized vs. non-synchronized, respectively). This may partially explain the reduction in birth BW. Cows at GSL calve in a common group and consume a higher quality diet during calving than during late gestation. Thus, cows calving later are on a higher plane of nutrition during late gestation than earlier calving cows, perhaps leading to heavier calves at birth. Whittier et al. (1991) found that a single injection of PGF administered 96 h after bull turn-in increased the percentage of cows calving in the first 50 d of the calving season. However, they detected no difference in the percentage calving in the first 21 d. Data from our group indicate more heifers injected with PGF 96 h after bull turn-in calved in the first 21 d of the season (Larson et al., in press).

The mechanism underlying this estrous synchronization system relies on the observation that the CL is unresponsive to PGF within 96 h after ovulation. Thus, bulls are allowed to inseminate cows at natural estrus for approximately 5 d; cows inseminated during this period will not respond to PGF. On d 5, PGF is administered to all cows and the bulls inseminate cows at synchronized estrus following PGF. It is imperative to administer PGF at the correct interval to avoid destroying the CL in cows inseminated on the d of bull turn-in. These data agree with previously published research in both mature cows and replacement heifers (Whittier et al., 1991 and Larson et al., in press). Calf birth date was unaffected, which may seem counterintuitive. Most likely, cows that fail to conceive at the synchronized estrus are inseminated 21 d later and thus average calving date is unaffected. As further evidence, 96 and 94% of the 94 to 95% of cows that became pregnant (estrous synchronized and non-synchronized; respectively), calved within the first 42 d of the season. Regardless, more calves are born early in the season with estrous synchronization. As more calves are born earlier in the season, one may expect weaning BW to be increased. Accordingly, calves from estrous synchronized dams were 9 kg heavier (P < 0.001) than calves from non-synchronized dams. This would likely make calves from estrous synchronized dams more valuable at weaning, improving profitability. Although the natural breeding season was shortened when estrous synchronization began, pregnancy rate was unaffected (P = 0.48) by synchronization. Perhaps this indicates a more efficient use of bull resources during the breeding season. At pregnancy diagnosis, both cow BW and BCS were similar ($P \geq 0.16$) between estrous synchronized and non-synchronized cows.

Estrous synchronization increased the percentage of cows calving in the first 21 d of the breeding season (Table 1). This indicates more cows were mated by natural service early in the breeding season. Estrous synchronization increased calf weaning BW and potential value. In addition, the breeding season was shortened from 60 to 45 d between non-synchronized and estrous synchronized seasons, respectively without negatively affecting pregnancy rate. In relation to the increased weaning BW associated with early calving, we sought to determine if early calving frequency affected carcass traits.

Recall that estrous synchronized cows, more of whom calved in the first 21 d of the season, gave birth to lighter calves. However, when evaluating only steer progeny, male calves born earlier in the season did not have a lighter (P = 0.47) birth BW than those born later. As the time of calving became more advanced, steer weaning BW was lower (P < 0.001) with each successive interval, likely related to calf age. Neither preweaning (P = 0.92) nor feedlot ADG (P = 0.90) were affected by time of calving.

Similar to weaning BW, HCW increased (P < 0.001) coordinately with early calving frequency. Perhaps more interestingly, marbling score and the percentage of steers achieving a USDA quality grade of modest or greater was greater (P = 0.001) in steers born earlier than those born later. It was, and perhaps still is, a common paradigm that intramuscular fat is a late developing trait. These data would support the hypothesis steers born earlier in the calving season are older at harvest. The increase in marbling score cannot be separated from a difference in caloric intake as DMI was not measured. However, older steers are also fatter, as evidenced by an increase (P < 0.001) in yield grade of earlier born steers. As time of calving became more advanced, the percentage of empty body fat (P < 0.001) decreased. Thus, it appears as time of calving advances, carcass fat content in all depots, including intramuscular, decreases. Although later born steers had a slightly lower yield grade, the reduction in marbling score made their carcasses less valuable (P < 0.001). The difference in carcass value is also related to the increased HCW of steers born earlier in the calving season. Therefore, carcasses of earlier born steers were more valuable on a weight basis and received a greater premium on a carcass basis than later born steers.

Implications

Estrous synchronization with a single injection of PGF can increase the percentage of cows naturally mated early in the breeding season. This improvement occurs even in a shorter breeding season. Moreover, most cows not mated at the first estrus become pregnant at the second. Steer calves born earlier in the calving season have greater weaning BW, HCW and marbling scores. Improving early calving frequency may increase progeny value at weaning and enhances carcass value of the steers.

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Table 1. Effect of estrous synchronization in a natural mating system on reproduction and calf production

Item	Estrous synchronized		SEM	*P*
	No	Yes		
n	2075	521		
Calf birth date, Julian d	86	85	1	0.23
Calf birth BW, kg	38	37	1	<0.001
Assisted births, %	4.4	1.7	5	<0.001
Calved in 1st 21 d, %	61	73	2	<0.001
Calved in 2nd 21 d, %	33	23	2	<0.001
Calf sex, % male	51	52	2	0.62
n	1790	408		
Calf weaning BW, kg	219	228	3	<0.001
Cow BW at weaning, kg	505	502	4	0.16
Cow BCS at weaning	5.2	5.2	0.1	0.25
Pregnant, %[1]	95	94	1	0.48

[1] Pregnancy rate after an estrous synchronized or unsynchronized natural mating season.

Table 2. Effect of calving period on feedlot performance and carcass characteristics of steer progeny

Item	Calving period[1]			SEM	*P*
	1	2	3		
n	347	259	53		
Calf birth BW, kg	37	37	37	1	0.47
Calf weaning BW, kg	233[a]	219[b]	197[c]	6	<0.001
Preweaning ADG, kg/d	0.96	0.96	0.97	0.02	0.92
Feedlot ADG, kg/d	1.64	1.64	1.65	0.05	0.90
HCW, kg	370[a]	363[b]	350[c]	5	<0.001
Marbling score[2]	574[a]	554[b]	527[c]	15	<0.001
Empty body fat, %	30.4[a]	29.9[b]	29.0[c]	0.4	<0.001
Yield grade	3.0[a]	2.8[b]	2.6[c]	0.2	<0.001
Choice or greater, %	84	83	73	8	0.17
Average choice or greater, %	30[a]	17[b]	12[b]	5	0.001
Carcass value, $	1102[a]	1079[b]	1025[c]	45	<0.001

[1] 1 = calved in the 1st 21 d, 2 = calved in the 2nd 21 d, 3 = calved in the 3rd 21 d.

[2] 500 = small^0.

[abc] Means without a common superscript differ ($P \leq 0.05$).