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Effect of Wintering System and Nutrition around Breeding on Gain and Reproduction in Heifers

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Summary

Replacement heifers were developed using corn stalks (Experiments 1 and 2), winter range (Experiment 1), or a dry lot (Experiment 2) with or without a high energy supplement around breeding. Corn stalk development reduced ADG and the percentage pubertal prior to breeding; however, neither first service conception nor pregnancy rates were affected. High energy supplemental nutrition around breeding tends to improve first service conception. Corn stalk development does not appear to negatively impact reproduction, although it resulted in lighter calf birth weight compared to winter range.

Introduction

The paradigm of developing replacement heifers to target 65% of mature body weight by breeding is costly and unrealistic for some producers. There is increasing interest in lower cost, lower gain development. Funston and Deutscher (*Journal of Animal Science, 2004,* 82:3094) indicated heifers reaching only 53% of mature body weight by breeding did not differ in pregnancy rate when compared to heifers developed to 58% of mature body weight. However, the effect of developing replacement heifers using corn stalks or dormant winter pasture on first service conception rate is unknown. Furthermore, supplementation offered to nutritionally restricted multiparous females prior to breeding improved embryo survival (Khireddine et al., *1998 Theriogenelogy,* 49:1409). Therefore, the current study evaluated the effect of low cost development with additional nutrition around the time of breeding on first service conception rate, pregnancy rate, and first calf production characteristics.

Procedure

All procedures were approved by the University of Nebraska Institutional Animal Care and Use Committee. Two studies were conducted: Experiment 1 was conducted at Gudmundsen Sandhills Laboratory, Whitman, Neb.; Experiment 2 was conducted at the West Central Research and Extension Center, North Platte, Neb.

Experiment 1

Weaned heifer calves (n = 96) were blocked by initial BW (489 ± 7 lb) and assigned randomly to graze either corn stalks (Stalk) or dormant native Sandhills Range from November through March. The heifers were weaned at an average age of 209 days and began treatment at an average age of 240 days. A daily supplement was offered (1 lb/head; Table 1). Both the Stalk and Range groups grazed for a period of 138 days. Subsequently, all heifers were recombined and grazed a common pasture for 48 days with a daily supplement (1 lb/head; Table 1). After the 48-day grazing period, heifers were reassigned to breeding treatments within winter development treatment randomly by BW. The breeding treatments included offering heifers a supplement (S; 3 lbs/day, Table 1) 7 days prior to and for 14 days following prostaglandin injection or not offering a supplement (NS). Body weight was measured after 138, 160, and 170 days on trial for both the Stalk and Range groups. Two blood samples were collected 26 and 14 days prior to PGF injection. Progesterone concentrations were quantified using radioimmunoassay and concentrations > 1 ng/ml were interpreted to indicate luteal activity and hence, attainment of puberty.

Table 1. Formulation of supplement offered while grazing for Experiments 1 and 2.

Item	DM%
Dried distillers grain	62
Wheat midds	11
Cottonseed meal	9
Corn gluten feed	5
Cane molasses	5
Other[a]	8

[a]Provided 80 mg/day of monensin.

Estrus was synchronized using a single injection of PGF (day 0). A progestin was not used to avoid confounding the effect of winter development on age at puberty. Five days prior to PGF, fertile bulls were turned in with both groups of heifers for a period of 45 days. The heifers were recombined after the supplementation period. Pregnancy rate was determined via transrectal ultrasonography 40 days after bull removal. At approximately 23 months of age, heifers were weighed and BCS was assessed. At parturition, calf birth date, birth weight, calving ease score, and sex were recorded.

The heifer weight, ADG, calf birth date, birth weight, and calving ease score data were analyzed using Proc Mixed of SAS. The interactions between winter development and supplemental nutrition were found to be insignificant and will not be presented. In addition, percentage of heifers pubertal, pregnancy rate, and calf sex were analyzed using a Chi-square analysis with Proc Freq of SAS.

Experiment 2

Weaned heifer calves (n = 99) were blocked by initial BW (571 ± 8 lb) and assigned randomly to graze either corn stalks (Stalk) or developed in a dry lot (Lot) from November through March. The lot heifers were fed the winter diet for 143 days (14 lb/head) and the spring diet for 45 days (15 lb/head; Table 2). A daily supplement

Table 2. Diets offered in dry lot, Experiment 2.

Item	Winter Lot	Spring Lot	Spring Stalk	HE	LE
			DM%		
Grass hay	62	57	61	57	74
Dry rolled corn	—	—	—	16	—
Corn silage	20	26	20	17	16
Dried distillers grain + solubles	13	12	13	—	—
Wet corn gluten feed	—	—	—	67	
Supplement[a]	5	5	5	3	4

[a]Provided 200 mg/day of monensin.

Table 3. Effect of wintering system and supplemental nutrition, Experiment 1.

	Range	Stalk	NS	S
n	48	48	48	48
Weight, lb				
Initial	489	492	—	—
Day 138	582[a]	536[b]	—	—
Day 170	655[a]	595[b]	—	—
Pregnancy diagnosis	802[a]	763[b]	—	—
Parturition	989	963	971	981
Daily gain, lb/day				
Prior to breeding	0.71[a]	0.44[b]	—	—
After breeding	1.57[a]	1.79[b]	1.70[x]	1.65[y]
BCS				
Pregnancy diagnosis	5.8	5.7	5.8	5.8
Parturition	5.1[x]	5.2[y]	5.2	5.1
Percent pubertal, %	72.9[a]	33.3[b]	—	—
Pregnancy rate, %	87.5	85.4	85.4	87.5
Calf birth weight, lb	73	72	73	72
Calving ease score	1.53	1.45	1.56	1.42
Bull calves/total calving	21/37	23/38	26/39	18/39
Heifer calves/total calving	16/37	15/38	13/39	18/39

[ab]Means differ, Range vs. Stalk ($P \leq 0.10$)
[xy]Means differ, NS vs. S ($P \leq 0.10$)

Table 4. Effect of wintering system and supplemental nutrition, Experiment 2.

	Lot	Stalk	HE	LE
n	49	50	50	49
Weight, lb				
Initial	571	569	—	—
Day 134	767[a]	635[b]	—	—
Day 193	912[a]	808[b]	—	—
Pregnancy diagnosis	1069[a]	1015[b]	1046	1038
Daily gain, lb/day				
Prior to breeding	1.70[a]	1.19[b]	—	—
After breeding	1.26[a]	1.63[b]	1.54[x]	1.37[y]
Percent pubertal, %	94.0[a]	46.9[b]	—	—
TAI conception rate, %	50.0	49.0	58.0[a]	40.8[b]
Pregnancy rate, %	88.0	81.6	86.0	83.7
Gestation length of TAI, day	281[x]	284[y]	282	282
Calf birth weight, lb	80	77	79	77
Calving ease score	1.46	1.40	1.47	1.39
Bull calves/total calving	26/39	21/44	24/42	23/41
Heifer calves/total calving	18/39	18/44	18/42	18/41

[ab]Means differ, Lot vs. Stalk ($P \leq 0.10$)
[xy]Means differ, HE vs. LE ($P \leq 0.10$)

was offered to the Stalk group while grazing (1 lb/head; Table 1). The Stalk heifers grazed for 134 days and were subsequently moved to the Lot for 59 days. The Lot diet for the Stalk group is described in Table 2 (14 lb/head) and was designed to target an ADG of 1 lb/day. Heifers were assigned within winter treatment by BW to receive either a high (HE) or low (LE) energy diet seven days prior to and for 12 days after timed artificial insemination (TAI). The HE diet and the LE diet compositions are described in Table 2. Body weight was assessed and blood samples were collected 62, 48, and 38 days prior to TAI. Progesterone concentrations were analyzed as described in Experiment 1.

Estrus was synchronized using an MGA/ PGF system. Beginning 36 days prior to TAI and continuing for 14 days, MGA was added to the diet. Eighteen and one-half days after MGA withdrawal, a single injection of PGF was administered and TAI was performed for both groups 60 hours after PGF. Thirteen days after TAI, fertile bulls were turned in with both groups for a period of 60 days. Transrectal ultrasonography was performed 44 days after TAI to determine first service conception rate and again approximately 50 days after bull removal to determine pregnancy rate. At parturition, calf birth date, birth weight, calving ease score, and sex were recorded.

The heifer weight, ADG, calf birth date, birth weight, and calving ease score data were analyzed using Proc Mixed of SAS. The interactions between winter development and supplemental nutrition were found to be insignificant and will not be presented. In addition, percentage of heifers pubertal, pregnancy rate, and calf sex were analyzed using a Chi-square analysis with Proc Freq of SAS.

Results

Experiment 1

Heifer performance data, puberty, and pregnancy rate are presented in Table 3. The Stalk heifers were lighter after grazing ($P < 0.001$), at PGF injection ($P < 0.001$), and at pregnancy diagnosis ($P = 0.004$) when compared to the Range heifers, although BCS at pregnancy diagnosis was not different ($P > 0.10$). The Stalk heifers also had a lower ($P < 0.001$) ADG prior to breeding compared to Range heifers. However, Stalk heifers had a greater ($P < 0.001$) ADG after breeding, which indicates compensatory gain. Supplemental nutrition did

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not affect ($P > 0.10$) weight nor BCS at pregnancy diagnosis or ADG after breeding. There were a greater ($P < 0.001$) percentage of Range heifers pubertal prior to breeding than Stalk heifers (73% vs. 33%). However, neither winter development nor supplemental nutrition affected ($P > 0.10$) overall pregnancy rate (86%).

First calf production data are presented in Table 3. Neither winter development nor supplemental nutrition affected ($P > 0.10$) BW prior to parturition. However, Stalk heifers tended to have a greater ($P = 0.06$) BCS than Range heifers. Winter development and supplement treatments did not affect ($P > 0.10$) calf birth weight, calving ease score, or sex distribution.

Experiment 2

Heifer performance, puberty, and pregnancy rate data are presented in Table 4. The Stalk heifers were lighter after grazing ($P < 0.001$), at PGF injection ($P < 0.001$), and at pregnancy diagnosis ($P = 0.003$) when compared to the Lot heifers. The Stalk heifers also had a lower ($P < 0.001$) ADG prior to breeding compared to Lot heifers. However, Stalk heifers had a greater ($P < 0.001$) ADG after breeding, indicating compensatory gain similar to Experiment 1. The HE diet also improved ($P = 0.02$) ADG after breeding. There was a lower ($P < 0.001$) percentage of Stalk heifers pubertal prior to breeding than Lot (47% vs. 94%) similar to Experiment 1 where Stalk group had a reduced percentage of pubertal heifers compared to WR. Winter development did not affect ($P > 0.10$) first service conception rate (50%) or overall pregnancy rate (85%). The HE heifers tended ($P = 0.09$) to have greater first service conception rates compared to LE heifers, although, there was no effect ($P > 0.10$) of supplemental nutrition on overall pregnancy rate.

First calf production data are presented in Table 4. For heifers conceived to TAI, the Stalk heifers had a longer ($P = 0.05$) gestation than the Lot heifers. However, neither winter development nor supplemental nutrition affected ($P > 0.10$) calf birth weight, calving ease score, or sex distribution. There were no interactions of winter development and breeding supplementation on calf parameters.

Conclusion

Winter development using corn stalks reduced ADG and the percentage of heifers attaining puberty prior to breeding compared with winter range or dry lot development. However, there was no effect of treatment on first service conception or pregnancy rates. Offering nutritionally challenged heifers a higher energy diet around the time of breeding may improve first service conception. While the factors that mediate these effects are unclear, developing heifers using corn stalks does not appear to negatively affect reproductive efficiency.

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