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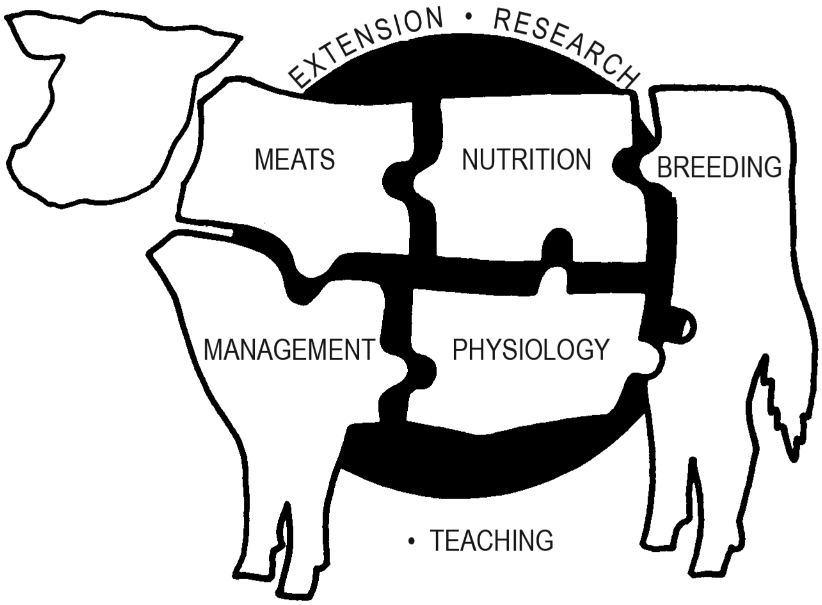

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Impact of Heifer Development System on Subsequent Gain and Reproduction

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Summary

Replacement heifers from 2 different calving herds (March and May) were fed ad libitum hay and 4 lb of supplement/day, or were allowed to graze meadow and received 1 lb of supplement/day from mid-January to mid-April prior to both breeding seasons. Heifers from both calving herds that received hay had a greater average daily gain during the treatment period compared with meadow grazing heifers. However, heifers grazing meadow experienced compensatory gain during their respective breeding season, resulting in similar body weights at pregnancy diagnosis for March-calving heifers. The proportion of heifers that attained puberty before breeding and became pregnant was similar between the treatment groups in both herds.

Introduction

Retaining replacement heifers can be a major expense to the cow-calf enterprise. The majority of this expense can be attributed to feed. Considering high feed costs, recent efforts have been made to devise more economical methods of developing heifers. It has been reported that heifers grown in a reduced input development system have comparable reproductive performance to heifers developed in higher input systems. Martin et al., (*2008 Nebraska Beef Cattle Report*, pp. 5-7) reported no significant difference in puberty attainment for heifers fed to 51% vs. 57% mature BW. However, a lesser percentage of heifers had reached puberty prior to the breeding season when developed on corn residue compared to winter range or drylot (*2008 Nebraska Beef Cattle Report*, pp. 8-10). The objective of this study was to determine the effect of reduced overwinter supplementation on ADG and reproductive performance in beef heifers in 2 breeding seasons.

Procedure

Replacement heifers from two calving seasons, March and May, were utilized in this study. Over a 2-year period, 100 March-born, crossbred (5/8 Red Angus, 3/8 Continental) heifers; and over a 3-year period, 196 May-born, crossbred (5/8 Red Angus, 3/8 Continental) heifers were utilized. Heifers were stratified by BW and randomly assigned to 1 of 2 post-weaning treatments (2 pastures·treatment^{-1}·year^{-1}) applied from mid-January to mid-April. Heifers in the HAY treatment were offered *ad libitum* meadow hay and 4 lb/day supplement (29% CP, DM basis). Heifers receiving MDW treatment were allowed to graze meadow and offered 1 lb/day supplement. Prior to and following treatment, all heifers were managed as a single herd until the respective breeding seasons. Immediately prior to each breeding season, 2 blood samples were drawn 10 days apart via caudal venipuncture for progesterone analysis to determine pubertal status. Five days after being placed with bulls (1:20 bull to heifer ratio), heifers were synchronized with a single $PGF_{2\alpha}$ injection and allowed a 45 day natural service breeding season beginning May 23 for March-calving heifers and July 10 for May-calving heifers. Pregnancy diagnosis was determined by ultrasound 40 days after bulls were removed.

Statistical Analyses

Data were analyzed using the GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, N.C.), evaluating year, treatment, and year × treatment. The proportions of pubertal and pregnant heifers were analyzed using an odds ratio. Least squared means and SE of the proportion of pubertal and pregnant heifers by treatment were obtained using the ILINK function.

Economic Analyses

A cost analysis of treatment was generated to compare the winter feeding cost of HAY and MDW treatments. Hay prices were extremely variable during this study, ranging from $50 to $230 per ton, with an average hay cost of $120/ton assumed. The cost of grazing meadow was one-half the cost of winter grazing for a mature cow, based upon average BW over the treatment period. Basic management and yardage was estimated at $0.20/day. A partial budget analysis was conducted using the procedure by Feuz (*Journal of the American Society of Farm Managers and Rural Appraisers*, 1992, 56(1): 61-66). The budget analysis was evaluated for season (March and May) and treatment (HAY and MDW). Summer grazing cost was based on $1.00/head/day, basic management was $0.20/head/day, with an additional fixed expense of $15.00 for the year calculated in. Heifer value at the beginning of the study (Jan. 15) and at pregnancy diagnosis (Sept. 10 and Oct. 30, March and May herds) was calculated from the Nebraska average price reported by the USDA Agricultural Marketing Service (2014) for each corresponding date and respective average heifer BW. Total breeding cost included a single PGF_2 injection at $2.80/heifer and bull expense of $37.20/heifer. Total heifer cost was calculated by adding the purchase price, treatment cost, summer grazing and management cost, breeding cost, and 6% interest on the heifer purchase price. The net cost of one pregnant heifer was calculated as the difference between total heifer cost and cull value, divided by pregnancy rate.

Results

Gain and Reproductive Performance

March-born heifer BW gain and reproductive data are presented in Table 1. A significant ($P = 0.04$) year × treatment interaction is noted for ADG during the Jan. 12 to April 22 treatment period, with HAY heifers having similar ($P = 0.99$) treatment

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Table 1. Effect of overwinter treatment on developing March-born heifer ADG, BW, and reproductive performance.

Item	Development Year 2012	Development Year 2013	SEM	*P*-value	Treatment HAY[1]	Treatment MDW[2]	SEM	*P*-value
n	50	50			50	50		
ADG								
Treatment ADG,[3] lb/day	1.36	1.44	0.04	0.10	1.77	1.03	0.04	<.01
Spring ADG,[4] lb/day	1.87	0.93	0.10	<.01	0.95	1.85	0.09	<.01
Summer ADG,[5] lb/day	0.58	1.37	0.04	<.01	0.94	1.02	0.04	0.36
Body Weight								
Weaning BW, lb	424	411	7	0.17	415	421	6	0.63
Post-treatment BW, lb	644	639	7	0.64	676	607	7	<.01
Prebreeding BW,[6] lb	702	665	8	<.01	704	662	8	<.01
Percent Mature BW,[7] %	58	54	7	<.01	58	54	7	<.01
Pregnancy Diagnosis BW, lb	768	816	8	<.01	809	775	10	0.25
Pubertal,[8] %	66	30	7	<.01	43	52	8	0.40
Pregnancy Rate, %	92	82	6	0.14	89	87	5	0.72

[1]HAY = heifers received *ad libitum* hay and 4 lb/day supplement from Jan. 15 to April 15.
[2]MDW = heifers grazed meadow and received 1 lb/day supplement from Jan. 15 to April 15.
[3]Treatment ADG from Jan. 16 to April 22 (96 days), includes the treatment period.
[4]Spring ADG from April 22 to May 22 (30 days).
[5]Summer ADG from May 22 to Sept. 10 (111 days).
[6]Prebreeding BW determined May 22.
[7]Percent of mature BW at breeding based on mature cow size of 1,218 lb.
[8]Considered pubertal if blood serum progesterone concentration >1 ng/mL.

Table 2. Effect of overwinter treatment on developing May born heifer ADG, BW, and reproductive performance.

Item	Development Year 2011	Development Year 2012	Development Year 2013	SEM	*P*-value	Treatment HAY[1]	Treatment MDW[2]	SEM	*P*-value
n	65	65	66			97	99		
ADG									
Treatment ADG,[3] lb/day	1.20[a,b]	1.27[a]	0.88[b]	0.17	<.01	1.46	0.77	0.08	<.01
Spring ADG,[4] lb/day	1.80[a]	1.93[a]	2.42[b]	0.06	<.01	1.93	2.23	0.04	<.01
Summer ADG,[5] lb/day	1.28[a]	0.68[b]	0.83[c]	0.03	<.01	0.87	0.99	0.03	<.01
Body Weight									
Weaning BW, lb	409[a]	434[b]	434[b]	7	<.01	425	426	5	0.91
Post-treatment BW, lb	558[a]	581[a]	523[b]	7	<.01	597	512	6	<.01
Prebreeding BW,[6] lb	673	695	673	11	0.11	713	647	7	<.01
Percent Mature BW,[7] %	54	56	55	1	0.59	59	52	1	<.01
Pregnancy Diagnosis BW, lb	806[a]	765[b]	773[b]	9	<.01	807	755	7	<.01
Pubertal,[8] %	69[a]	78[a]	37[b]	8	<.01	70	54	6	0.03
Pregnancy Rate, %	58	71	62	6	0.29	66	61	5	0.44

[1]HAY = heifers received *ad libitum* hay and 4 lb/day supplement from Jan. 15 to April 15.
[2]MDW = heifers grazed meadow and received 1 lb/day supplement from Jan. 15 to April 15.
[3]Treatment ADG from Jan. 5 to May 10 (125 days), includes the treatment period.
[4]Spring ADG from May 10 to July 9 (60 days).
[5]Summer ADG from July 9 to Sept 10 (63 days).
[6]Prebreeding BW determined Sept 10.
[7]Percent of mature BW at breeding based on mature cow size of 1,218 lb.
[8]Considered pubertal if blood serum progesterone concentration >1 ng/mL.
[a,b,c]Means in a row with different superscripts are different (P < 0.01).

period ADG between development years 2012 and 2013 (1.78 vs. 1.76 ± 0.07 lb/day, respectively), whereas MDW heifers ADG tended to differ ($P = 0.05$) between development years (2012 vs. 2013, 0.93 vs. 1.13 ± 0.07 lb/day). Heifers born in March on HAY had greater ($P < 0.01$) ADG during the treatment period than MDW heifers (1.77 vs. 1.03 ± 0.04 lb/day, respectively). However, following treatment, from April 22 to May 22, MDW heifers experienced a compensatory gain resulting in significantly ($P < 0.01$) greater ADG compared to HAY heifers (1.85 vs. 0.95 ± 0.09 lb/day, respectively). During the time period from May 22 to Sept. 10, ADG was similar ($P = 0.36$) between HAY and MDW heifers (0.94 vs. 1.02 ± 0.04 lb/day, respectively). Significant year effects ($P < 0.01$) are noted on spring and summer ADG between heifers developed in 2012 and 2013, most likely due to the severe drought experienced in 2012. Post-treatment BW was significantly ($P < 0.01$) greater for HAY vs. MDW heifers (676 vs. 607 ± 7 lb, respectively), which carried over to prebreeding BW (HAY vs. MDW; 704 vs. 662 ± 8 lb, respectively). At breeding, HAY heifers had reached a greater ($P < 0.01$) percent mature BW (58 vs. 54 ± 7%, for HAY and MDW, respectively). At pregnancy diagnosis, BW was similar ($P = 0.25$) between HAY and MDW heifers (809 vs. 775 ± 10 lb, respectively). The proportion of heifers attaining puberty prior to the breeding season was similar ($P = 0.40$) between HAY and MDW heifers (43 vs. 52 ± 8%, respectively). Pregnancy rate was also similar for HAY (89 ± 5%) and MDW (87 ± 5%, $P = 0.72$) heifers.

Table 3. Cost analysis of heifer development overwinter nutritional treatments.

Item	HAY[1]	MDW[2]
Hay,[3] $/head/day	0.66	—
Meadow pasture, $/head/day	—	0.50
Supplement,[4] $/head/day	0.77	0.19
Yardage, $/head/day	0.20	0.20
Total, $/head/day	1.63	0.89
Treatment total,[5] $/head	146.70	80.10

[1]HAY = heifers received *ad libitum* hay and 4 lb/day supplement from Jan. 15 to April 15.
[2]MDW = heifers grazed meadow and received 1 lb/day supplement from Jan. 15 to April 15.
[3]Hay cost assumed as $120/ton (11 lb/day).
[4]Supplement containing 29% CP, DM priced at $385/ton, comprised of processed grain byproducts, plant protein products, roughage products, calcium carbonate, molasses products, urea, vitamin A supplement, copper sulfate, zinc oxide, magnesium sulfate, and monensin.
[5]Treatment total for 90 day period.

Table 4. Partial budget analysis of heifer development calving season and overwinter nutritional treatments.

	March-calving		May-calving	
Item	HAY[1]	MDW[2]	HAY[1]	MDW[2]
Opportunity Cost of Heifer, Jan. 15, $	775.52	777.06	700.52	707.20
Feed Cost:				
Winter Treatment Period,[1,2] $	146.70	80.10	146.70	80.10
Summer grazing,[3] $	148.00	148.00	198.00	198.00
Breeding Expense,[4] $	40.00	40.00	40.00	40.00
Fixed Expenses, $	25.00	25.00	25.00	25.00
Management Expense,[5] $	29.60	29.60	39.60	39.60
Interest @ 6.0%, $	46.53	46.62	42.03	42.43
Total cost, $	1,211.35	1,146.38	1,191.85	1,132.33
Less: Value of cull heifers,[6] $	147.21	163.51	386.38	418.12
Net Cost, $	1,064.14	982.87	805.47	714.21
Net cost per pregnant heifer, $	1,195.66	1,129.74	1,220.41	1,170.84

[1]HAY = heifers received *ad libitum* hay and 4 lb/day supplement from Jan. 15 to April 15.
[2]MDW = heifers grazed meadow and received 1 lb/day supplement from Jan. 15 to April 15.
[3]Summer grazing calculated at $1.00/head/day.
[4]Breeding expense includes cost of bull use and a single injection of $PGF2_{\alpha}$.
[5]Management expense calculated at $0.20/head/day.
[6]Heifer cull value calculated from prices the week of pregnancy diagnosis.

Table 2 presents the BW and reproductive results for May-born heifers. Similar to the March-born heifers, May-born heifers on HAY treatment had greater ($P < 0.01$) ADG during the treatment period, from Jan. 5 to May 10, compared with MDW heifers (1.46 vs. 0.77 ± 0.08 lb/day, respectively). However, heifers grazing meadow experienced greater ($P < 0.01$) ADG following treatment, from May 10 to July 9 (HAY vs. MDW; 1.93 vs. 2.23 ± 0.04 lb/day). Furthermore, MDW heifers continued to have greater ($P < 0.01$) ADG, from July 9 to Sept. 10, compared with HAY heifers (0.87 vs. 0.99 ± 0.03 lb/day, respectively). Post-treatment BW was greater ($P < 0.01$) for heifers on HAY treatment compared with heifers on MDW treatment (597 vs. 512 ± 6 lb, respectively). This increased BW for HAY heifers continued to prebreeding (HAY vs. MDW, 713 vs. 647 ± 7 lb; $P < 0.01$) and pregnancy diagnosis (HAY vs. MDW; 807 vs. 755 ± 7 lb; $P < 0.01$). Significant effects of development year is noted for all ADG time periods and BW (except prebreeding BW) as a result of the extreme variability in forage quality between the relatively normal year, 2011; the severe drought year, 2012; and the unique post-drought recovery year, 2013. Heifers on HAY treatment were 59 ± 1% of their mature BW, while MDW were 52 ± 1% of mature BW at breeding ($P <0.01$). The proportion of heifers attaining puberty prior to the breeding season was greater ($P = 0.03$) for HAY vs. MDW heifers (70 vs. 54 ± 6%, respectively). Pregnancy rate was similar ($P = 0.44$) between treatments (66 vs. 61 ± 5% for HAY and MDW heifers, respectively). These lower pregnancy rates are attributed to the decreasing forage quality and availability on Sandhills range during the breeding season (July and August) for a May-calving herd. Currently, breeding season supplementation strategies for the May-calving herd are being investigated to determine effect on pregnancy rates.

Economic Analysis

The treatment cost analyses is presented in *Table 3*. The overwinter daily cost for HAY heifers was $1.63/head/day compared to MDW heifers at $0.89/head/day, resulting in a $0.74/day savings. Over the 3 month treatment period, this equates to a significant difference ($P < .01$) in cost; $146.70 total cost for HAY heifers compared with $80.10 for MDW heifers, resulting in $66.60/heifer savings by grazing meadow with 1 lb of supplement compared with *ad libitum* hay and 4 lb of supplement.

The partial budget analyses (*Table 4*) reveals the cost per pregnant heifer is $65.92 greater for March-born heifers on HAY compared with MDW treatment. May-born heifers on HAY had $49.57/pregnant heifer greater cost than their contemporaries on MDW treatment.

Heifers on the HAY treatment had greater ADG during the winter feeding period resulting in greater prebreeding BW for HAY heifers compared with MDW heifers resulting in HAY heifers reaching a greater percentage of their mature BW at breeding. There was no difference in pubertal status or pregnancy rate between HAY and MDW heifers, indicating a lower input winter management system is viable to maintain heifer pubertal status and pregnancy rates in 2 breeding seasons. A $66.60/heifer savings from January to April in the MDW treatment indicates an economic advantage to the grazed meadow heifer development system.

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