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Extending Grazing in Heifer Development Systems Decreases Cost Without Compromising Production

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Summary

Three experiments compared heifer development in the dry lot, grazing either dormant winter range or corn crop residue. Grazing corn residue may reduce pre-breeding gain and in doing so increase age at puberty. Compared to dry lot development, grazing corn residue reduced AI pregnancy rate, but final pregnancy rate was similar for both development systems. Calf production and rebreeding efficiency were not affected by the development system. However, grazing corn residue during heifer development reduced cost compared to development in the dry lot. Developing heifers by grazing dormant forage does not affect final pregnancy rate and reduces cost, improving the sustainability of beef production.

Introduction

Current recommendations indicate a heifer should reach approximately 65% of her mature body weight by the first insemination for successful reproduction (Patterson et al., 1992, *Journal of Animal Science,* 70:4018–4035). Prompted by rising input costs, there is increasing interest in alternative heifer development systems minimizing the use of harvested feedstuffs in favor of grazing. However, dormant forages are lower in available nutrients and may result in poorer animal performance, leading to lower BW at breeding. Recent data indicate heifers reaching less than 58% of mature BW by breeding have similar reproductive ability as their heavier counterparts (Funston and Deutscher, 2004, *Journal of Animal Science,* 82:3094–3099; Martin et al., 2008, *Journal of Animal Science,* 86:451-459). Moving heifer development out of the dry lot (DL) in favor of grazing standing forage may be cost effective. Corn residue (CR) and winter range (WR) are abundant sources of standing winter forage in Nebraska. These studies evaluated the effect of grazing CR or WR compared to DL on first service conception, pregnancy rate, and first calf production.

Procedure

The University of Nebraska–Lincoln Institutional Animal Care and Use Committee approved the procedures and facilities used in these experiments.

Experiment 1

Two hundred ninety-nine crossbred nulliparous heifers (558 ± 4 lb initial BW) from 3 production years were utilized to compare traditional post-weaning DL development to grazing CR during the same period. After a receiving period at the University of Nebraska West Central Research and Extension Center, heifers were blocked by initial BW and randomly assigned to graze CR or consume a diet in a DL for approximately 145 days. The CR heifers were offered 1.0 lb/day of a 28% crude protein (DM basis) supplement. Subsequently, heifers were placed in the DL and offered a common diet for 42 days each year. Heifers assigned to the DL treatment were offered a common diet for 187 days each year, formulated to produce an ADG that would allow heifers to reach approximately 65% of mature BW (1,250 lb) prior to AI.

In year 1, estrus was synchronized using MGA/PGF, followed by timed AI (TAI). In years 2 and 3, estrus was synchronized using MGA/PGF, followed by estrous detection and AI. After AI, heifers were exposed to fertile bulls for 45 days. Approximately 45 days after AI, AI conception was determined, and final pregnancy rate was determined 45 days after bulls were removed. During the subsequent winter, all pregnant heifers grazed CR and were offered the equivalent of 1.0 lb/day of a 28% CP (DM basis) supplement. After calving, heifers consumed a common diet through AI breeding. Approximately 60 days after calving, estrus was synchronized using CIDR/PGF, followed by timed AI. All cows were exposed to fertile bulls for a period not less than 45 days. Approximately 45 days after TAI, first service conception was assessed, and at weaning, final pregnancy rate was determined and calf BW was collected. The data were analyzed using the MIXED and GLIMMIX procedures of SAS.

Experiment 2

Experiment 2 was conducted using heifers from the Gudmundsen Sandhills Laboratory (GSL) near Whitman, Neb. Composite Red Angus x Simmental weaned heifer calves (n = 270) were assigned randomly by initial BW (495 ± 5 lb) to graze either CR or WR during post weaning development. Heifers either grazed WR pastures at GSL or were transported to CR fields and grazed for approximately 100 days each year. A daily supplement was offered (1.0 lb/head; 28% CP) while grazing. Subsequently, all heifers grazed WR for 100 days prior to breeding with a daily supplement (1.0 lb/head; 28% CP) until breeding. Estrus was synchronized with a single i.m. injection of $PGF_{2\alpha}$ administered 108 hours after bulls were turned in with the heifers; bulls remained in for 45 days. Pregnancy diagnosis was performed approximately 45 days following completion of the breeding season. During the breeding season and until pregnancy diagnosis, heifers grazed upland summer Sandhills range. Between pregnancy diagnosis and calving, pregnant heifers grazed upland Sandhills range until mid-November and then grazed CR during

Table 1. Effect of winter system on gain and reproduction in heifers, experiments 1, 2 and 3.

	Treatment											
	Exp. 1[1]			Exp. 2[2]			Exp. 3[3]			*P*-values		
Item	DL	CR	SEM	WR	CR	SEM	WR	CR	SEM	Exp.1	Exp.2	Exp.3
n	150	149		136	134		90	90				
Pre-breeding BW, lb	853	740	6	656	622	5	808	813	7	< 0.001	< 0.001	0.62
Percentage of mature BW	65	56	1	55	52	5	63	62	1	< 0.001	< 0.001	0.62
Pregnancy diagnosis BW, lb	978	917	6	792	769	592	6	917	8	< 0.001	0.003	0.44
ADG during grazing, lb/day [4]	1.27	0.42	0.02	0.54	0.30	0.02	0.94	0.82	0.03	< 0.001	< 0.001	0.002
Pre-breeding ADG, lb/day [5]	1.49	0.92	0.02	0.84	0.64	0.02	1.20	1.22	0.02	< 0.001	< 0.001	0.66
ADG from breeding to pregnancy diagnosis, lb/ day	1.04	1.47	0.03	1.48	1.61	0.02	1.02	0.91	0.04	< 0.001	< 0.001	0.05
Pubertal by AI, %	88	46	4	—	—	—	57	63	5	< 0.001	—	0.36
Year 1	—	—	—	73	33	7	—	—	—	—	< 0.001	—
Year 2	—	—	—	77	61	8	—	—	—	—	< 0.001	—
Year 3	—	—	—	49	58	7	—	—	—	—	0.003	—
Pregnant to AI, %	64	54	8	—	—	—	43	44	5	0.08		0.89
Yearling pregnancy, %	94	92	5	85	84	3	83	89	4	0.37	0.85	0.27
n	88	75		72	75		24	26				
Pre-calving BW, lb	983	945	11	981	969	8	926	1016	9	0.01	0.33	0.16
AI pregnant, 2-year old, %	62	66	6	—	—	—	61	56	10	0.61	—	0.75
Pregnant, 2-year old, %	87	81	5	85	77	7	92	100	6	0.39	0.37	0.98

[1]DL = developed in the dry lot; CR = developed on corn residue (145 days) and fed in the dry lot (42 days) before AI.
[2]WR = developed on winter range; CR = developed grazing corn residue (100 days) and grazed winter range (100 days) before breeding.
[3]WR = developed on winter range; CR = developed grazing corn residue (120 days) and grazed winter range (100 days) before AI.
[4]ADG during the winter grazing period.
[5] ADG after the winter grazing period prior to breeding.

the winter with a supplement (1.0 lb/day, 28% CP) until calving. The data were analyzed using the MIXED and GLIMMIX procedures of SAS.

Experiment 3

Experiment 3 was conducted at the Agricultural Research and Development Center near Mead, Neb. Composite MARC III x Red Angus weaned heifer calves (n = 180) were assigned randomly by initial BW (578 + 6 lb) to graze either CR or WR between weaning and breeding. Heifers grazed WR or CR for 119 days each year. A daily supplement was offered (1.0 – 2.0 lb/day; 29% CP) while winter grazing. Subsequently, all heifers grazed WR for 100 days prior to breeding with a daily supplement (1.0 lb/head; 28% CP). Estrus was synchronized using 2 i.m. injections of $PGF_{2\alpha}$ administered 16 and 2 days prior to AI breeding. Following the second $PGF_{2\alpha}$ injection, estrus was detected for at least 5 days. After AI, bulls were turned in with the heifers for 45 days. Pregnancy to AI was determined approximately 45 days after AI, and final pregnancy rate was determined 45 days after bulls were removed. Following pregnancy diagnosis, pregnant heifers grazed CR with a daily supplement (3.0 lb/day; 10.5% CP). Data were analyzed using the MIXED and GLIMMIX procedures of SAS.

Results

Heifer gain and reproduction data for Exp. 1, 2, and 3 are summarized in Table 1. In Exp. 1, heifers grazing CR gained 0.86 lb/day less ($P < 0.001$) than DL heifers. In Exp. 2, CR heifers gained 0.14 lb/day less ($P < 0.001$) than heifers grazing WR during the winter grazing period. Heifers grazing CR in Exp. 3 gained 0.13 lb/day less ($P = 0.002$) than heifers grazing WR.

In Exp. 1 and 2, heifers grazed with minimal hay supplementation; however, snow cover necessitated more extensive hay feeding in Exp. 3. Pre-breeding BW was related to pre-breeding ADG, with heifers grazing CR being lighter ($P < 0.001$) prior to breeding compared to heifers in the DL (Exp. 1) or grazing WR (Exp. 2). However, pre-breeding BW of both groups was similar ($P = 0.62$) in Exp. 3. The CR heifers in Exp. 1 were 56% of mature BW and DL heifers 65% of mature BW before breeding. In Exp. 2, CR-developed heifers were 52% of mature BW, and WR heifers were 55% of mature BW at breeding. In Exp. 3, CR and WR heifers were approximately 62-63% of mature BW at breeding.

Likely due to decreased pre-breeding BW, fewer ($P < 0.001$) heifers grazing CR were pubertal before breeding, compared to DL heifers in Exp. 1 and compared to WR heifers in years 1 and 2 of Exp. 2. However, a similar ($P = 0.36$) percentage of heifers from each treatment were pubertal at AI in Exp. 3. In Exp. 1, AI pregnancy rate was 10% lower ($P = 0.08$) in CR heifers compared to DL heifers, possibly due to pubertal differences. However, AI pregnancy rates in both treatment groups were similar ($P = 0.89$) in Exp. 3. Regardless of the percentage of pubertal heifers, final pregnancy rates were similar ($P \geq 0.27$) in Exp. 1, 2, and 3.

Prior to calving, the CR heifers were still lighter ($P = 0.01$; Exp. 1) than DL heifers, although pre-calving BW was not different ($P \geq 0.16$) in Exp. 2 and 3. The percentage of heifers that calved in the first 21 days of the season was not different ($P \geq 0.18$) between CR and DL in years 1 or 3 (Exp. 1) or between CR and WR (Exp. 2 and 3; Table 2). However, in year 2 of Exp. 1, 22% more ($P = 0.02$) DL heifers calved in the first

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Table 2. Effect of winter system on calf production, experiments 1, 2 and 3.

	Treatment									*P*-values		
	Exp. 1[1]			Exp. 2[2]			Exp. 3[3]					
Item	DL	CR	SEM	WR	CR	SEM	WR	CR	SEM	Exp.1	Exp.2	Exp.3
n	136	127		111	109		49	52				
Calved in 1st 21 days, %				81	78	4	65	64	7		0.57	0.99
Year 1	75	83	5							0.41		
Year 2	91	69	7							0.02		
Year 3	77	64	7							0.18		
Calf birth date, Julian day	70	74	1	68	69	1	77	77	2	0.06	0.85	0.84
Calf birth BW, lb	75	74	1	70	71	1	75	79	1	0.46	0.55	0.05
Assisted births, %	20	25	4	23	29	4	7	29	7	0.29	0.33	0.009
Sex, % male	47	48	5	52	51	5	59	69	7	0.92	0.85	0.30
Calf weaning BW, lb	425	435	10	393	399	8	485	498	12	0.49	0.59	0.44
Calf 205 day BW, lb	397	410	9	429	434	7	474	483	10	0.31	0.59	0.51

[1] DL = developed in the dry lot; CR = developed grazing corn residue (145 days) and fed in the dry lot (42 days) before AI.
[2] WR = developed on winter range; CR = developed grazing corn residue (100 days) and grazed winter range (100 days) before breeding.
[3] WR = developed on winter range; CR = developed grazing corn residue (120 days) and grazed winter range (100 days) before AI.

21 days. Similarly, average calf birth date also was not different ($P \geq 0.84$) in Exp. 2 and 3; however, in Exp. 1, CR heifers tended to give birth 4 days later ($P = 0.06$) than DL heifers. Both calf birth BW ($P \geq 0.46$) and the percentage of male calves ($P \geq 0.85$) were similar in Exp. 1 and 2. Although the percentage of male calves was similar ($P = 0.30$) for CR and WR heifers in Exp. 3, CR heifers gave birth to heavier ($P = 0.05$) calves. A primary concern associated with this system is an increase in calving difficulty because heifers are lighter at calving. The percentage of heifers requiring calving assistance was not different ($P \geq 0.29$) in Exp. 1 and 2. However, in Exp. 3, 22% more ($P = 0.009$) CR-developed heifers than WR-developed heifers required calving assistance.

Pregnancy rates to AI in the second breeding season were similar ($P \geq 0.61$) in Exp. 1 and Exp. 3 (Table 1). Final pregnancy rates after the second breeding season also were similar ($P \geq 0.37$) among treatment groups in all three experiments. Neither calf weaning BW ($P \geq 0.44$) nor calf adjusted 205-day BW ($P \geq 0.31$) were different among treatments in Exp. 1, 2 or 3. These data agree with previous research conducted by Funston and Deutscher (2004, *Journal of Animal Science,* 82:3094–3099) and Martin et al. (2008, *Journal of Animal Science,* 86:451-459), indicating that although heifers developed to 50% of mature BW at breeding are lighter through the third breeding, long term reproduction and calf production are not impacted.

Table 3. Effect of winter system on heifer development cost, experiments 1, 2 and 3.

	Treatment								
	Exp. 1[1]			Exp. 2[2]			Exp. 3[3]		
Item	DL	CR	Diff	WR	CR	Diff	WR	CR	Diff
n	150	149		136	134		90	90	
Feeding cost, $/heifer	237	195	-42	124	123	-1	128	121	-8
Total development cost, $/heifer	982	941	-41	832	838	6	853	848	-5
Cull heifer value, $/heifer exposed	53	77	-24	131	135	4	160	104	-56
Net cost of 1 pregnant heifer, $	985	940	-45	821	832	11	831	835	4

[1]DL = developed in the dry lot; CR = developed grazing corn residue (145 days) and fed in the dry lot (42 days) before AI.
[2]WR = developed on winter range; CR = developed grazing corn residue (100 days) and grazed winter range (100 days) before breeding.
[3]WR = developed on winter range; CR = developed grazing corn residue (120 days) and grazed winter range (100 days) before AI.

Non-pregnant heifers developed by grazing standing forage are lighter at pregnancy diagnosis than traditionally developed heifers and may be better suited for a long-yearling feedlot program. Cull heifers were considered an additional source of revenue in this system. Developing heifers by grazing CR reduced winter feed cost by $42/heifer compared to development in the dry lot (Table 3). In addition, slightly more CR heifers were not pregnant after breeding, increasing the value of culled heifers. After considering feeding cost and cull value difference, CR development reduced the net cost of developing one pregnant heifer by $45 compared to DL development. However, as WR and CR were charged to the development system at a similar cost and pregnancy rates were similar, there was little difference in the cost of developing a pregnant heifer on either CR or WR.

Implications

Winter development using corn residue is a suitable alternative to development on a winter range or a dry lot. The reduction in the percentage of pubertal heifers developed grazing corn residue may reduce AI conception rate, but final pregnancy rate is similar. The factors that mediate these effects are complex; however, developing heifers using corn residue does not negatively influence long-term production. Developing heifers by grazing dormant forage reduces cost compared to dry lot feeding, improving sustainability.

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