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Impact of Winter Supplementation of May Calving Cows and Heifer Development System in Two Different Breeding Seasons on Subsequent Growth and Reproduction

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Summary with Implications

In Exp. 1, May-calving cows were utilized to evaluate the effects of winter supplementation on heifer progeny. Cows grazed either dormant upland winter range with or without a protein supplement or grazed dormant meadow with or without a protein supplement. In Exp. 2, replacement heifers from March and May calving herds were offered ad libitum meadow hay and 4 lb/d supplement or grazed meadow and offered 1 lb/d supplement from mid-January to mid-April. Calf weaning BW and ADG from birth to weaning was less for calves from cows grazing winter range with no supplement compared with all other dam treatments. Heifer development system did not impact final pregnancy rates. Therefore, a reduced input winter heifer development system is a viable option in both early and late summer breeding seasons. However, winter supplementation of May-calving dams did influence heifer progeny ADG from birth to weaning.

Introduction

The amount of harvested and purchased feed required to sustain a cow herd in the Nebraska Sandhills can be reduced by a late spring calving date, in which the cow's nutritional demands better match forage quality and quantity. Protein is commonly supplemented to maintain cow BCS during winter grazing. Supplementing beef cows during late gestation can affect the lifetime productivity of the calf by altering post-weaning growth and heifer fertility.

Traditional recommendations suggest heifers reach 55 to 65% of mature BW at the time of breeding. Due to the cost of retaining replacement heifers, more efforts have been made to devise economical heifer development methods. Previous studies have indicated heifers developed to lower target BW have comparable reproductive performance to heifers developed in higher input systems (2017 Nebraska Beef Report, pp. 5–7). Furthermore, it has been reported heifers fed to 51 vs. 57% mature BW showed no difference in attaining puberty.

Therefore, objectives of these studies were to evaluate winter supplementation of May-calving cows grazing dormant winter range or meadow on gain and reproduction in addition to its impact on heifer progeny performance, and to determine the impact of heifer development system on subsequent growth and reproductive performance in early and late summer breeding seasons.

Procedure

Experiment 1

Over a 4-yr period, May-calving cows were utilized to evaluate the effects of winter supplementation on cow gain and reproduction in addition to its impact on heifer progeny. Cows grazed either dormant upland winter range with or without supplement (**RS**, **RNS**, respectively) or dormant meadow with or without supplement (**MS**, **MNS**, respectively) from December 1 to March 29 at the Gudmundsen Sandhills Laboratory (**GSL**), Whitman, NE. Each cow assigned to RS or MS overwinter treatment received the equivalent of 1 lb/d of a 32% CP (DM) supplement cube. Supplement was delivered 3 times/wk on a pasture (35.6 ha) basis. Following treatment, cows were managed as a single group and grazed native upland range the remainder of the year. Fertile bulls were placed with cows (1:20 bull to cow ratio) approximately August 1 for a 45 d breeding season. Five d after bull placement, cows were estrus synchronized with a single injection of $PGF_{2\alpha}$ (Lutalyse, Zoetis, Parsippany, NJ). Pregnancy was determined via rectal palpation or ultrasonography (ReproScan, Beaverton, OR) at weaning in early January.

Experiment 2

A 4-yr study conducted at GSL utilized replacement heifers from 2 calving seasons. March-born (n = 225) and May-born (n = 258), crossbred (5/8 Red Angus, 3/8 Continental) heifers were stratified by BW and randomly assigned to 1 of 2 postweaning nutritional treatments (2 pastures·treatment^{-1}·year^{-1}) from mid-January to mid-April. The May-born heifer progeny from Exp. 1 were included in this study. March heifers were weaned in October while May heifers were weaned in early January. Heifers were offered ad libitum meadow hay (**HAY**) and a 4 lb/d (32% CP, DM) supplement cube or allowed to graze meadow (**MDW**) and offered 1 lb/d of the same supplement. Prior to and following treatment, heifers were managed together within their respective breeding group. Following the treatment period, March-born heifers grazed meadow until June 1 and then grazed upland range. May-born heifers grazed range immediately following the treatment period.

Prior to each breeding season, 2 blood samples were collected via coccygeal venipuncture 10 d apart to determine pubertal status. Samples were collected in May on March-born heifers and early July on May-born heifers. Heifers with plasma progesterone concentrations greater than 1 ng/mL at either collection were considered pubertal. Heifers were synchronized with a single $PGF_{2\alpha}$ injection 5 d after bull placement (1:20 bull to heifer ratio) for 45 d. Bulls were placed with March heifers May 23 and with May heifers on July 10. Heifers grazed Sandhills upland range through final pregnancy diagnosis. Pregnancy diagnosis was conducted via transrectal ultrasonography 40 d following bull removal. Forage samples were collected each yr to determine CP and

Table 1. Nutritional composition of range and hay in each development year[1]

	2011	2012	2013	2014
Development period diet				
Winter range CP,[2] % DM	5.6	5.4	7.8	6.2
Winter range TDN,[2] % DM	51.7	52.5	54.4	51.0
Winter meadow CP,[2] % DM	7.7	10.7	9.9	12.7
Winter meadow TDN,[2] % DM	55.8	60.7	61.2	68.9
Hay CP, [3] % DM	7.3	7.3	6.8	7.7
Hay TDN,[3] % DM	54.4	55.9	48.2	58.5
March-calving breeding season				
June range CP, % DM	14.0	10.1	19.3	14.1
June range TDN, % DM	64.3	61.5	79.7	61.6
May Calving breeding season				
July range CP, % DM	11.1	10.6	14.7	10.1
July range TDN, % DM	61.2	59.6	71.0	59.0
Sept. range CP, % DM	6.9	8.2	9.8	10.4
Sept. range TDN, % DM	61.4	58.5	65.0	60.4

[1] Collected from esophageally fistulated cows.
[2] Values for the developmental period are obtained from the previous December.
[3] Hay used during development yr was harvested the previous summer.

Table 2. Effect of winter supplementation on cow BW and reproduction

	Dam Treatment[1]					
Item	MS	MNS	RS	RNS	SEM	*P*-value
BW						
Jan. BW, lb	930	928	930	928	9	0.94
Overwinter BW change, lb	115[a]	101[a,c]	93[b,c]	49[d]	7	0.01
Precalving BW, lb	1,045	1,030	1,021	974	11	0.17
Early lactation BW change, lb	57[d]	62[c,d]	79[b]	104[a]	4	0.04
Prebreeding BW, lb	1,104	1,087	1,100	1,082	11	1.00
Mid-late lactation BW change, lb	-71	-44	-46	-0.9	7	0.15
BCS						
Jan. BCS	4.5	4.6	4.6	4.6	0.04	0.43
Overwinter BCS change	0.28	0.22	0.37	0.29	0.05	0.84
Precalving BCS	4.7	4.7	4.7	4.6	0.05	0.26
Early lactation BCS change	0.96	0.96	0.91	1.00	0.05	0.29
Prebreed BCS	5.7	5.6	5.6	5.6	0.04	1.00
Mid-late lactation BCS change	-0.17	-0.03	-0.2	0.01	0.05	0.54
Calved in first 21 d, %	73	82	80	81	3	0.26
Rebreed pregnancy rate, %	89	89	87	82	3	0.40

[1]MS = dams grazed dormant meadow and received 1 lb as-fed·animal^{-1}·d^{-1} 32% CP supplement; MNS = dams grazed meadow and received no supplementation; RS = dams grazed dormant range and received 1 lb as-fed·animal^{-1}·d^{-1} 32% CP supplement; RNS = dams grazed dormant range and received no supplementation.
[a,b,c,d] For dam treatment, means in a row with different superscripts are different ($P \leq 0.05$).

TDN via esophageally fistulated cows for winter range, winter meadow, June range, July range, and September range (Table 1).

Calving performance of March-born and May-born heifers was measured by recording birth BW, calving ease, calf vigor, and dystocia rate. A calving ease scoring system of 1 to 5 was utilized with 1 representing no assistance and 5 indicating a Caesarean section. Calf vigor was determined with a 1 to 5 scoring system where 1 referred to the calf nursing immediately and 5 signified dead on arrival. Dystocia rate was characterized as a calving ease score of 2 and greater. Furthermore, udder score, proportion of bull calves, and rebreed pregnancy rate was determined on heifers. An udder scoring system of 1 to 5 with 1 representing poor udder quality and 5 signifying a superior udder was used on March-born and May-born heifers.

Statistical Analysis

Data for both experiments were analyzed using the GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, N.C.). The main effect for Exp. 1 was dam treatment, while Exp. 2 main effect was heifer development treatment. Pasture was considered a replication as each development treatment occurred in 2 pastures each year. Therefore, pasture × year × treatment is the experimental unit. Pregnancy rate, calving rate, pubertal status, and the proportion of heifers that calved in the first 21 d represent binomial distribution and were analyzed using an odds ratio. Least squared means and SE of the proportion were obtained using the ILINK function. Differences were considered significant when $P \leq 0.05$, while differences with $0.05 < P \leq 0.10$ were tendencies.

Results

Experiment 1

Cow Gain and Reproductive Performance

Throughout the winter treatment period, RNS cows gained significantly less BW ($P = 0.01$) when compared with cows from the other treatments (Table 2). Previous research has indicated a loss in BW for cows not fed a protein supplement overwinter when compared with cows fed supplemen-

Table 3. Heifer progeny gain and reproductive performance from May-calving cows

	Dam Treatment[1]					
Item	MS	MNS	RS	RNS	SEM	*P*-value
n	54	53	53	54		
Birth BW, lb	75[x]	75[x]	75[x]	73[y]	1	0.07
ADG from birth to weaning, lb	1.57[a]	1.52[a]	1.52[a]	1.48[b]	0.04	<0.01
Weaning BW, lb	428[a]	423[a]	423[a]	406[b]	9	<0.01
Spring ADG,[2] lb/d	2.25	2.27	2.20	2.09	0.18	0.46
Prebreeding BW,[3] lb	697[a]	697[a,b]	675[a,b]	655[b]	25	<0.01
Summer ADG,[4] lb/d	1.15	1.21	1.15	1.12	0.26	0.73
Percent of mature BW,[5] %	57[a]	56[a,b]	56[a,b]	54[b]	1	<0.01
Pregnancy diagnosis BW, lb	789[a]	778[a,b]	772[a,b]	754[b]	9	0.02
Pubertal,[6] %	79	67	64	77	19	0.31
Pregnancy rate, %	72	72	66	64	7	0.73
Calving rate[7], %	67	65	64	62	7	0.96
Calved in first 21 d, %	68	63	80	75	8	0.36

[1]MS = dams grazed dormant meadow and received 1 lb as-fed·animal^{-1}·d^{-1} 32% CP supplement; MNS = dams grazed meadow and received no supplementation; RS = dams grazed dormant range and received 1 lb as-fed·animal^{-1}·d^{-1} 32% CP supplement; RNS = dams grazed dormant range and received no supplementation.
[2] May 10 to July 9 (67 d).
[3] Determined July 9.
[4] July 9 to Sept 10 (63 d).
[5]Percent of mature BW at breeding based on mature cow BW of 1,218 lb.
[6]Considered pubertal if blood plasma progesterone concentration > 1 ng/mL.
[7]Percentage of heifers that calved.
[a,b,c] For dam treatment, means in a row with different superscripts are different ($P \le 0.05$).
[x,y,z] For dam treatment, means in a row with different superscripts are tendencies ($0.05 < P \le 0.1$).

Table 4. Effect of over-winter treatment on March-born heifer gain and reproductive performance

	Heifer Treatment[1]			
Item	HAY	MDW	SEM	*P*-value
n	113	112		
Weaning BW, lb	443	441	13	0.52
Initial BW, lb	529	529	13	0.89
Post-treatment BW, lb	683	633	15	<0.01
Treatment ADG,[2] lb/d	1.72	1.12	0.07	<0.01
Spring ADG,[3] lb/d	0.46	1.21	0.42	<0.01
Prebreeding BW,[4] lb	705	672	11	<0.01
Summer ADG,[5] lb/d	1.12	1.21	0.20	0.09
Percent of mature BW,[6] %	58	55	1	<0.01
Pregnancy diagnosis BW, lb	831	809	20	0.02
Pubertal,[7] %	64	69	19	0.82
Pregnancy rate, %	87	88	3	0.92
Calving rate[8], %	85	83	3	0.61
Calved in 1st 21 d, %	79	74	4	0.33

[1]HAY = heifers received ad libitum hay and 4 lb/d supplement (32% CP DM) from Jan 15 to Apr 15; MDW = heifers grazed meadow and received 1 lb/d supplement (32% CP DM) from Jan 15 to Apr 15.
[2]Jan 16 to Apr 22 (96 d) and includes the treatment period.
[3]Apr 22 to May 22 (30 d).
[4]May 22.
[5]May 22 to Sept 10 (111 d).
[6]Percent of mature BW at breeding based on mature cow BW of 1,218 lb.
[7]Considered pubertal if blood plasma progesterone concentration > 1 ng/mL.
[8]Percentage of heifers that calved.

tal protein prepartum. Body weight at other time points during gestation to lactation, however, did not differ ($P > 0.15$) among cows, apart from the BW change in early lactation where RNS cows exhibited greater ($P = 0.04$) BW gain than other treatments, likely due to a compensatory gain effect. Body condition score did not differ ($P > 0.26$; Table 2) among treatments from gestation through lactation. The proportion of cows that calved in the first 21 d and rebreed pregnancy rate were not different ($P > 0.26$) among winter supplementation treatments.

Heifer Progeny Performance

Birth BW tended to be lower ($P = 0.07$) in heifers born to RNS cows (Table 3). Birth to weaning ADG was less ($P < 0.01$) in daughters born to RNS cows compared with other dam treatments, thus leading to a lower ($P < 0.01$) weaning BW in RNS heifer progeny. The lower birth to weaning ADG and weaning weights in daughters from RNS cows could potentially be a fetal programming effect where cows on winter range without supplement had the least BW gain over the treatment period. Heifer progeny ADG during the spring and summer period was not affected ($P > 0.46$) by previous dam treatment. Heifers born to MS cows had greater ($P < 0.01$) percent of mature BW than heifers from RNS cows. At heifer prebreeding and pregnancy diagnosis, BW was greater ($P < 0.02$) in daughters born to MS cows than RNS cows. Pubertal status and pregnancy rate were similar ($P > 0.31$) among heifer progeny. Furthermore, calving rate and the proportion of heifers calving in the first 21 d did not differ ($P > 0.36$) among dam treatments.

Experiment 2

March-born Heifer Gain and Reproductive Performance

Heifer BW, ADG, and reproductive performance are summarized in Table 4. Weaning and initial BW was not different ($P \ge 0.52$) between over-winter treatments. March-born HAY heifers had greater ($P < 0.01$) ADG during the treatment period than MDW heifers, leading to a greater BW following the treatment period. However, spring (April 22 to May 22) ADG was greater ($P < 0.01$) for March-born MDW heifers compared with HAY heifers.

Table 5. Effect of overwinter treatment on May-born heifer gain and reproductive performance

	Treatment[1]			
Item	HAY	MDW	SEM	*P*-value
n	128	130		
Initial treatment BW, lb	419	419	9	0.99
Post-treatment BW, lb	573	507	15	<0.01
Treatment ADG,[2] lb/d	1.30	0.77	0.11	<0.01
Spring ADG,[3] lb/d	1.96	1.92	0.24	0.66
Prebreeding BW,[4] lb	707	652	9	<0.01
Summer ADG,[5] lb/d	1.08	1.26	0.24	<0.01
Percent of mature BW,[6] %	58	54	1	<0.01
Pregnancy diagnosis BW, lb	789	758	7	<0.01
Pubertal,[7] %	79	65	18	0.02
Pregnancy rate, %	72	68	4	0.69
Calving rate[8], %	67	65	5	0.88
Calved in first 21 d, %	64	79	6	0.02

[1]HAY = heifers received ad libitum hay and 4 lb/d (32% CP DM) supplement from Jan 15 to Apr 15; MDW = heifers grazed meadow and received 1 lb/d (32% CP DM) supplement from Jan 15 to Apr 15.
[2] Jan 5 to May 10 (125 d), includes the treatment period.
[3] May 10 to July 9 (67 d).
[4] Determined July 9.
[5] July 9 to Sept 10 (63 d).
[6]Percent of mature BW at breeding based on mature cow BW of 1,218 lb.
[7]Considered pubertal if blood plasma progesterone concentration > 1 ng/mL.
[8]Percentage of heifers that calved.

Throughout the summer (May 22 to Sept. 10), ADG tended (*P* = 0.09) to be greater for the MDW heifers. The greater spring and summer ADG most likely reflects a compensatory gain effect exhibited by the MDW heifers. However, HAY heifer BW at breeding and pregnancy diagnosis continued to be greater than MDW heifers. Percent of mature BW prior to the breeding season was greater (*P* < 0.01) for HAY compared with MDW. However, pubertal status prior to breeding and pregnancy rate did not differ (*P* ≥ 0.82) between HAY and MDW heifers. Furthermore, calving rate and the proportion of heifers calving in the first 21 d was not different (*P* ≥ 0.33) between over-winter treatments.

March-born Calving Performance

Calf birth BW did not differ (*P* = 0.70) among progeny from different heifer over-winter treatments (66 vs 66 ± 2 lb; HAY vs MDW, respectively). The proportion of bull calves born was not different (*P* = 0.32) between HAY and MDW heifers. Additionally, calving ease, calf vigor, and dystocia rate were similar (*P* > 0.62) between treatments. Udder score, however, was more desirable (*P* = 0.03) for MDW vs. HAY heifers. Rebreed pregnancy rate was not different (*P* > 0.52) between HAY and MDW heifers (87 ± 8%) in addition to BW at rebreeding. Furthermore, calf BW at weaning was not affected (*P* = 0.35) by heifer over-winter treatments (447 ± 9 lb).

May-born Gain and Reproductive Performance

Initial treatment BW was not different (*P* = 0.99) between treatments (Table 5). Similar to March-born heifers, May-born heifers on HAY had greater (*P* < 0.01) ADG during the treatment period. Spring ADG did not differ (*P* = 0.66) between treatments, and summer ADG was greater (*P* < 0.01) for MDW heifers, likely due to a compensatory gain effect. Post-treatment, prebreeding, and pregnancy diagnosis BW was greater (*P* < 0.01) for HAY compared with MDW heifers. Therefore, increased growth rates following the treatment period for MDW heifers did not result in similar heifer BW following these time periods. Percent of mature BW prior to the breeding season was greater (*P* < 0.01) for HAY (58%) compared with MDW (54%). More May-born heifers on HAY were (*P* = 0.02) pubertal prior to breeding than MDW. Pregnancy and calving rates were similar (*P* ≥ 0.69) between treatments, although, the proportion of heifers calving in the first 21 d was greater (*P* = 0.02) for MDW compared with HAY. Heifer development system did not impact pregnancy rate in the March or May replacement heifers; however, March heifer pregnancy rate was greater (*P* < 0.01) than in May (87 vs. 70 ± 3%). The lower pregnancy rate in May heifers may be due to declining forage quality during the later breeding season (Table 1).

May-born Calving Performance

Calf birth BW (64 ± 2 lb) and calf weaning BW (368 ± 11 lb) were similar (*P* > 0.36) for progeny from HAY and MDW dams. The proportion of bull calves born did not differ (*P* = 0.95) between HAY and MDW heifers. Additionally, calving ease, calf vigor, dystocia rate, and udder score were similar (*P* > 0.71) between development treatments. Rebreed pregnancy rate was not different (*P* = 0.60) between development (80 ± 8%) treatments in addition to heifer BW (*P* = 0.31) at rebreeding.

Implications

In Exp. 1, calf weaning BW and ADG from birth to weaning were less for daughters from cows that grazed winter range without supplementation than daughters from other dam treatments, potentially a result of fetal programming due to lower body weight gain in cows grazing winter range without supplement. However, reproductive performance did not differ among heifer progeny from dams that received different overwinter treatments. In Exp. 2, heifer development system did not impact final pregnancy rates; however, March-born heifer pregnancy rate was greater compared with May-born heifers. A reduced input winter heifer development system is a viable option in both early and late summer breeding seasons.

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