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# Effect of Estrous Synchronization With Natural Service or Fixed-Timed Artificial Insemination Using Conventional or Gender-Kkewed Semen in Beef Females on Calving Distribution and Post Weaning Calf Performance

Julie Walker

Jerica J.J. Rich

Warren Rusche

Matthew Diersen

George Perry

# Effect of estrous synchronization with natural service or fixed-timed artificial insemination using conventional or gender-kkewed semen in beef females on calving distribution and post weaning calf performance


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## Objective

The objectives of this study were to evaluate estrous synchronization and/or artificial insemination (AI) with conventional (CONV) or gender-skewed (SEXED) semen on calving distribution and to evaluate the impact of assisted reproductive technologies on post weaning calf performance.

## Study Description

Within 10 herds, beef females (n = 1,620) were either: 1) not synchronized (NonSyn) and mated to bulls, 2) synchronized (7-d controlled internal drug release (CIDR)) and mated to bulls (SynNS) 3) synchronized (7-d CO-Synch plus CIDR) and artificially inseminated with conventional semen (SynAI), or 4) synchronized (7-d CO-Synch plus CIDR) and artificially inseminated with SEXED semen. Calving distributions (calves born from d 1 to 14, 1 to 21, 22 to 42, and 43 and greater) were determined by actual birthdates and calf gender was determined at birth. Over a two-year period, a subset of calves (n = 508) born to cows subjected to the previously discussed reproductive treatments in each of the 10 herds were fed to reach a target backfat (BF) of 0.50 inches, sent to harvest, and carcass data were collected. Calves were classified into calving groups as natural service born early (NS-Early, n = 189), natural service born late (NS-Late, n = 203), or AI sired born early (AI-Early, n = 116). Early was defined as the first 21 days of the calving season.

## Take Home Points

Synchronization resulted in more calves born from d 1 to 14 of the calving season ($P < 0.01$; 62% vs 47%; Fig. 1); however, there were no differences ($P = 0.31$) between Syn and NonSyn in the percent of calves born by d 21. Between d 22 and 42, there were more ($P = 0.04$) calves born in the NonSyn group and no difference between groups ($P = 0.32$) for d 43 and greater. When evaluating the impact of AI, a greater proportion of calves were born between d 1 and 14 for SynNS compared to SynAI ($P < 0.02$; 46% vs 38%; Fig. 2), but from d 1 to 21 and 22 to 42 there were no differences between treatments ($P \geq 0.13$). It should be noted that SynAI females remained separate from bulls for 7 to 10 days post AI to allow identification of AI versus natural service conceptions and this could have affected the proportion of calves born in the first 21 days. There were no differences ($P \geq 0.14$; Fig. 3) between CONV and SEXED for the proportion of calves born from d 1 to 14 or d 1 to 21. However, more of the desired gender were born in the SEXED group during d 1 to 14 of the calving season ($P < 0.01$; 84% vs 68%; Fig. 4), and more total calves born from d 22 to 42 in the SEXED group compared to the CONV group ($P < 0.05$; 49% vs 33%). There were no differences between CONV and SEXED ($P = 0.07$) for the number of calves born on d 43 or beyond. In summary, estrus synchronization increased the proportion of cows that calved early in the calving season, and incorporation of SEXED semen increased the proportion of the desired gender born early in the calving season without influencing the calving distribution.

Birth timing influenced the weaning weight of calves as calves born within the first 21-day window of the calving season were heavier ($P < 0.0001$) than late born calves (573 and 577 pounds versus 504 pounds for NS-Early, AI-Early and NS-Late, respectively; Fig. 5). Final harvest weight was lighter ($P < 0.01$) for NS-Early (1,355 lb) compared to NS-Late and AI-Early (1,384 and 1,403 lb for NS-Late and AI-Early, respectively; Fig. 5). This was because of differences in days on feed as NS-Early were fed 260 days compared to 295 d and 276 d for NS-Late and AI-Early, respectively ($P < 0.001$; Fig. 6). A similar pattern was found in age at harvest day ($P < 0.02$). As with harvest weight, hot carcass weight was lighter in NS-Early (833.8 lb) carcasses compared to AI-Early (862.4 pounds; $P < 0.02$) and NS-Late carcasses (844.6 lb) tended ($P = 0.07$) to be lighter than AI-Early (Table 1). Marbling, ribeye area, back fat (BF), yield and quality grades were not different between treatments ($P > 0.10$).

## Introduction

According to USDA, only 11% of beef producers use artificial insemination and/or estrous synchronization technologies in their herds (USDA, 2017). However, purchase price of an average herd bull between years 2008 ($3,031) and 2014 ($4,997) increased 65%, compared to only a 23% increase in the average price of a straw of semen over the same period of time ($17.62 and $21.72, respectively; American Angus Association, 2014). Semen cost per service for herd bulls was calculated at average bull prices/30 cows per year/4 years (American Angus Association, 2014). Estrous synchronization is a reproductive technology to increase the percentage of calves born early in the calving season resulting in a more uniform calf crop and heavier weaning weights.

Calves that are born later in the calving season weigh less at a fixed weaning date compared to their older herd mates. An analysis of weaning records from USDA – Meat Animal Research Center shows that one day of age difference at weaning translates to 2.42 lb less weaning weight (R. Cushman, personal communication). This translates to a loss of approximately $4.37 per day, or $30 per week per calf as the calving season progresses (assuming a market price of $180/cwt). Given such economic ramifications, there is a clear advantage to having calves born as early as feasible in the calving season and/or maintaining a shorter calving season.

The ability to produce calves of a specific gender has the potential to tremendously impact the profitability of cow-calf operations. Even though the relative value of steer and heifer calves depends on factors such as expected value of fed cattle, the price of corn and other inputs and market expectations related to the cattle cycle, the common pattern is for steers to sell for a premium compared to heifers of the same weight. Therefore, the ability to skew the gender ratio of an entire calf crop could have dramatic impacts on the profitability of cow-calf operations, not only in the gender produced but also by increasing the lot size of the desired gender to be marketed.

## Experimental Procedures

### *Reproductive technologies*

Reproductive technologies (estrous synchronization and/or AI) were applied to beef females (n = 1,620) over a two-year period. Treatment 1: within 6 herds, beef females (n = 339) were either estrous synchronized (7-d CIDR: Syn) or not synchronized (NonSyn) and mated to bulls. Treatment 2: within 10 herds, beef females (n = 736) were estrous synchronized (7-d CIDR) and mated to bulls (SynNS) or artificially inseminated (SynAI) after CIDR removal (cows 60-66 h; heifers 52-56 h). Treatment 3: within 5 herds, beef females (n = 545) were estrous synchronized (7-d CO-Synch plus CIDR) and fixed timed artificially inseminated with either CONV or SEXED semen. Animals remained separated from bulls for at least 7 days after AI. Calving distributions (calves born from d 1 to 14, 1 to 21, 22 to 42, and 43 and greater) were determined by birthdates and calf gender was determined at birth. Calving distribution and gender were determined at birth and were analyzed using the GLIMMIX procedure in SAS.

### *Post weaning management*

Each year a subset of calves from each herd and treatment were fed an accelerated finishing program in a commercial feedyard or SDSU Southeast Research Farm (Beresford, SD) to determine feedlot performance. Due to small numbers of calves in some of the treatments, calves were classified as: 1) natural service early born (NS-Early, n = 189); 2) natural service born late (NS-Late, n = 203) or 3) AI-sired early born (AI-Early, n = 116). These calves were fed as part of the SDSU Calf Value Discovery program. Animals were selected for harvest based on estimated backfat of 0.50 inches or if the animals were at risk of being discounted for heavy carcass weight (> 1,050 pounds hot carcass weight). Video image data were obtained from the plant for ribeye area, backfat, calculated USDA Yield Grade (YG), and USDA marbling scores. Data were analyzed using the MIXED procedure in SAS with calving group, year and calf gender in the model.

## Results and Discussion

### *Reproductive technologies*

Synchronization resulted in more calves born from d 1 to 14 ($P < 0.01$; 62% vs 47%) of the calving season. There were no differences ($P = 0.31$) between Syn and NonSyn in the percent of calves born after d 21, but between d 22 and 42, more ($P = 0.04$) calves were born in the NonSyn group. A greater proportion ($P < 0.02$; 46% vs 38%) of calves were born in SynNS between d 1 and 14 compared to SynAI. One potential reason for the decrease in SynAI performance could be due to cows having been separated from bulls for 10 days post artificial insemination to allow detection of AI calves. There was no difference between treatments ($P > 0.12$) from d 1 to 42, but more calves were born for SynAI after d 43. With SEXED semen, there were no differences ($P > 0.14$) between CONV and SEXED for the proportion of calves born from d 1 to 14 or d 1 to 21; however, more of the desired gender were born in the SEXED group during d 1 to 14 of the calving season ($P < 0.01$; 84% vs 68%). Hall and Glaze (2013) reported a shift in gender ratio from 50:50 to 78:22 female (semen sorted for X chromosome), and 65:35 male to female ratio (semen sorted for Y chromosome), after only one use of sexed semen following estrous synchronization. Additionally, CONV semen had greater conception rates compared to SEXED semen (67% vs 53; $P < 0.01$). Several studies have reported reductions in AI pregnancy rates when using sexed semen (Deutscher et al., 2002, 3% to 13% reduction; Rhinehart et al., 2011, 4% to 38% reduction; Meyer et al., 2012, 17% reduction). More total calves were born from d 22 to 42 in the SEXED group compared to the CONV group ($P < 0.05$; 49% vs 33%).

### *Post weaning management*

Weaning weights were similar between AI-Early and NS-Early; however, earlier born calves (AI-Early and NS-Early) were heavier ($P < 0.0001$) than NS-Late. AI-Early calves had heavier finished bodyweight (1,403 lb: $P = 0.0024$) compared to NS-Early (1,355 lb) and heavier HCW compared to both NS-Early and NS-Late ($P < 0.01$). NS-Early calves reached 0.50-inch BF inches fewer days than AI-Early (260 d and 276 d, respectively; $P < 0.01$) with NS-late requiring the most days on feed to reach the same endpoint (295 d, $P < 0.01$). No differences in Quality Grade, Yield Grade, REA, marbling, or BF were detected between AI-Early, NS-Early, and NS-Late, or between early- and late-born calves ($P > 0.38$). Funston et al. (2012) reported lighter hot carcass weight, less backfat, and lower marbling scores as steers were younger at harvest; however, no change in ribeye area. Hence younger calves had lower yield grade. It should be noted that all steers calves were marketed on the same day. Late-born calves required 29 more days on feed ($P < 0.001$) to reach 0.50-inch BF resulting in greater final bodyweight compared to early-born calves (1,379 lb and 1,351 lb, respectively; $P = 0.04$); however, hot carcass weights were similar between early- and late-born calves. When controlling for the value of calves at the time of placement in the feedlot, there was not a difference in performance across treatments.

## Implications

Estrous synchronization increased number of calves born early in the calving season which increased weaning weight and post weaning growth performance. However, when high quality natural service sires were used, AI sires did not improve carcass quality characteristics. Gender-skewed semen increased the proportion of the desired gender born early in the calving season. Post-weaning performance was not different when high quality bulls were used compared to AI sires. Late-born calves required 29 more days on feed to reach 0.50-inch backfat resulting in greater final bodyweight compared to early-born calves. Carcass characteristics were similar for early- and late-born calves except for hot carcass weights.


## Acknowledgements

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## Tables

**Table 1.** Influence of treatment on hot carcass weight (HCW), yield grade, ribeye area, marbling and backfat thickness.

| Item | NS-Early | NS-Late | AI-Early | P-value |
|---|---|---|---|---|
| HCW, lb | 833.8[a *†] | 844.6[ab *] | 862.4[b †] | 0.02 |
| Yield Grade | 3.68 | 3.64 | 3.76 | 0.39 |
| Ribeye area, sq. in. | 12.81 | 12.92 | 13.03 | 0.44 |
| Marbling | 535.00 | 535.95 | 547.82 | 0.63 |
| Back fat, in | 0.66 | 0.64 | 0.67 | 0.38 |

[abc] Different superscripts within a row indicate a difference between treatment (P < 0.05)
[*†] Different superscripts within a row indicate a tendency between treatment (P > 0.05)

## Figures

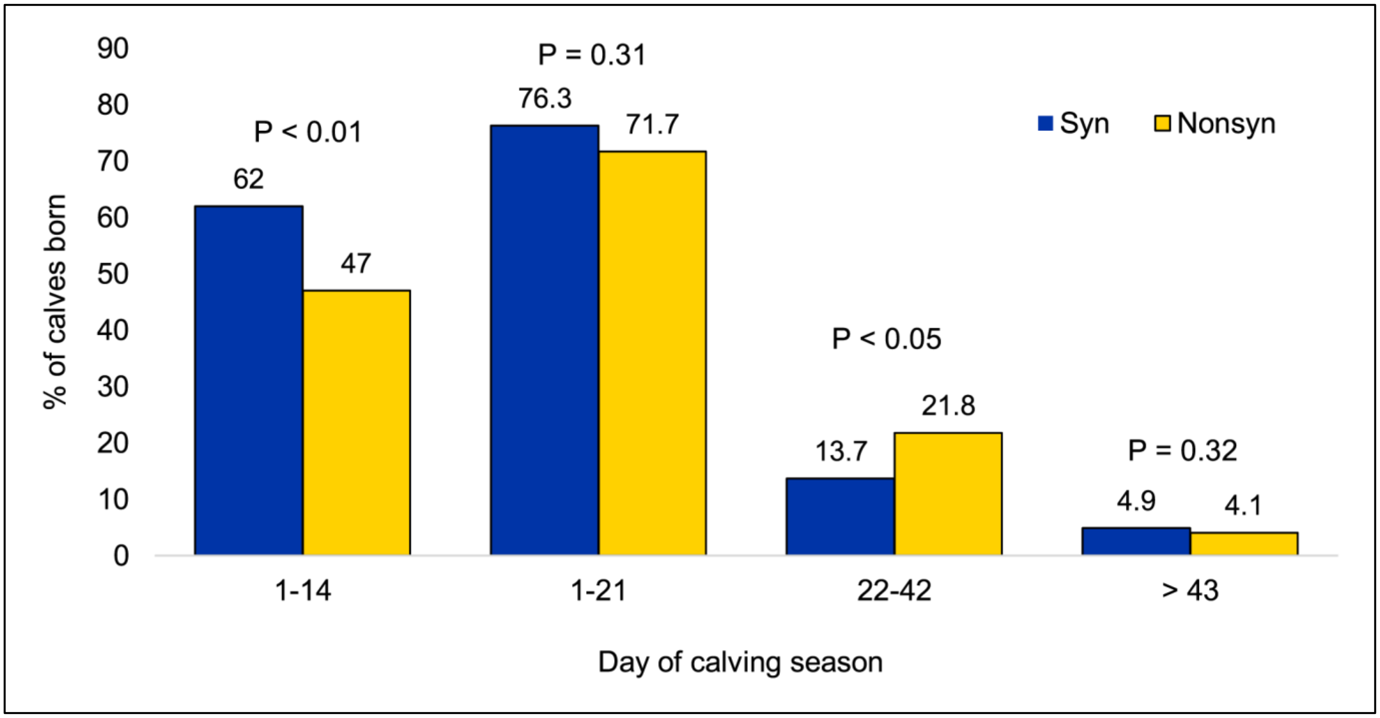


**Figure 1.** Influence of estrous synchronization (Syn) or no estrous synchronization (NonSyn) with natural service on calving distribution.

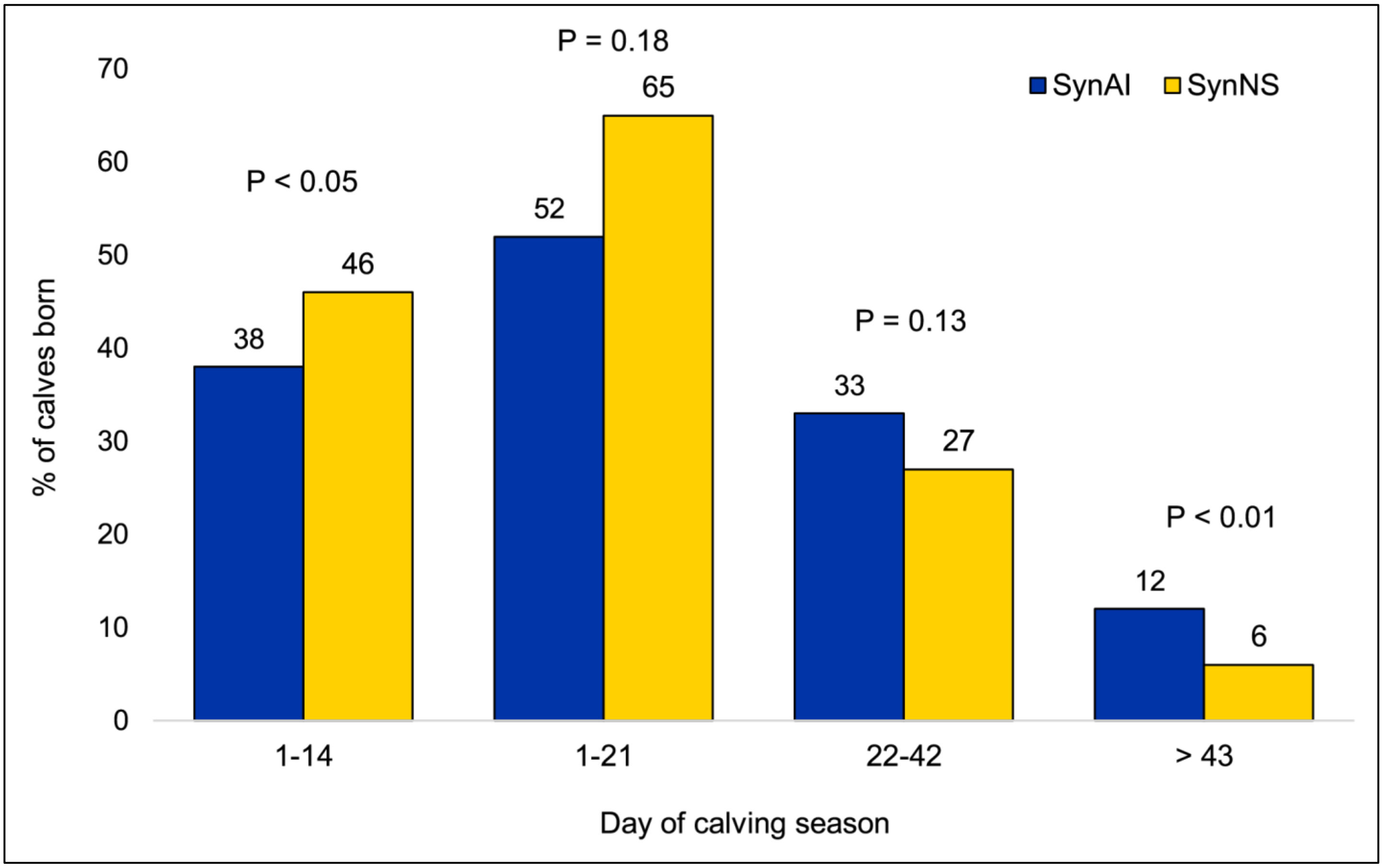


**Figure 2.** Influence of estrous synchronization with natural service (SynNS) and artificial insemination (SynAI) on calving distribution.

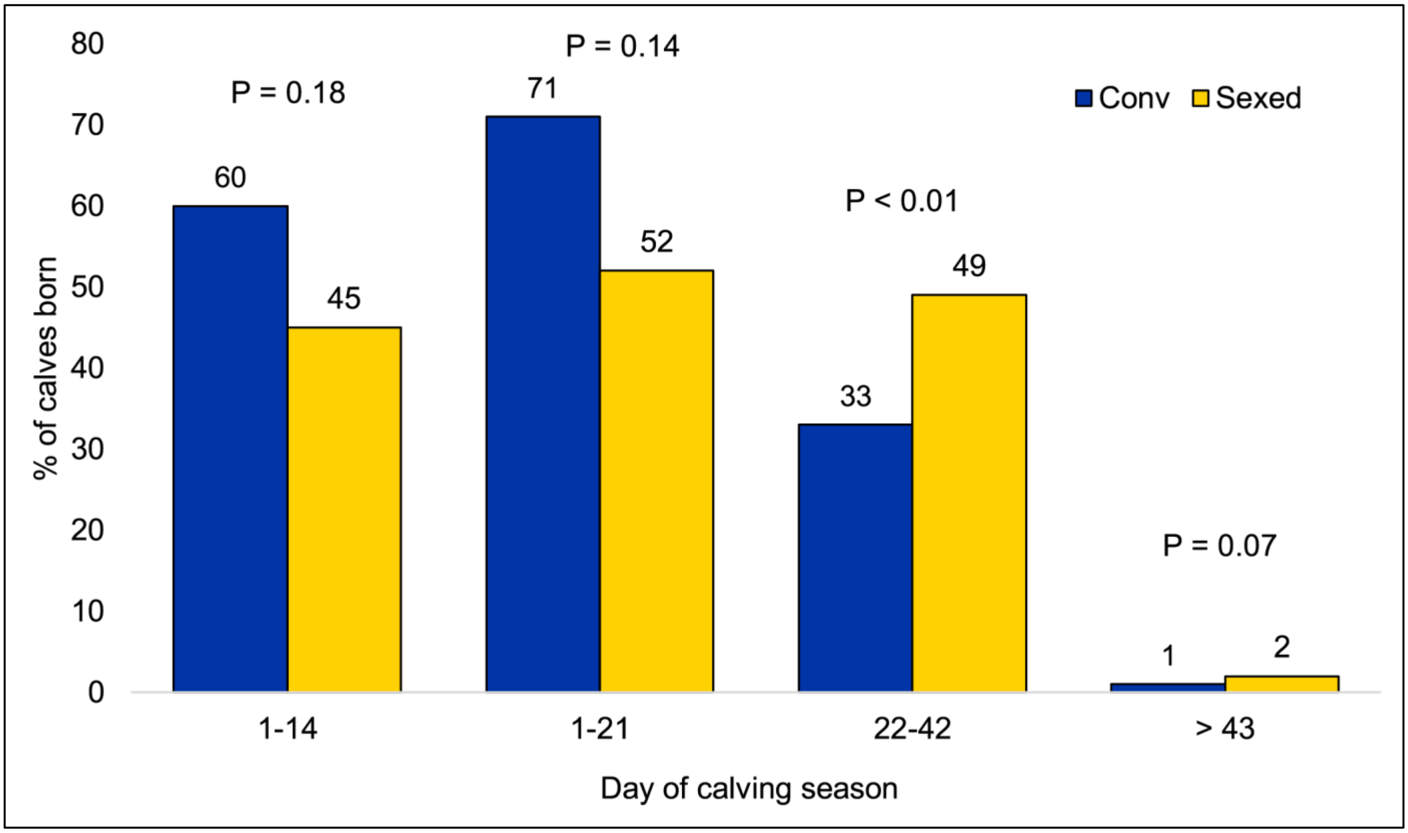


**Figure 3.** Influence of artificial insemination with conventional semen (CONV) or gender-skewed (SEXED) semen on calving distribution.

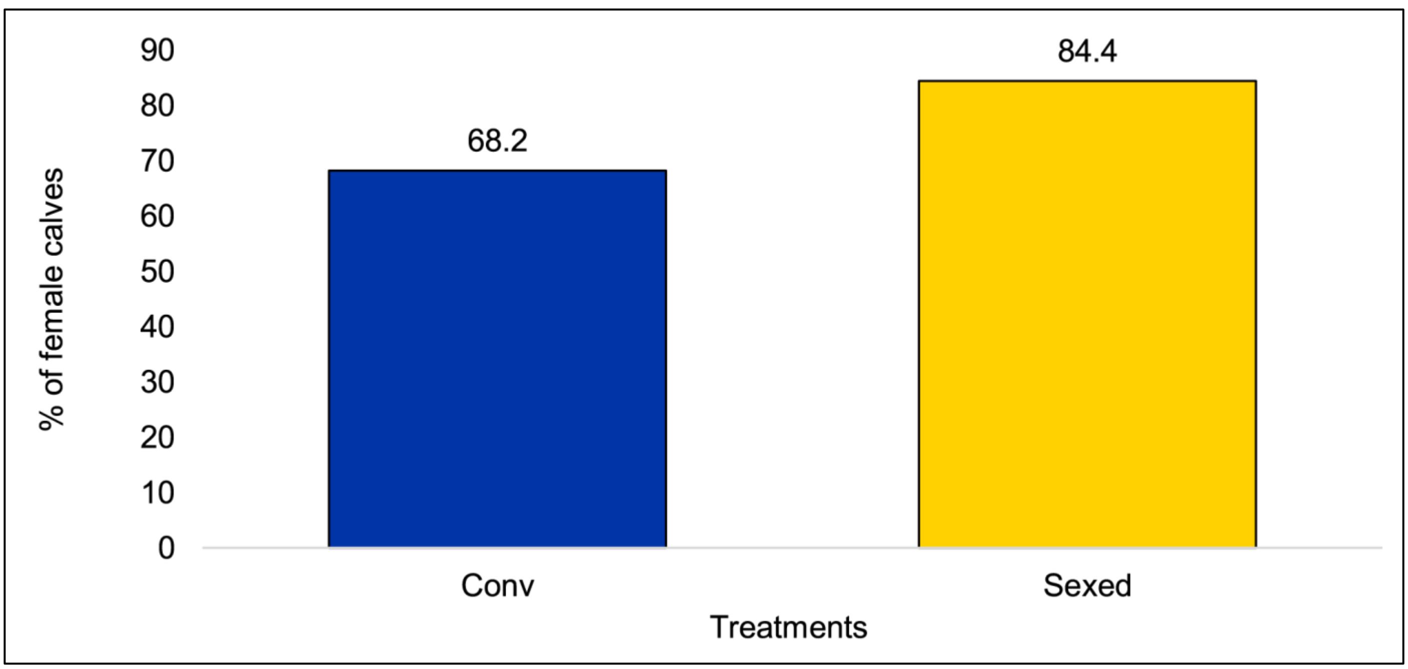


**Figure 4.** Influence of artificial insemination with conventional semen (CONV) and gender-skewed (SEXED) semen on gender distribution ($P < 0.01$).

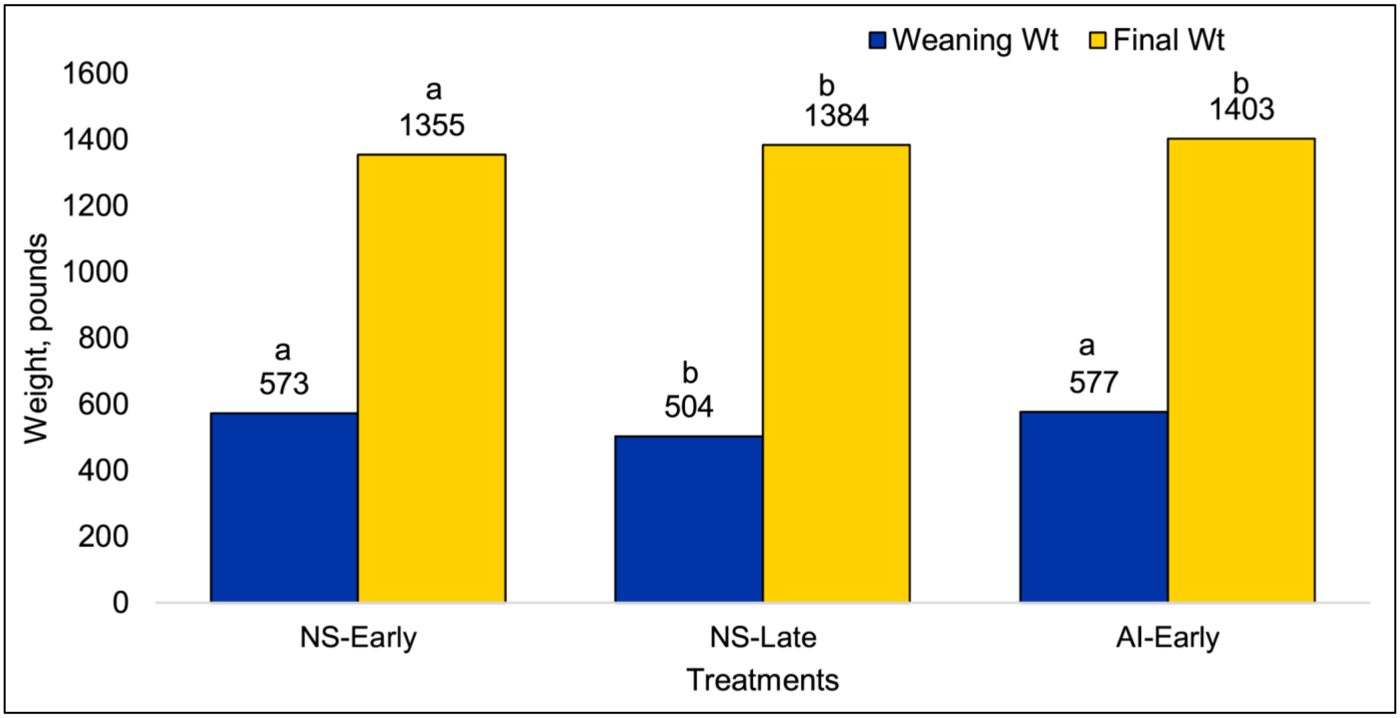


**Figure 5.** Influence of birth timing and insemination method on weaning (P < 0.0001) and final harvest (P < 0.01) weights. [ab]Different superscripts within a variable indicate a difference between treatment (P < 0.05).

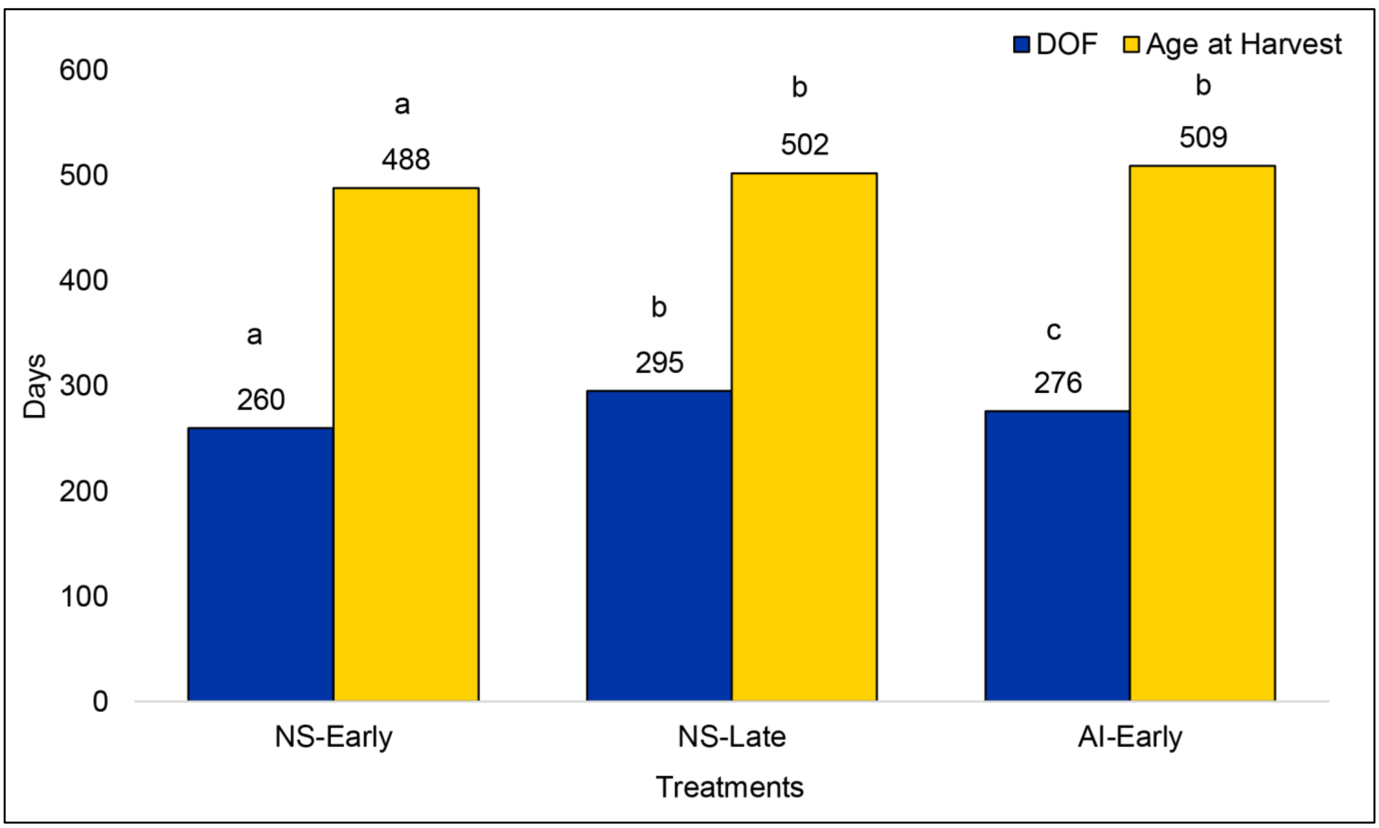


**Figure 6.** Influence of treatment on days on feed (DOF; P < 0.001) and age at harvest (P < 0.02). [abc]Different superscripts within a variable indicate a difference between treatments (P < 0.05).