Effects of breeding system of origin (natural service or artificial insemination) on pregnancy rates, distribution of calving and calf weaning weights of commercial beef cow herds in North Dakota

Mellissa. R. Crosswhite[1], Danielle. N. Black[1], Tammi. L. Neville[1], Sarah. R. Underdahl[1] and Carl. R. Dahlen[1]

The objective of this study was to examine the pregnancy rates, calving distribution and calf weaning weights of commercial beef cows bred by artificial insemination (AI) or natural-service breeding systems. Cows exposed to AI calved earlier in the breeding season, compared with cows exposed only to natural service. Furthermore, calves born to AI-exposed cows were heavier at weaning, compared with calves born from cows exposed only to natural service.

Summary

The objectives of this study were to compare pregnancy rates, calving distribution and calf weaning weights of commercial beef cows exposed to two different breeding systems. North Dakota county Extension agents were recruited by researchers for the involvement and selection of producers in their areas. The producers recruited (n = 10) never had implemented estrus synchronization and AI into their reproductive management plan. Within each herd, cows were assigned randomly to one of two breeding system treatments: 1) only exposed to natural-service herd bulls (NS; n = 1,122) or 2) exposed to ovulation synchronization and fixed-time AI followed by natural service bulls (TAI, fixed-time artificial insemination; n = 1,284). Production, performance and profit outcomes were evaluated within/across herds for each breeding system. Females exposed to TAI were exposed to a 7-d CO-Synch + CIDR protocol with fixed-time AI at 60 to 66 hours after CIDR removal. Cleanup bulls were placed in breeding pastures one day after AI and remained with females until the end of the producer-defined breeding season. The presence of a viable fetus was determined at least 45 days after the conclusion of the breeding season. At parturition, birth date was recorded. No differences ($P = 0.54$) were observed in the proportion of females pregnant at the end of the breeding season between NS (93.1 percent) and TAI (93.2 percent) treatments. Cows in the TAI treatment calved 7.8 days earlier ($P < 0.001$) in the calving season, compared with NS cows. A greater proportion ($P < 0.001$) of TAI cows (44.8 percent) gave birth in the first 21 days of the calving season, compared with NS cows (26 percent). From days 22 to 42, a greater proportion ($P < 0.001$) of NS cows (41.6 percent) gave birth, compared with TAI cows (28.2 percent), and a greater proportion of NS cows (23.7 percent) gave birth from day 42 to the end of the calving season, compared with TAI cows (17.2 percent). A treatment x calving group interaction was present for weaning weight. Greater ($P = 0.002$) weaning weights were observed for calves born from TAI cows in the first 21 days of the calving season (592.5 ± 4 pounds), compared with NS calves born in the first 21 days (566.7 ± 5.8 pounds), but weaning weights of calves born in the second 21 days and from day 42 to the end of the calving season were similar ($P = 0.17$) among treatments. Use of TAI in commercial beef herds increased the number of calves born earlier in the calving season and increased the weaning weights of calves.

Introduction

Estrous synchronization and artificial insemination (AI) are management techniques available for the advancement of herd genetics by the selection of highly proven sires without the overhead cost of the equivalent of a natural-service sire. Estrous synchronization and AI create the opportunity for potential benefits, including shortening the breeding and calving seasons, increasing the number of early births resulting in older and heavier calves at weaning (Odde, 1990; Rodgers et al., 2012). However, less than 8 percent of the beef industry utilizes AI, citing labor and time as major contributors (NAHMS, 2009).

Our previous research has highlighted the fact that incorporating AI into a management scheme resulted in older, heavier calves at weaning, compared with a breeding system that relied solely on natural-service breeding (Steichen et al., 2013). In addition, a North Dakota survey determined that more than

[1]Department of Animal Sciences, NDSU

51 percent of producers staying in the beef industry for at least the next 10 years were likely to utilize AI on their operations (Schook et al., 2014).

With an increase in potential adoption of AI in North Dakota, the objectives of this study were to compare the effects of artificial insemination and natural-service breeding systems on pregnancy rates, calving distribution and calf weaning weights of commercial beef cow-calf operations never previously utilizing TAI on their herds.

Experimental Procedures

Two thousand three hundred ninety-nine crossbred commercial cows originating from 10 commercial beef herds in North Dakota were used to compare pregnancy rates, calving distribution and calf weaning weights of beef cows exposed to two different breeding systems. North Dakota county Extension agents were selected for their involvement and identification of commercial cattle producers in their respective areas.

The producers recruited never had implemented estrous synchronization or AI into their management plans. Each herd was managed according to predefined producer management techniques with the addition of the new breeding system.

Within each herd, females were stratified by days postpartum and randomly assigned to one of two treatments: 1) only exposed to natural-service herd bulls (natural service; NS; n = 1,114) and 2) exposed to ovulation synchronization and fixed-time AI followed by natural-service bulls (timed AI; TAI, n = 1,285).

To achieve a common breeding date, all TAI females were exposed to ovulation synchronization (7-d CO-Synch + CIDR for cows and heifers; Lamb et al., 2006, Larson et al., 2006, respectively) consisting of inserting a controlled internal drug-releasing insert (CIDR,1.38 grams (g) of Progesterone, Zoetis Inc., Florham, N.J.) and 100 micrograms (µg) of Gonadotrophin Releasing Hormone (GnRH) intramuscular (i.m.) (2 mL Factrel, Zoetis Inc.), followed in seven days by CIDR removal and 25 milligrams (mg) of PGF2α i.m. (5 mL Lutalyse, Zoetis Inc.), followed in 60 to 66 hours by 100 µg of GnRH i.m. and TAI.

At the time of the CIDR insertion, body condition scores (BCS) were recorded on all TAI females. Each producer was responsible for the selection of AI sires for the TAI treatment for their given herd.

Within each herd, females from both treatments were comingled on common pastures and managed together. Bulls were placed into breeding pastures at least one day after TAI. The presence of a viable fetus was determined by the herd veterinarian of each operation a minimum of 45 days after the conclusion of the producer-defined breeding season.

Birth date was recorded at parturition and individual weaning weights were collected at weaning. Calves born from cows exposed to TAI will be referred to as TAI-grouped calves and calves born from dams only exposed to NS will be referred to as NS-group calves.

The MIXED procedure of SAS (SAS Inst. Inc., Cary, N.C.) was used to analyze all continuous data (calf birth date and calf weaning weights). For all analysis of calf data, treatments will be applied by dam treatment origin (cows exposed to TAI will calve TAI-grouped calves, etc.).

The GENMOD procedure of SAS was used to analyze the binomial data (pregnancy rate calving distribution). Each model included the effect of treatment (natural service or fixed-timed AI breeding systems) and ranch location. When analyzing the effects of days postpartum (DPP) and BCS, categories were created to determine differences in groups of data and included in the model.

For DPP, cows were less than or equal to 40, 41 to 70, 71 to 100 or more than 100 based on the time between their last calving and current breeding date. For BCS, cows were less than 4, 4, 5 or greater than 5 based on their condition at the time of treatment administration. Significance was declared at $P \leq 0.05$.

Results and Discussion

The current study was conducted to evaluate the impact of two different breeding systems, natural service and timed-AI, on commercial beef operations in North Dakota. Days postpartum were similar ($P = 0.97$) between treatments, with an average of 65 days, and the average BCS was 4.4 on a 1-to-9 scale. A similar proportion of cows became pregnant by the end of the producer-defined breeding season between treatments (93.2 percent; $P = 0.58$).

At the time of calving, birth date was recorded. Cows in the TAI group calved 7.7 days earlier ($P < 0.001$) than those in the NS group (27.1 and 34.8 days, respectively). Because pregnancy was determined at the end of the breeding season, pregnancy to AI is unknown. The proportion of cows calving in the first 21-day period of the calving season is not an exact measurement; however, it can be used as an indicator for cows becoming pregnant to TAI.

In addition, a greater ($P < 0.001$) proportion of cows in the TAI group calved in the first 21-day period of the calving season (Figure 1). When evaluating the second and third 21-day periods, a greater proportion ($P < 0.001$) of NS-bred females calved.

Finally, we found no difference ($P = 0.59$) in the proportion of cows

that did not calve. Similarly, Rodgers et al. (2012) and Steichen et al. (2013) reported that incorporating estrous synchronization and AI into herds shifted the calving date earlier in the calving season, with a greater proportion of females calving in the first 21-day period of the calving season.

Weaning weights of calves born from the two breeding systems were collected at each producer location. Greater ($P < 0.001$) weights were observed in calves born to dams in the TAI group, compared with the NS group (549.8 ± 3.5 pounds and 534 ± 3.7 pounds, respectively; Table 1).

A treatment x calving group interaction also was present for weaning weight. Greater ($P = 0.002$) weaning weights were observed for calves born from TAI cows in the first 21 days of the calving season (592.5 ± 4 pounds), compared with NS-born calves (566.7 ± 5.8 pounds).

For the second 21-day period, a treatment x calving group interaction also was present, where greater ($P = 0.05$) weaning weights were observed in NS-group calves when compared with calves born to TAI cows (542.7 ± 5.1 pounds and 527.3 ± 2.8 pounds, respectively). We found no differences ($P = 0.76$) in the weights of calves born on day 42 or later in the calving season.

The incorporation of estrous synchronization and AI did not affect the proportion of cows becoming pregnant; however, it did increase the number of calves born early in the calving season. In addition, calves born to dams in the TAI treatment were heavier at weaning. For these reasons, the use of estrous synchronization and AI could have potential benefits for producers. Subsequent analysis will determine if earlier calving and heavier weaning weights resulted in any differences in profit.

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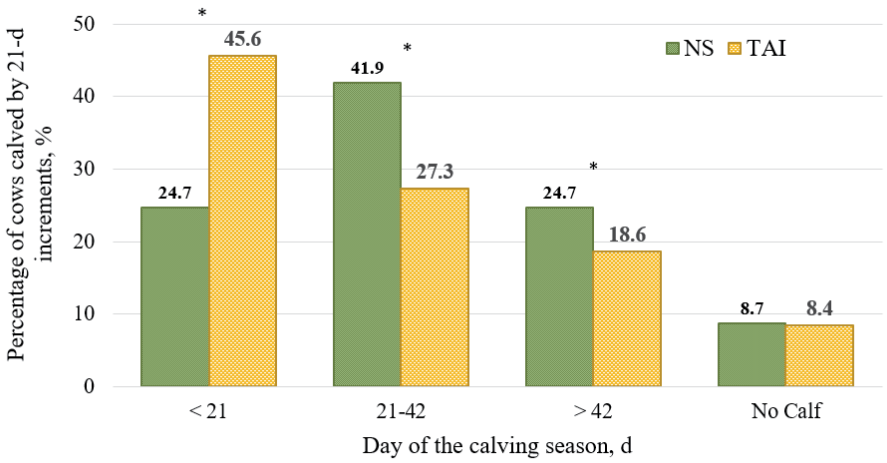

*Treatment differ within calving group ($P \leq 0.05$)

Figure 1. Effect of breeding system of origin on calving distribution.

Table 1. Effect of breeding system of origin on weaning weights of calves.

Item	Treatment[1]		*P* – value	
	NS	TAI	Treatment	Treatment x Calving Group
No. of calves	655	759	–	–
Weaning weights, lb.	534.0	549.8	<0.001	–
< 21	566.7	592.5	–	< 0.01
22-42	542.7	527.3	–	0.05
> 42	481.8	478.8	–	0.76

[1]Treatments: NS = Natural service only; TAI = Fixed-time AI bred with cleanup natural service

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