Applied Animal Science 40:191–198
https://doi.org/10.15232/aas.2023-02399

PRODUCTION AND MANAGEMENT: *Original Research*

Effects of short-term nutritional increase before artificial insemination on average daily gain and reproductive efficiency in March-calving beef heifer development systems

L. F. Tadich,[1] R. E. S. Rogers,[2] and R. N. Funston,[1*] PAS
[1]West Central Research and Extension Center, Department of Animal Science, University of Nebraska, North Platte, NE 69101; and [2]Department of Statistics, University of Nebraska, Lincoln, NE 68583

ABSTRACT

Objective: Our objective was to evaluate increased nutritional energy before AI on BW, ADG, and reproductive efficiency in heifers developed on range or in a drylot.

Materials and Methods: A 3-yr study used Angus crossbred heifers (n = 100/yr) near North Platte, Nebraska. Heifers were stratified by BW and assigned to 1 of 3 treatments. During winter development (131 ± 3.5 d/yr), heifers grazed upland range (RANGE) or were fed a drylot diet in 2 pens with a targeted gain of 0.68 kg/d to achieve 65% of mature BW (6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed, and 0.34 kg/head per day supplement). Thirty-three days before AI, one drylot group remained on this diet (DLLO) while the other (DLHI) received an additional 4.08 kg/head per day wet corn gluten feed. Heifers developed on RANGE received 0.45 kg/head per day of a 29% CP, dried distillers grain–based pellet until 38 d before AI, when they were fed the DLLO diet.

Results and Discussion: Prebreeding BW was greater for DLHI (375 ± 3.4 kg) and DLLO (363 ± 3.4 kg) compared with RANGE (312 ± 3.4 kg), but breeding ADG was greater for RANGE (0.69 ± 0.01 kg) compared with DLHI (0.35 ± 0.02 kg) and DLLO (0.37 ± 0.02 kg). Pregnancy rates to AI were similar among DLHI (69%), DLLO (63%), and RANGE (49%); final pregnancy rates tended to be different: DLHI (96%), DLLO (95%) and RANGE (84%). Calving rate and calving in the first 21 d was similar.

Implications and Applications: Greater nutrient and energy intake for DLHI and DLLO led to greater BW and ADG compared with RANGE, but short-term nutritional increase had no effect on pregnancy rate to AI nor final pregnancy rates.

Key words: compensatory gain, heifer development, nutrition, puberty, reproduction

INTRODUCTION

The USDA reported 19.8 million beef heifers in the United States, with 5.61 million labeled as replacement heifers (USDA, National Agricultural Statistics Service, 2023). Heifer development systems represent a crucial part of the beef industry, affecting its genetics, efficiency of the system, and economic impact on the producer. The greatest costs for cow-calf producers include feed costs and heifer development. Heifers developed to reach puberty earlier are more likely to conceive sooner and experience reproductive longevity (Short and Bellows, 1971; Perry and Cushman, 2013). Reproductive efficiency commonly refers to a heifer's ability to attain pregnancy and birth a calf within a producer's desired calving interval and maintain this year to year. The goal of this study was to investigate heifer development systems that allow for decreased inputs without compromising reproductive success. Springman et al. (2017) evaluated BW, ADG, and reproductive efficiency in heifers developed for 160 d. Treatments included (1) corn residue and range, (2) winter range, (3) drylot low (12% wet corn gluten feed [**WCGF**] on a DM basis), and (4) drylot high (21% WCGF on a DM basis). Despite drylot heifers developing on greater energy diets and achieving greater ADG, no differences were seen in AI or final pregnancy rate. Another study by Funston and Larson (2011) showed little difference in reproductive performance between heifers developed in a drylot or on range, despite differences in ADG and BW. It is understood that an increase in plane of nutrition and body condition at critical time points promotes cyclicity, puberty attainment, and lifelong reproductive efficiency (Bergfeld et al., 1994). The minimum threshold of inputs to acquire optimal pregnancy rates and development of productive cows is less clear. Furthermore, compensatory gain and grazing behavior can contribute to a heifer's ability to

The authors have not declared any conflicts of interest.
*Corresponding author: rick.funston@unl.edu

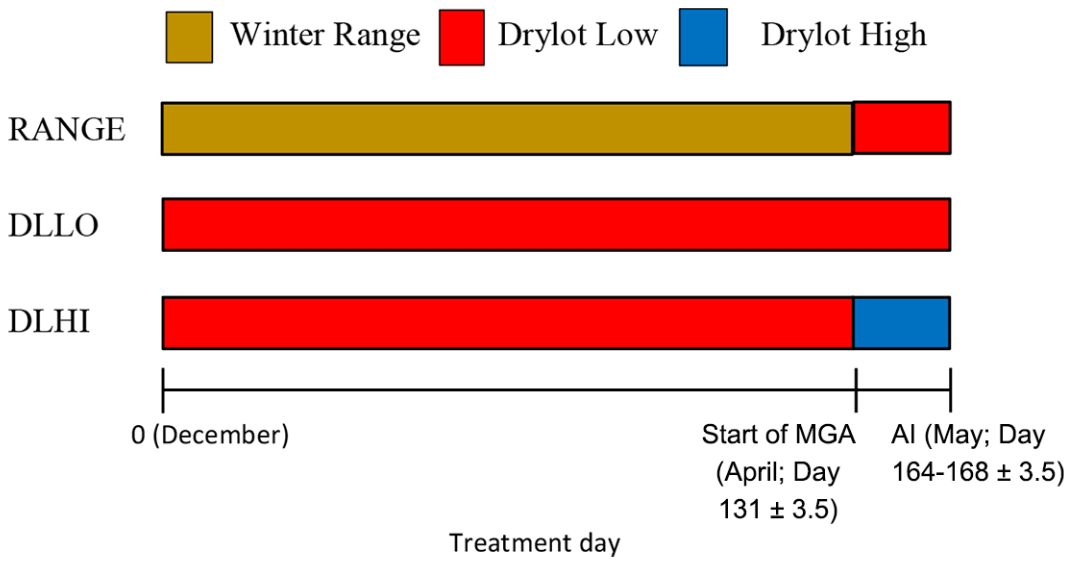

Figure 1. Time period heifers grazed winter range (RANGE; brown), were provided the lesser energy drylot diet (DLLO; red), or were provided the greater energy drylot diet (DLHI; blue) during the development and treatment periods after a 30-d receiving period and before commingling with bulls on spring range. Heifers on RANGE received the equivalent of 0.45 kg/head per day of 29% CP dried distillers grain–based pellets while grazing winter range for 131 ± 3.5 d until they were moved into the drylot 38 d before AI when they were provided 6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed (WCGF; 60% DM), and 0.34 kg/head per day supplement. Heifers on DLHI and DLLO were placed in the drylot for the duration of the development period and synchronization. They were provided 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement diet until 33 d before AI when DLHI received an additional 4.08 kg/head per day of WCGF (60% DM) and DLLO continued the development diet. MGA = melengestrol acetate.

achieve puberty and become pregnant in a timely manner (Funston et al., 2012). Synchronization using melengestrol acetate (**MGA**) requires heifers to be supplemented before AI. Therefore, evaluating the effects of increased energy during this period among heifers developed under different strategies could determine whether these development strategies increases reproductive efficiency.

MATERIALS AND METHODS

All procedures and facilities were approved by the University of Nebraska–Lincoln Institutional Animal Care and Use Committee (IACUC Project 2129).

Heifer Development

A 3-yr study beginning in 2018 used Angus crossbred heifers (n = 100/yr) at the West Central Research and Extension Center in North Platte, Nebraska. Following a 30-d acclimation period, heifers were blocked by BW and randomly assigned to 1 of 3 winter development groups (Figure 1). Heifers remained in their assigned treatment groups throughout the development and synchronization periods until they were moved to pasture as one group after AI. During the winter development period from November to April (131 ± 3.5 d/yr), heifers were assigned to either upland range (**RANGE**, n = 34/yr) or fed the same drylot diet in 2 separate pens with a targeted gain of 0.68 kg/d to achieve 65% of their mature BW. Heifers developed on RANGE grazed upland winter range during the winter development period and were provided the equivalent of 0.45 kg/head per day of a 29% CP, dried distillers grain–based pellet containing 80 mg/head per day monensin until 38 d before AI. The synchronization period represents the 33-d synchronization protocol before AI. During this time, one drylot group remained on the development diet (**DLLO**; 6.35 kg/head per day hay, 2.27 kg/head per day WCGF [60% DM], and 0.34 kg/head per day supplement) while the other (**DLHI**) received an additional 4.08 kg/head per day WCGF (6.35 kg/head per day hay, 6.35 kg/head per day WCGF [60% DM], and 0.34 kg/head per day supplement). Both drylot diets contained 200 mg/head per day monensin. Heifers on RANGE entered the third drylot pen and were provided the same diet as the DLLO group for a total of 38 d. Following each day of AI in May, heifers were placed on upland spring range and consolidated as one group after d 6 of heat detection.

Average diet composition and nutrient analysis for the diets and heifer supplement during the synchronization treatment period before AI are presented in Table 1. All feed samples were sent to Ward Laboratories Inc. (Kearney, NE) for nutrient analysis. As adapted from Springman et al. (2017), range warm-season grass species consisted of little bluestem (*Schizachyrium scoparium* [Michx.] Nash), big bluestem (*Andropogon gerardii* Vitman), sideoats grama (*Bouteloua curtipendula* [Michx.] Torr.), blue grama (*Bouteloua gracilis* (Willd. ex Kunth) lag. ex Griffiths), and switchgrass (*Panicum virgatum* L.). Primary cool-season grasses were Scribner's panicum (*Dichanthelium oligo-*

santhes [Schult.] Gould var. *scribnerianum* [Nash] Gould), western wheatgrass (*Agropyron smithii* Rydb.), and needle and thread (*Stipa comata* Trin. & Rupr.). Cheatgrass (*Bromus tectorum* L.), smooth bromegrass (*Bromus inermis* L.), and Kentucky bluegrass (*Poa pratensis* L.) were introduced grass species. During the winter development period, RANGE heifers would have grazed both dormant cool- and warm-season grasses with limited cool-season forage growth available late in the development period. This late-spring growth of cool-season grasses would be variable with temperature and precipitation.

Before synchronization, heifers were bled via coccygeal venipuncture 10 d apart into glass vacutainer blood collection tubes (Becton, Dickinson and Company, Franklin Lakes, NJ) containing 12 mg of EDTA and placed on ice. Collections occurred in early and mid-April, before the start of the synchronization protocol. Progesterone (**P4**) assays were performed in 2018 and 2019 (n = 200) to determine puberty status. Samples were lost in yr 3. As described by Nafziger et al. (2021), blood samples were centrifuged at ~700 × *g* and 4°C for 30 min. Plasma was removed and stored in polypropylene tubes (Globe Scientific Inc., Paramus, NJ) at −20°C within 5 h of collection. Plasma sample P4 concentration was detected using radioimmunoassay. Samples were assayed in duplicate, and the average of the duplicates was recorded as the P4 concentration for that sample. Duplicates with a coefficient of variation greater than 15% were re-analyzed. Progesterone concentrations were determined using the ImmuChem Coated Tube Progesterone 125I RIA kit (ICN Pharmaceuticals Inc., Costa Mesa, CA). Inter- and intra-assay CV were 10.41% and 7.89%, respectively. Heifers with blood plasma progesterone concentrations greater than or equal to 1 ng/mL were considered pubertal. Puberty rate was calculated by dividing the number of pubertal heifers by the number of treated heifers in 2018 and 2019.

Heifers were synchronized with the melengestrol acetate–prostaglandin $F_{2\alpha}$ (**PG**) heat detection and AI protocol. Each heifer received 0.5 mg/d MGA pellets (Zoetis, Florham Park, NJ) for 14 d beginning in late April in addition to the diets provided in Table 1. Nineteen days following MGA withdrawal, heat detection aids (Estrotect, Rockway Inc., Spring Valley, WI) were applied and 2 mL of PG (12.5 mg/mL; Lutalyse Highcon, Zoetis, Florham Park, NJ) was administered intramuscularly. This 33-d period of synchronization represents the time frame for diet treatments with RANGE heifers having an additional 5 d of acclimation before the start of synchronization. Detection of estrus followed PG administration for 5 d twice daily. Estrus was characterized by either exhibiting standing estrus or at least 50% of the Estrotect coat being removed. Heifers exhibiting estrus were AI 12 h later. All heifers were placed with bulls 10 d following AI on native upland range at a 1:50 bull-to-heifer ratio for a 60-d breeding period. Rate of estrus after PG administration was calculated by dividing the number of heifers detected expressing estrus by the number of treated heifers. Those heifers that did not express estrus within 6 d following the first PG administration were recorded, administered PG a second time, and then immediately placed with bulls but were not AI. Pregnancy diagnosis to AI was conducted via transrectal ultrasonography (ReproScan, Winterset, IA) 45 d following AI. Pregnancy rate to AI was calculated by dividing the number of pregnant heifers by the number of treated heifers, including those that did not express estrus and were not AI. Forty-five days after the bulls were removed, a second pregnancy diagnosis determined final pregnancy rate. Final pregnancy rate was calculated by dividing the total number of pregnant heifers by the number of treated heifers. All BW were recorded before feeding in the morning. Time points of interest for BW included the following: initial BW at the start of the development period (December), postdevelopment BW at the end of the development period (average BW between the 2 P4 blood collections in April or end of development period BW [2020]), prebreeding BW at PG administration after the synchronization

Table 1. Drylot diets of beef heifers during the 33-d synchronization treatment period (DM basis)

Item	RANGE,[1] DLLO[2]	DLHI[3]
Ingredient, %		
Hay	77	57
Wet corn gluten feed	19	40
Heifer supplement[4]	4	3
Nutrient analysis, %		
DM	78	72
CP	13	15
TDN	62	71

[1]The RANGE heifers were offered the equivalent of 0.45 kg/head per day of 29% CP dried distillers grain–based pellets, containing 80 mg/head per day monensin, while grazing winter range 131 ± 3.5 d/yr until they were moved into the drylot 38 d before AI and received 6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed (WCGF; 60% DM), and 0.34 kg/head per day supplement.

[2]DLLO heifers were developed in the drylot 131 ± 3.5 d/yr and continued through estrous synchronization and AI receiving 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement.

[3]DLHI heifers were developed in the drylot 131 ± 3.5 d/yr and received 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement diet until 33 d before AI when they were provided an additional 4.08 kg/head per day of WCGF (60% DM).

[4]Supplement = dry-rolled corn (81.35% of supplement, DM basis); limestone (11.11%); iodized salt (5.55%); trace mix (1.39%); Rumensin-90 (0.37%; 200 mg/head per day; Elanco, Greenfield, IN); and vitamins A, D, and E (0.22%).

Table 2. Effect of nutritional increase on ADG during a 33-d synchronization treatment period in beef heifers

Item	RANGE[1]	DLLO[2]	DLHI[3]	SEM[4]	*P*-value
n[5]	3	3	3		
Initial BW, kg	219	218	219	4.75	0.96
Postdevelopment BW,[6] kg	288[b]	337[a]	336[a]	14.67	0.01
Development ADG (131 d), kg	0.26[b]	0.64[a]	0.64[a]	0.065	0.02
Prebreeding BW, kg	312[b]	363[a]	375[a]	11.18	<0.01
Percentage of mature BW,[7] %	57[b]	66[a]	68[a]	2.0	<0.01
Synchronization ADG (33 d), kg	0.67	0.75	1.13	0.127	0.12
AI pregnancy diagnosis BW, kg	351[b]	385[a]	395[a]	13.37	<0.01
Final pregnancy diagnosis BW, kg	413[b]	442[a]	448[a]	8.84	<0.01
Breeding ADG,[8] kg	0.69[b]	0.38[a]	0.35[a]	0.076	<0.01

[a,b]Means in a row with different superscripts differ using a Tukey adjustment ($P \leq 0.05$).

[1]RANGE = each heifer received the equivalent of 0.45 kg/head per day of 29% CP dried distillers grain–based pellets while grazing winter range 131 ± 3.5 d/yr until they were moved into the drylot 38 d before AI and received 6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed (WCGF; 60% DM), and 0.34 kg/head per day supplement.

[2]DLLO = heifers were developed in the drylot 131 ± 3.5 d/yr and continued through estrous synchronization and AI receiving 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement.

[3]DLHI = heifers were developed in the drylot 131 ± 3.5 d/yr and received 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement diet until 33 d before AI when they were provided an additional 4.08 kg/head per day of WCGF (60% DM).

[4]Standard error of the difference between 2 LSM.

[5]Represents the number of replications; 1 yr = 1 replication.

[6]Body weight following the development period before the synchronization treatment period.

[7]Percentage of mature BW at prebreeding based on mature cow size of 544 kg.

[8]The ADG between prebreeding and first pregnancy diagnosis.

treatment period (May), and at AI and final pregnancy diagnosis (July and September). Reported ADG include the following: development ADG between the start and end of the development period, synchronization ADG between postdevelopment and prebreeding, and breeding ADG between prebreeding and AI pregnancy diagnosis. Percent mature BW was calculated from the prebreeding BW and based on a mature cow weight of 544 kg reported by the producer from whom the heifers were purchased. Calving rate was calculated by dividing the number of heifers that gave birth to a live calf by the number of treated heifers. Calving rate in the first 21 d included all calves born after the first live calf birth divided by the number of treated heifers and is strongly influenced by pregnancy rate to AI.

Experimental Design and Statistical Analysis

This experiment was treated as randomized complete block design with year as the block. All analyses were conducted using the GLIMMIX procedure of SAS 9.4 (SAS Institute Inc., Cary, NC). The statistical model included the fixed effects of treatment, random year, and treatment by year effects. Each year, heifers within a treatment group were managed as a single group so treatment group × year was the experimental unit. Therefore, the error term to test for treatment effect was tested over the random treatment by year effect. Response variables included BW recorded throughout the study, ADG during each phase of the study, puberty attainment rate, percentage expressing estrus, pregnancy rate to AI, final pregnancy rate, calving rate, and first-21-d calving rate. Response variables related to weight were assumed to follow a normal distribution, whereas response variables related to pregnancy, percent pubertal, percent expressing estrus, and calving rates were assumed to follow a binomial distribution. A P-value ≤ 0.05 was considered significant, and a P-value between 0.05 and 0.10 was considered a tendency. All data are reported as LSM, which were separated using Tukey's adjustment.

RESULTS AND DISCUSSION

Heifer BW and ADG are reported in Table 2, and reproductive performance is summarized in Table 3. Heifer ADG

Table 3. Effect of nutritional increase on reproductive performance during a 33-d synchronization treatment period in beef heifers

Item	RANGE[1]	DLLO[2]	DLHI[3]	*P*-value
n[4]	3	3	3	
Percentage cycling,[5] %	14	62	24	0.16
Detection of estrus,[6] %	70	93	89	0.07
AI pregnancy (100 per trt),[7] %	49	63	69	0.34
Final pregnancy,[8] %	84	95	96	0.09
Calving rate,[9] %	77	85	93	0.11
Calved in first 21 d,[10] %	42	41	55	0.23

[1]RANGE = each heifer received the equivalent of 0.45 kg/head per day of 29% CP dried distillers grain–based pellets while grazing winter range 131 ± 3.5 d/yr until they were moved into the drylot 38 d prior AI and received 6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed (WCGF; 60% DM), and 0.34 kg/head per day supplement.

[2]DLLO = heifers were developed in the drylot 131 ± 3.5 d/yr and continued through estrous synchronization and AI receiving 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement.

[3]DLHI = heifers were developed in the drylot 131 ± 3.5 d/yr and received 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement diet until 33 d before AI when they were provided an additional 4.08 kg/head per day of WCGF (60% DM).

[4]Represents the number of replications; 1 yr = 1 replication.

[5]Percentage of heifers with ≥1 ng/mL of progesterone in at least 1 of 2 blood samples taken 10 d apart before the synchronization period.

[6]Percentage of treated heifers that expressed estrus after estrous synchronization.

[7]Percentage of treated heifers that were successfully bred to AI.

[8]Percentage of treated heifers that became pregnant to AI or access to bulls for 60 d following AI.

[9]Percentage of treated heifers that gave birth to a live calf.

[10]Percentage of treated heifers that gave birth to a live calf within the first 21 d of the first live birth.

among DLLO and DLHI heifers was greater ($P = 0.02$ and $P = 0.03$, respectively) than that of RANGE during the development period (131 ± 3.5 d/yr), but there were no differences observed in ADG during the 33-d synchronization treatment period ($P = 0.12$) among DLHI, DLLO, and RANGE. Given that the DLHI diet had greater CP (15.42% DM) and TDN (70.56% DM) compared with the 12.84% CP and 62.18% TDN received by the RANGE and DLLO groups during synchronization (Table 1), significant differences may be seen with more treatment replications. As seen in Table 4, there was variation by year in ADG of RANGE heifers, which affected the current study's ability to identify differences in ADG for this time period. In the years that heifers on RANGE gained less BW during the development period, greater ADG were seen during the synchronization period and vice versa, illustrating how range conditions affect ADG and compensatory gain year to year. Prebreeding BW was greater ($P < 0.01$) for DLHI and DLLO compared with RANGE. However, breeding ADG, the time period between prebreeding and first pregnancy diagnosis, was greater ($P < 0.01$) for RANGE compared with DLHI and DLLO. This may be attributed to compensatory gain, grazing behavior, and metabolic differences in the heifers developed on range compared with heifers developed in the drylot. In a study by Sprinkle et al. (2020), heifers characterized as having less residual feed intake were found to lose less weight and more adequately maintain their BCS while out on Idaho range later in life when compared with their greater intake counterparts. Changes in pubertal attainment due to nutritional status were reported by Cardoso et al. (2014) following weaning in a stair-step nutritional regimen, which coincides with the influence of diet and metabolic status on BW and reproductive efficiency.

In the current study, no differences were seen in the percentage of heifers cycling among treatment groups (Table 3). The number of heifers cycling was dramatically less than expected, based on previous studies in our laboratory, especially when compared with the percentage of heifers that expressed estrus and the percentage of heifers that became pregnant. Variation among the 2 yr of samples may have led to no significant differences despite numerically greater numbers of DLLO heifers cycling. The reason for these numerical differences is unknown given the similar environment and nutrition among DLLO and DLHI heifers when samples were collected. Studies have shown that MGA may induce pubertal attainment, and this may play a part in the results shown (Jaeger et al., 1992; Martin et al., 2008). Compared with RANGE, there was a tendency ($P = 0.07$) for more DLLO and DLHI heifers to express estrus after synchronization, but there were no significant differences in average pregnancy rates to AI among DLHI (69%), DLLO (63%), or RANGE (49%) over the course of the 3-yr study (Table 3). The percentage of RANGE heifers expressing estrus was far less in 1 yr of the study compared with the others as depicted in Figure 2A. This led to fewer heifers receiving AI and lesser pregnancy rates to AI in the same year (Figure 2B), but this difference was not repeated in subsequent replications of treatment. Variation in pregnancy rates to AI among different years could be the result of adverse conditions of the range environment but is difficult to assess, with multiple factors contributing to the conditions experienced by heifers on winter range. It is unclear why these values do not reflect the percentage of heifers cycling, especially for DLHI heifers. The same variation among years is not seen in the final pregnancy rate (Figure 2C). The percentage of heifers calving in the first 21 d was, however, decreased among 2018 heifers that were developed in a drylot (Figure 2D). Given that all heifers grazed spring and summer range following AI, this further brings into question the condition of the range environment during that year of the study and the effect it may have had on early embryonic development, but there are no data from this time point to validate or refute this conclusion. It has been shown that cold stress and adverse environment may affect fertility in cattle (Gwazdauskas, 1985). Displayed in Figure 3 is the average daily temperature and average monthly precipitation during the winter development periods of the current study. Although the first year of the study appears to be one of the colder years, there are no clear associations with weather and decreased reproductive performance, and the cause of those differences is unknown. Precipitation the summer before the winter development period could have affected the amount of stockpiled dormant forages available during the winter to RANGE heifers, but no data are available from these time points at the area of the current study. Nutritional inputs provided to drylot groups may result in more consistent pregnancy rates to AI over multiple years, but poor summer grazing range environment may be detrimental to heifers conditioned to greater nutritional inputs before AI. There was a tendency for final pregnancy rates to be different ($P = 0.09$) among DLHI (96%), DLLO (95%), and RANGE (84%; Table 3). This is most likely the result of limitations put forth by the current study when pertaining to the number of experimental units. Despite a tendency, the numerical differences seen in final pregnancy rates and the resulting calving rate is an important factor to consider. The current study shows that the number of calves born may be less in heifers that were developed on range, especially during certain years. This is an important economic consideration for producers. Understanding the variation in development systems and year can have a significant effect on a cow-calf operation.

Table 4. Effect of nutritional increase on ADG during a 33-d synchronization treatment period by year of study in beef heifers

Item	RANGE[1]	DLLO[2]	DLHI[3]
Development ADG, kg			
Yr 1	0.15	0.68	0.74
Yr 2	0.19	0.57	0.56
Yr 3	0.44	0.68	0.61
Synchronization ADG, kg			
Yr 1	0.98	0.83	1.05
Yr 2	0.74	0.84	1.12
Yr 3	0.30	0.59	1.22

[1]RANGE = each heifer received the equivalent of 0.45 kg/head per day of 29% CP dried distillers grain–based pellets while grazing winter range 131 ± 3.5 d/yr until they were moved into the drylot 5 d before the start of synchronization and received 6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed (WCGF; 60% DM), and 0.34 kg/head per day supplement.

[2]DLLO = heifers were developed in the drylot 131 ± 3.5 d/yr and continued through estrous synchronization and AI receiving 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement.

[3]DLHI = heifers were developed in the drylot 131 ± 3.5 d/yr and received 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement diet until 33 d before AI when they received an additional 4.08 kg/head per day of WCGF (60% DM).

APPLICATIONS

Ultimately, greater dietary protein and energy for DLHI and DLLO heifers led to greater BW and ADG, but overall short-term nutritional increase had no detectable effect on pregnancy rate to AI nor final pregnancy rates across heifer development systems. These findings illustrate that some years may have a suitable range environment adequate for developing spring calving heifers through winter. When evaluating the best heifer development system, these data may encourage producers to evaluate current development systems and develop heifers on range or decrease the time spent in a feed lot to reduce cost. Conversely, in some years, heifers developed on

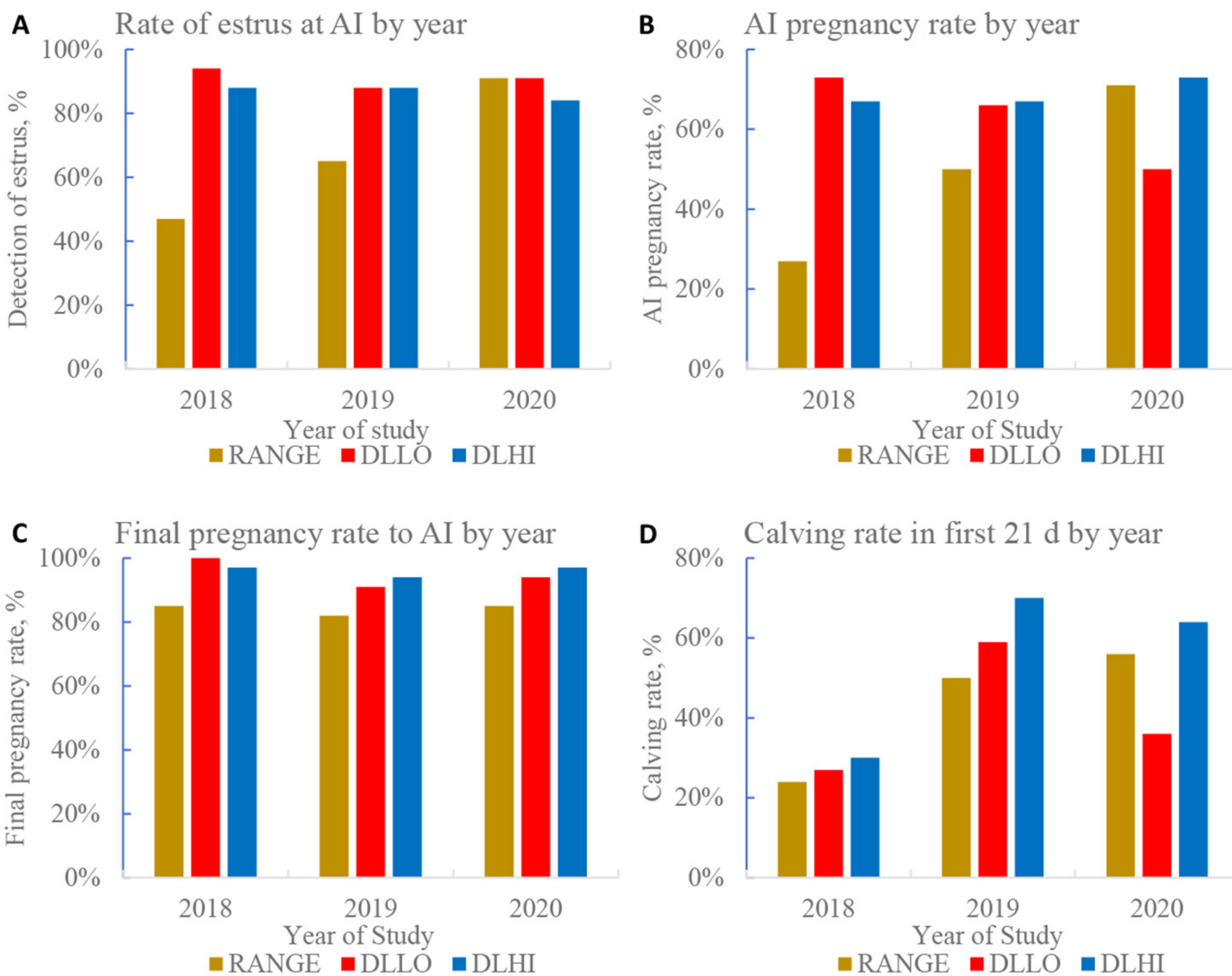

Figure 2. Rate of estrus at AI by year (A), AI pregnancy rates by year (B), final pregnancy rates by year (C), calving rate in the first 21 d by year (D). RANGE (brown) heifers received the equivalent of 0.45 kg/head per day of 29% CP dried distillers grain–based pellets while grazing winter range 131 ± 3.5 d/yr until they were moved into the drylot 38 d before AI when they were provided 6.35 kg/head per day hay, 2.27 kg/head per day wet corn gluten feed (WCGF; 60% DM), and 0.34 kg/head per day supplement; DLLO (red) heifers were provided 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement for the development and synchronization period; DLHI (blue) heifers received 6.35 kg/head per day hay, 2.27 kg/head per day WCGF (60% DM), and 0.34 kg/head per day supplement diet until 33 d before AI when they were provided an additional 4.08 kg/head per day of WCGF.

range may have decreased final pregnancy rates resulting in fewer calves born. This, in addition to rebreeding rates the following year, should be considered when a producer is evaluating the best development strategies for their operation. Development strategies involving increased levels of nutrition over longer time periods may improve pregnancy rates to AI despite the current study's ability to display those differences. It should be kept in mind that the direct cause of numerically decreased pregnancy rates in RANGE heifers the first year of the study is unknown, and a negative effect originating from lower levels of nutrition over the development period or from moving into the drylot is a possibility. There are major environmental and economic considerations when deciding the best heifer development strategies for an operation. Further investigation into the effects certain weather events may have on range conditions and heifer performance would lead to a better understanding of this topic.

ACKNOWLEDGMENTS

The authors extend thanks to Zoetis for providing Lutalyse HighCon (Florham Park, NJ); Estrotect (Rockway Inc., Spring Valley, WI) for providing estrus detection patches; and Jim Teichert, our beef herds person, for providing health and nutritional treatment to the heifers.

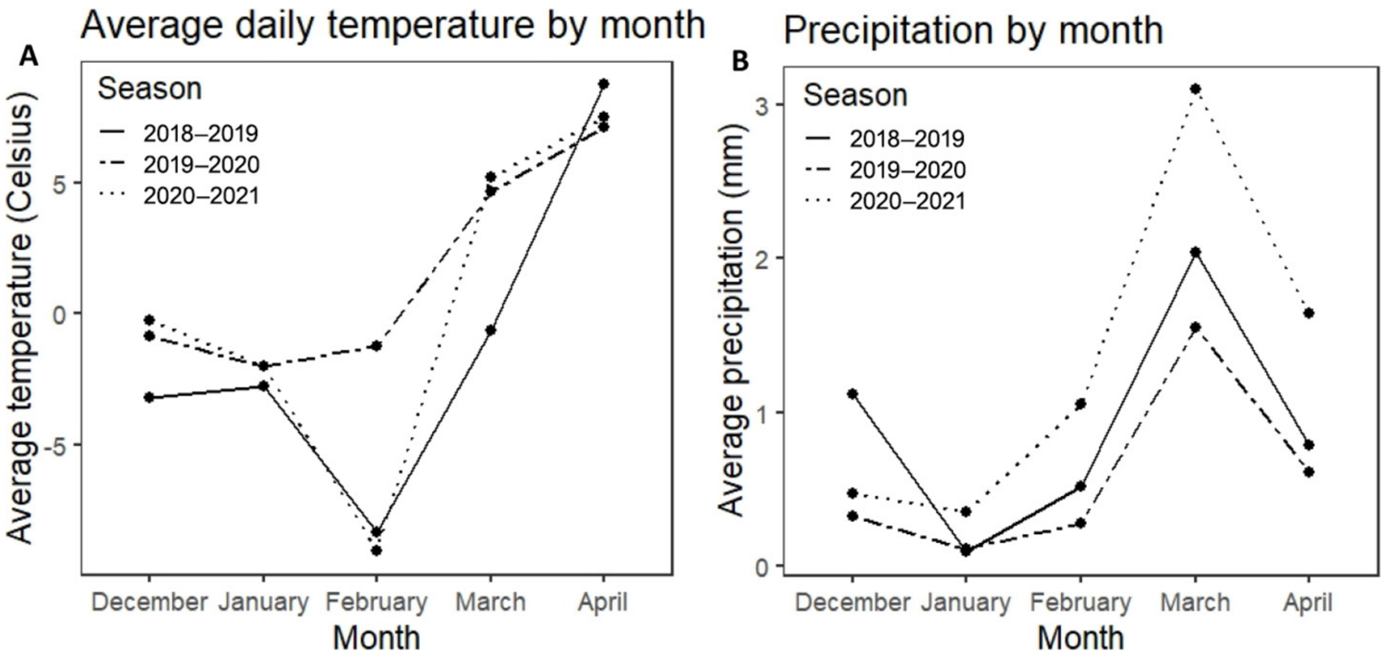

Figure 3. Average daily temperature (A) and average precipitation (B) by month during the winter development period of the current study (fall 2018–spring 2021) at the University of Nebraska West Central Research and Extension Center.

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ORCIDS

R. E. S. Rogers https://orcid.org/0000-0002-4145-9630
R. N. Funston https://orcid.org/0000-0003-1713-6804