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Field Trial Assessing the Use of Sex-Sorted Semen in Beef Cattle

K. W. Aubuchon
Kansas State University, kolton@k-state.edu

J. A. Odde
Odde Ranch, Pollock, SD

C. Bronkhorst
University of Wisconsin-River Falls; River Falls, WI

See next page for additional authors

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Field Trial Assessing the Use of Sex-Sorted Semen in Beef Cattle

Abstract

Objective: The objective was to evaluate the reproductive performance of sex-sorted semen on beef cows and heifers.

Study Description: For this trial, 320 Angus and SimAngus cows and heifers from four groups were used. Group 1 yearling heifers (n = 101) were synchronized using the melengestrol acetate plus prostaglandin $F_{2\alpha}$ (MGA-$PGF_{2\alpha}$) protocol and Groups 2, 3, and 4 cows (n = 219) were synchronized using the 7-Day CO-Synch + CIDR protocol. Insemination was done with semen from an Angus sire (Group 1 yearling heifers and Group 2 young cows) sorted to contain >90% X-bearing sperm, or a Charolais sire (Groups 3 and 4 mature cows) sorted to contain >90% Y-bearing sperm. Females were bred after visual estrus detection (Group 1 yearling heifers), fixed time artificial insemination (AI; Group 4 mature cows), or split time AI (Group 2 young cows and Group 3 mature cows).

The Bottom Line: These results indicate that sex-sorted semen has potential in commercial beef cows and heifers. Increasing carcass weights in the beef industry has caused a greater price spread between steers and heifers. With increasing spread in value between heifer calves and steer calves, opportunity exists for economic gain with “bull” sexed semen, especially in terminal sire programs.

Keywords

beef, sex-sorted semen, reproduction

Cover Page Footnote

Thanks to STgenetics (Navasota, TX) for providing the semen for this project.

Authors

K. W. Aubuchon, J. A. Odde, C. Bronkhorst, E. M. Bortoluzzi, M. J. Goering, K. E. Fike, and K. G. Odde

K-STATE Research and Extension

CATTLEMEN'S DAY 2022

KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

Field Trial Assessing the Use of Sex-Sorted Semen in Beef Cattle

K.W. Aubuchon, J.A. Odde,[1] C. Bronkhorst,[2] E.M. Bortoluzzi, M. Goering, K.E. Fike, and K.G. Odde

Abstract

Sex-sorted semen utilization holds the potential to create a high percentage of either bull or heifer calves, but often comes with a reduction in fertility. The objective of this study was to evaluate the reproductive performance of sex-sorted semen (both X- and Y-sorted semen) in commercial beef cows and heifers. For this trial, 320 Angus and SimAngus cows and heifers from four groups were used. The groups were: yearling heifers (Group 1, n = 101); young cows (Group 2, n = 51) bred to an Angus sire sorted for >90% X-bearing sperm; and 168 mature cows (Group 3, n = 80; and Group 4, n = 88) bred to a Charolais sire sorted to contain >90% Y-bearing sperm. Heifers were synchronized using melengestrol acetate plus prostaglandin $F_{2\alpha}$ (MGA-$PGF_{2\alpha}$) and were bred based on visual estrus detection. The three cow groups were synchronized using the 7-Day CO-Synch plus CIDR protocol. Group 2 young cows and Group 3 mature cows were inseminated using a split-time artificial insemination (STAI) approach, while Group 4 mature cows were inseminated using a fixed-time AI (FTAI) approach. The estrus responses were: 95.1% (Group 1), 88.2% (Group 2), 75.0% (Group 3), and 69.3% (Group 4). The AI pregnancy rates were: 63.4% (Group 1), 47.1% (Group 2), 46.3% (Group 3), and 40.2% (Group 4). The Group 1 heifers had a high estrus response and AI pregnancy rate likely due to the inherent fertility of heifers and intensive estrus detection used. The AI pregnancy rates for the Group 2 young cows and Group 3 mature cows were similar to what is seen in the literature. Group 4 mature cows' decreased estrus response and AI pregnancy rate were lower than reported in other studies. Finally, the Charolais sired calves averaged around 100 lb heavier than their Angus sired counterparts. These results show the commercial potential of using "bull" sex-sorted semen in terminal sire programs.

Introduction

Sex-sorted semen utilization holds the potential to create a high percentage of either bull or heifer calves. Most of the research to date has investigated success rates utilizing "heifer" semen. The objective of this study was to evaluate the success of "bull" and "heifer" sex-sorted semen in a commercial cattle operation.

[1] Odde Ranch, Pollock, SD.

[2] Department of Animal Sciences; College of Agriculture, Food and Environmental Sciences; University of Wisconsin-River Falls; River Falls, WI.

Experimental Procedures

This trial was conducted on the Odde Ranch in North Central South Dakota from the summer of 2019 through fall 2020. There was a total of 320 Angus and SimAngus cows and heifers from four separate groups utilized in this trial (Table 1). The groups were: yearling heifers housed in a dry lot system (Group 1, n = 101); young cows (nursing calves) on pasture (Group 2, n = 51); cows (nursing calves) on pasture (Group 3, n = 80); and cows (nursing calves) on pasture (Group 4, n = 88).

The yearling heifers and young cows were inseminated to a commercially available Angus sire (Sire A) sorted to contain >90% X-chromosome bearing sperm cells. The mature cows were inseminated to a commercially available Charolais sire (Sire B) sorted to contain >90% Y-chromosome bearing sperm cells. All semen was packaged at a concentration of 4×10^6 sperm cells per 0.25 mL dose.

The Group 1 yearling heifers were estrus synchronized using the melengestrol acetate plus prostaglandin $F_{2\alpha}$ (MGA-$PGF_{2\alpha}$) protocol. Heifers were fed MGA for 14 days at a concentration of 0.5 mg/head/day. After feeding MGA for 14 days, MGA was removed from the ration for 19 days. On day 19 after the final day of MGA feeding, heifers received a 5 mL injection of $PGF_{2\alpha}$ (Lutalyse; Zoetis, Madison, NJ). Estrus was synchronized in Groups 2, 3, and 4 using the 7-day CO-Synch plus CIDR protocol. Cows received a progesterone insert (CIDR; Zoetis, Madison, NJ) along with a 2 mL injection of a gonadotropin-releasing hormone (GnRH) analog (Gonadorelin; Cystorelin; Merial, Athens, GA) at the start of the protocol. After seven days, CIDRs were removed and cows received a 5 mL injection of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$; Lutalyse; Zoetis, Madison, NJ). Estrus detection aids (Estrotect, Rockway Inc., Spring Valley, WI) were applied at time of $PGF_{2\alpha}$ injection at all locations. Estrus was defined as >50% of the patch coating removed. Group 1 heifers were also visually observed for signs of estrus every four hours for five days following injection of $PGF_{2\alpha}$.

Group 1 heifers were inseminated at 15 to 21 hours after the onset of estrus. The Group 2 young cow group was inseminated using a split-time artificial insemination (AI) system with those showing estrus by 70 hours post $PGF_{2\alpha}$ inseminated at 70 hours. Those with inactive patches were injected with GnRH and were inseminated at 94 hours post $PGF_{2\alpha}$. Group 3 cows with active patches were inseminated at 70 hours post $PGF_{2\alpha}$. Those with inactive patches were administered GnRH and inseminated at 82 hours post $PGF_{2\alpha}$. Group 4 cows were inseminated at 70 hours post $PGF_{2\alpha}$ with cows with inactivated patches getting an injection of GnRH. Females were exposed to bulls approximately 5–7 days after AI for the remainder of the breeding season.

Pregnancy diagnosis was conducted approximately 65–90 days post insemination via transrectal ultrasonography (ReproScan XTC equipped with a 4.0 MHz 60 mm convex rectal probe; ReproScan, Winterset, IA). Fetal size was used to differentiate AI pregnancies from natural service pregnancies. Gender was determined at birth. Gender accuracy to sex-sorted semen for each sire was calculated at the end of the calving season for all AI pregnancies. Gender skew, defined as the number of the desired gender divided by the total in the group, was calculated for each group. All calves were weighed prior to weaning in the fall. An adjusted 200-day calf weight was calculated using the fall weight and an average birth weight of 80 lb using the following equations:

Average daily gain (ADG) = [fall weight - standard birth weight (80 lb)]/days of age.
Adjusted 200-day weight = (ADG × 200 days) + standard birth weight (80 lb).

Results and Discussions

The results of this trial are shown in Table 2. Group 1 yearling heifers had an observed estrus response of 95.1% 5-days post $PGF_{2\alpha}$ injection and AI pregnancy rate of 63.4%. The gender accuracy of the AI calves was 94.3% heifers with an overall gender skew of 77.7% for heifer calves. The pregnancy rate observed was acceptable for sex-sorted semen and higher than what is typically found in the literature (Thomas et al., 2017). This is likely attributed to the intensive heat detection conducted on the heifers and the increased fertility seen with heifers in general.

Group 2 young cows had an estrus response of 88.2% overall with an AI pregnancy rate of 47.1%. The gender accuracy of AI calves was 89.5% heifers with an overall gender skew being 76.1% heifer calves. Group 3 mature cows had an estrus response of 75% and an AI pregnancy rate of 46.3%. The gender accuracy of AI calves was 91.0% bulls resulting in a gender skew of 68.8% bull calves. Group 4 mature cows had an estrus response of 69.3% and an AI pregnancy rate of 40.2%. The gender accuracy of AI calves was 84.8% bulls resulting in a gender skew of 58.7% bull calves.

Results for Groups 2 and 3 are similar to what has been reported in the literature for sexed semen (Andersen et al., 2020; Thomas et al., 2019). Results for Group 4 are lower than some other reported studies, possibly due to the use of fixed-time AI instead of split-time AI.

Adjusted 200-day weights (Table 2) were approximately 100 lb heavier for Groups 3 and 4 compared to Groups 1 and 2. This is likely due to cows in Groups 3 and 4 being older and implanted, that calves in these groups were sired by high growth Charolais bulls, and that these calves have more heterosis (cows were Angus-Simmental).

Implications

These results show that sex-sorted semen has potential on beef cows and heifers. Steer calves are worth more than heifers, and this difference is increasing due to increased carcass weights. "Bull" sex-sorted semen in terminal sire programs appears to have significant commercial potential.

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Table 1. Average age, estrus synchronization method, breeding method, and artificial insemination (AI) sire by group

Group	Number	Average age (years)	Estrus synchronization method	Breeding method	AI sire
Group 1 yearling heifers	101	---	MGA-$PGF_{2\alpha}$[1]	Bred by estrus[2]	Angus[6]
Group 2 young cows	51	2.2 ± 0.5	7-day CO-Synch+CIDR	STAI[3]	Angus[6]
Group 3 mature cows	80	6.0 ± 2.2	7-day CO-Synch+CIDR	STAI[4]	Charolais[7]
Group 4 mature cows	88	6.8 ± 2.6	7-day CO-Synch+CIDR	FTAI[5]	Charolais[7]

[1]Melengestrol Acetate plus Prostaglandin $F_{2\alpha}$.
[2]Heifers were inseminated 15 to 21 hours after the observation of estrus.
[3]Split-Time AI - young cows that did not display estrus by 70 hours after $PGF_{2\alpha}$ received an injection of gonadotropin-releasing hormone (GnRH) and inseminated 24 hours later.
[4]Split-Time AI - cows that did not display estrus at 70 hours after $PGF_{2\alpha}$ received an injection of GnRH and were inseminated 12 hours later.
[5]Fixed-Time AI - all cows were inseminated by 70 hours after $PGF_{2\alpha}$, and cows that did not show signs of estrus by 70 hours received an injection of GnRH.
[6]Angus sire semen was sorted to contain >90% X-chromosome bearing sperm cells at a concentration of 4×10^6 per 0.25 mL straw.
[7]Charolais sire semen was sorted to contain >90% Y-chromosome bearing sperm cells at a concentration of 4×10^6 per 0.25 mL straw.

Table 2. Estrus response, artificial insemination (AI) pregnancy rate, breeding season pregnancy rate, gender accuracy, gender skew, and 200-day adjusted calf weight by group

Group	Estrus response (%)	AI pregnancy rate (%)	Breeding season pregnancy rate (%)	Gender accuracy[1] (%)	Gender skew[2]	200-Day adjusted calf weight[3] (lb)
Group 1 yearling heifers	95.1	63.4	87.0	94.3	77.7% Heifers	496.6
Group 2 young cows	88.2[a]	47.1	92.2	89.5	76.1% Heifers	505.6
Group 3 mature cows	75.0[b]	46.3	92.3	91.0	68.8% Bulls	606.5
Group 4 mature cows	69.3	40.2	90.9	84.8	58.7% Bulls	595.6

[1]Gender accuracy is the total number of AI calves of the desired gender divided by the total number of AI calves born.
[2]Gender skew is the total number of calves born of the desired gender divided by the total number of calves born.
[3]Average daily gain (ADG) = [fall weight - standard birth weight (80 lb)]/days of age.
Adjusted 200-day weight = (ADG × 200 days) + standard birth weight (80 lb).
[a]Response rate is the number of cows showing estrus by 70 hours plus those showing estrus by 94 hours.
[b]Response rate is the number of cows showing estrus by 70 hours plus those showing estrus by 82 hours.