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Evaluating Conventional and Sexed Semen in a Commercial Beef Heifer Program

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Summary

Heifers (n = 500) were fed 0.5 mg/day of melengestrol acetate for 14 days, and 19 days later, administered $PGF_{2\alpha}$. Following $PGF_{2\alpha}$, heifers were detected for estrus and artificially inseminated (AI) approximately 18-24 hours later. Three days following $PGF_{2\alpha}$, heifers not detected in estrus were given GnRH and AI. Heifers were AI with one of two sires, either conventional or sexed semen, creating four possibilities for AI sire. Pregnancy rate was greater for conventional than sexed semen. In addition, more heifers detected in estrus were pregnant than heifers time AI. Further research is needed to establish the optimum estrus synchronization program with sexed semen.

Introduction

Sex-sorting sperm relies on the fact the bovine X chromosome has 3.8% more DNA than the Y chromosome. This principle enables sperm to be sorted using a flow cytometer. However, the process damages sperm and reduces fertility when compared to conventional semen (Tubman et al., *Journal of Animal Science,* 2004, 82:1029-1036).

Protocols for artificially inseminated (AI) with sexed semen have been similar to those utilized with conventional semen without modification. Objectives of this study were to evaluate the use of sexed semen compared to conventional semen in a commercial heifer development program with a slightly modified, commonly used synchronization system for beef heifers.

Procedure

Yearling heifers (n = 500) were managed together at the Kelly Ranch (KR), Sutherland, Neb. Approximately one week prior to initiation of synchronization, a subset (n = 100) of heifers was randomly sorted and transported to the University of Nebraska West Central Research and Extension Center (WCREC), North Platte, Neb.; the balance of heifers (n = 400) remained at the KR.

Heifers at the KR grazed dormant upland Sandhills range receiving 2.8 lb/day (DM) dried distillers grains. Sixty-six days before initiation of synchronization, each heifer also began receiving 6.4 lb/day (DM) alfalfa. Alfalfa was fed *ad libitum* beginning the end of March through early April due to decreasing winter range.

Heifers at WCREC were placed in a drylot and fed 18.1 lb/day (DM) of a diet consisting of 10% corn, 71% prairie hay, 16% wet corn gluten feed, and 3% heifer supplement. Heifer BW was measured (648 lb) upon arrival to WCREC.

Beginning April 8, heifers at both locations were fed 0.5 mg/day melengestrol acetate (MGA) per animal for 14 days. At WCREC, MGA pellet was added as part of the complete diet; at the KR, MGA pellet was mixed with 4.6 lb/day ground hay and 1.8 lb/day wet distillers grains (DM). Prostaglandin $F_{2\alpha}$ (PGF) was administered intramuscular (i.m.). Nineteen days later, heat detection patches were placed on tail heads. In addition, BW was measured (719 lb) for heifers at WCREC.

Following PGF injection, heifers were detected for estrus by one of two methods: visual observation of standing estrus or activated heat detection patches. Three people detected estrus at the KR, while two detected estrus at WCREC during daylight hours. Heifers were AI approximately 18-24 hours following detection of standing estrus to place insemination closer to ovulation, due to sperm damage in the sex-sorting process. Heifers detected in estrus before 0800 were AI late the same day. Heifers detected between 0800 and 1400 were AI early the next morning. Heifers detected between 1400 and the end of the day were AI early afternoon the next day.

Three days following PGF injection, heifers with activated Estrotect patches and observed in standing estrus prior to 0800 were sorted for breeding late the same day. Heifers detected the previous morning and early afternoon were AI early morning on day 3. Heifers detected in estrus late on day 2 were inseminated early afternoon of day 3. Following the early afternoon AI, heifers not detected in estrus were given a GnRH injection i.m. and AI (mass bred, MB). Following MB, heifers detected the morning of day 3 were inseminated as late as possible with consideration given to the number of heifers to inseminate and remaining daylight.

Heifers were AI with one of two sires, either conventional or sexed semen, creating four possibilities for AI sire. At each AI session, heifers were divided evenly to receive either sexed or conventional semen from the same sires. Six AI technicians were used at the KR and two at WCREC.

The sexed semen was sorted at 90% purity for heifer calf pregnancies. Each sexed semen straw contained 2×10^6 sperm.

The day after MB, heifers at WCREC were transported back to the KR. Heifers were managed as one group, grazing upland Sandhills range. Clean-up sires (n = 12) were turned in with heifers 12 days after MB, at a ratio of 1 bull to 42 heifers.

Fifty-five days after MB, BW was measured (805 lb), and pregnancy was detected via transrectal ultrasonography. Heifers were identified as pregnant by AI, bull, or open and sorted accordingly. Nonpregnant heifers (n = 124) and heifers pregnant

Table 1. Pregnancy rates by sire for conventional and sexed semen.

	Conventional Semen	Sexed Semen	SE	*P* value
Both sires, % pregnant	58.4[a]	41.0[b]	4.2	<0.01
Sire 1, % pregnant	59.4[a]	36.1[b]	5.4	<0.01
Sire 2, % pregnant	57.5[a]	46.2[b]	5.6	<0.01

[a,b]Row means without a common superscript differ ($P < 0.05$).

Table 2. Pregnancy rates by insemination time for conventional and sexed semen.

	AM[1]	EPM[2]	LPM[3]	MB[4]	SE	*P* value
Overall	64.2[a]	55.9[a]	57.0[a]	24.0[b]	6.8	<0.01
Conventional	69.6[a]	59.9[a]	68.0[a]	34.9[b]	7.0	<0.01
Sexed	58.4[a]	51.9[a]	45.3[a]	15.8[b]	9.0	<0.01

[1]Heifers detected in estrus between 0800 and 1400 hours were AI early the next morning.
[2]Heifers detected in estrus between 1400 hours and the end of the day were AI early afternoon the next day.
[3]Heifers detected in estrus before 0800 hours were AI late the same day.
[4]Heifers not detected in estrus were given a GnRH injection and mass AI.
[a,b]Row means without a common superscript differ ($P < 0.05$).

Table 3. Various costs for AI with conventional semen, sexed semen, and natural service in a commercial beef heifer development program.

	Conventional Semen	Sexed Semen	Natural Service
Semen cost/straw, $	14.00	45.00	—
Semen cost/AI pregnancy, $	24.39	109.22	—
Breeding system cost per pregnant heifer, $	68.66	111.47	63.39
Pregnant heifer net cost, $	1,264.00	1,308.00	1,259.00

by bull (n = 247) were maintained with bulls for an additional 18 days and checked for pregnancy via ultrasound approximately 60 days later. Data were analyzed using PROC GLIMMIX of SAS (SAS Inst., Inc., Cary, N.C.).

Results

The subset of heifers at WCREC had an ADG of 1.70 lb during the 45 day period at WCREC. This same group of heifers weighed 816 lb at the time of ultrasound, for an ADG of 1.65 lb from AI to first pregnancy detection. Location did not affect ($P = 0.28$) pregnancy rates.

There was no ($P > 0.10$) sire × type of semen (conventional or sexed) interaction; therefore, sires were combined for analysis. Pregnancy rate was greater ($P < 0.01$) for heifers AI with conventional than sexed semen (58 vs. 41%, Table 1). These results agree with previous research indicating pregnancy rates using sexed semen are generally 70-90% of conventional semen (Seidel, *Journal of Animal Science,* 2010, 88:E-Supplement 2 (Abstract), p. 783) with quality of herd management playing a key role (Garner and Seidel, *Theriogenology,* 2008, 69:886-895).

More ($P < 0.01$) heifers detected in standing estrus were pregnant (56% or greater, Table 2) than heifers MB (24%). A review by Seidel (Theriogenology, 2003, 59:585-598) indicated most inseminations with sexed semen have been conducted at 12 or 24 hours after observed standing estrus, and fertility with timed AI was markedly lower. Work conducted at Colorado State University found pregnancy rates in lactating cows from insemination 6-14 hours after estrus detection were similar to inseminations 21-26 hours after estrus detection, recommending detection of estrus and once a day breeding using sexed semen. Pregnancy rates using sexed semen were not statistically ($P > 0.10$) different between sires or technicians; however, there was a 10% numerical difference between sires. Other studies have reported a difference in fertility rates among bulls when using sexed semen (Doyle et al., Proceedings, Western Section American Society of Animal Science, 1999, 50:203-205). Overall pregnancy rate (including natural service) was 93%.

Breeding costs based on breeding system were highest numerically for AI with sexed semen (Table 3), due to lower pregnancy rates and greater semen costs ($14 for conventional vs. $45 for sexed). A portion of the pregnant heifers (n = 417) were marketed following the breeding season. Heifers pregnant by AI were sold at $1,344/animal and heifers pregnant by natural service sold at an average of $1,238/animal. Gender difference for replacement heifers AI with sexed semen was not considered as all AI pregnant heifers sold for the same price.

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