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Effect of Winter Grazing System and Supplementation on Beef Cow and Progeny Performance

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Summary

Cows grazed winter range (WR) or corn residue (CR) during late gestation and received protein supplement (PS) of 1 lb/day 28% CP cubes or no supplement (NS). Pre-calving and pre-breeding body weight (BW) and body condition score (BCS) were greater for PS and CR cows. Pregnancy rate was not affected by treatments. Calf weaning BW was greater for PS cows that grazed WR. Final BW and 12th rib fat tended to be greater for steers from cows on CR. Steers from PS cows graded a higher proportion USDA Choice or greater. More heifers were pubertal before breeding from dams receiving PS on WR. Dam treatment did not affect heifer pregnancy rate.

Introduction

Protein supplementation of spring calving beef cows grazing dormant Sandhills range during late gestation does not improve cow reproductive performance (*2006 Nebraska Beef Report*, pp. 7-9), despite the fact nutrient requirements are greater than nutrient content of the grazed forage. Supplementation does increase progeny weaning weight and fertility of heifer progeny (*2006 Nebraska Beef Report*, pp. 7-9; *2006 Nebraska Beef Report*, pp. 10-12). Corn crop residue provides a winter grazing alternative more economical than harvested forage. Decreasing harvested forage needs can reduce breakeven costs of weaned calves or finished steers.

The fetal programming hypothesis states postnatal growth and physiology can be influenced by stimulus experienced *in utero*. Previous research (*2006 Nebraska Beef Report*, pp. 7-9; *2006 Nebraska Beef Report*, pp. 10-12) provides evidence for fetal programming of reproductive tissue and endocrine metabolism of progeny from cows grazing dormant winter range without supplementation. The objectives of the current study were to determine effects of grazing dormant Sandhills range or corn crop residue with or without supplementation on performance of cows and their progeny.

Procedure

A three-year study utilized composite Red Angus x Simmental cows and their progeny at Gudmundsen Sandhills Laboratory (GSL), Whitman, Neb., and West Central Research and Extension Center (WCREC), North Platte, Neb. Cows were used in a 2 x 2 factorial treatment arrangement to determine effects on cow and progeny performance of grazing dormant Sandhills winter range (WR) or corn crop residue (CR) and receiving protein supplement (PS) or no supplement (NS). Pregnant, spring-calving cows (n = 109) between 3 and 5 years of age were stratified by age and weaning weight of their previous calf and assigned randomly to treatment in year 1. Cows remained on the same treatment for the length of the study unless removed due to reproductive failure or injury. Pregnant 3-year-old cows were stratified by age and weaning weight of their previous calf and assigned randomly to treatment, to replace cows removed from the study and to increase cows as forage availability allowed. Data are reported for 2005 (n = 109), 2006 (n = 114) and 2007 (n = 116). Current results include three years of data through weaning, three years of feedlot and carcass data for steers, and three years of data through pregnancy diagnosis for heifers.

Cows grazing winter range were divided into four, 79-acre upland pastures; two pastures received protein supplement, two did not. Cows grazing cornstalks were maintained in four fields; two fields received protein supplement.

On a pasture or field basis, cows received the equivalent of 1 lb/day of 28% CP supplement three times/week or no protein supplement from Dec. 1 until Feb. 28. The supplement contained 62.0% dried distillers grains plus solubles, 10.6% wheat middlings, 9.0% cottonseed meal, 5.0% dried corn gluten feed, 5.0% molasses, 3.0% calcium carbonate and 2.0% urea on a DM basis. Additionally, the supplement was formulated to meet vitamin and trace mineral requirements of the heifers and to supply 80 mg/animal/day monensin (Rumensin, Elanco Animal Health, Indianapolis, Ind.).

After winter grazing, cows were managed in a common group and fed hay harvested from subirrigated meadows and protein supplement. Cows returned to upland range in late May and remained in a common group throughout the breeding season until the subsequent winter grazing period. Cows were exposed to fertile bulls at a ratio of approximately one bull to 25 cows for 60 days each year.

Pre-calving, pre-breeding and weaning BW and BCS (1-9; 1 = emaciated, 9 = obese) were recorded each year. Cows were not limit fed prior to weighing. A subset of cows (n = 12-15 per treatment) was assigned randomly to one of four weigh-suckle-weigh groups. Milk production data were collected each year in late May, prior to the grazing season and at weaning. Pregnancy was diagnosed via rectal palpation and/or transrectal ultrasonography 60 or more days following the end of the breeding season.

Treatments included only dam winter grazing system and late gestation protein supplementation; no further treatments were applied to calves. Approximately 14 days following

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Table 1. Effects of grazing WR or CR and PS during the last trimester of gestation on cow performance and reproduction.

	Treatment[1]					Treatment *P*-value[2]		
Trait	PS/WR	NS/WR	PS/CR	NS/CR	SEM	Sys	Supp	S*S
Pre-calving BW, lb	1105[a]	1032[b]	1169[c]	1144d	44	< 0.001	< 0.001	0.02
Pre-calving BCS	5.11[a]	4.75[b]	5.34[c]	5.20a	0.05	< 0.001	< 0.001	0.03
Calf birth date, day	83[a]	89[b]	82[a]	84[a]	2	0.24	0.02	0.03
Calf birth BW, lb	79	77	81	80	0.99	0.01	0.10	0.46
Calved in first 21 days, %	83[a]	62[b]	78[a]	78[a]		0.31	0.06	0.02
Pre-breeding BW, lb	996	974	1054	1041	27	< 0.001	0.06	0.67
Pre-breeding BCS	5.22	4.99	5.36	5.22	0.05	< 0.001	< 0.001	0.32
Pre-breeding calf BW, lb	198[a]	187[b]	203[a]	203[a]	2	< 0.001	0.01	0.01
May 24-hour milk, lb	11.9	11.7	13.2	12.6	2.2	0.11	0.41	0.69
Nov. 24-hour milk, lb	5.5	6.2	8.4	8.4	0.9	< 0.01	0.69	0.55
Calf weaning BW, lb	518[a]	485[b]	518[a]	518[a]	7	0.01	0.03	< 0.01
Calf adj. 205 day BW, lb	485[a]	465[b]	489[a]	487[a]	13	0.01	0.03	0.07
Cow weaning BW, lb	1056	1043	1094	1100	18	< 0.001	0.80	0.30
Cow weaning BCS	5.13	5.07	5.08	5.14	0.07	0.83	0.06	0.20
Pregnancy rate, %	96.4	92.6	97.7	95.3	—	0.46	0.20	0.96

[1]PS = dams supplemented with 1 lb/day 28% CP during gestation; NS = dams not supplemented; CR = dams grazed winter corn residue; WR = dams grazed winter range.
[2]Sys = winter system; Supp = supplementation treatment; S*S = winter system by supplementation treatment interaction.
[abc]Within a row, means without a common superscript differ at $P < 0.05$.

weaning, calves were transported to WCREC, North Platte, Neb. After arrival, steers were limit fed a starter diet containing 35% ground alfalfa hay, 40% wet corn gluten feed, 7.5% supplement and 17.5% dry-rolled corn at 2.0% of BW (DM basis) for five days, prior to being weighed on two consecutive days. At this time, an initial implant containing 20 mg estradiol benzoate and 200 mg progesterone (Synovex S, Ft. Dodge Animal Health) and moxidectin (Cydectin, Ft. Dodge Animal Health) were administered. Approximately 100 days prior to estimated harvest date, steers were implanted with 24 mg estradiol and 120 mg trenbolone acetate (Revelor S, Intervet). Steer calves were penned by dam treatment and replication and were adapted over 21 days to a finishing diet including 48% dry-rolled corn, 40% wet corn gluten feed, 7% ground alfalfa hay and 5% supplement (DM basis).

Steers were harvested when estimated visually to have 0.5 inches fat thickness over the 12th rib when fed for an average of 222 days. Steers were harvested at a commercial abattoir, and carcass data were collected.

Heifers remained in a single group for approximately 50 days following transport to WCREC. They were acclimated to a diet consisting of corn gluten feed and low quality forage. In year 1, heifers were fed 25% WCGF and 75% prairie hay (DM basis) *ad libitum*. In year 2, heifers were allowed *ad libitum* intake of 20% wet corn gluten feed and 80% (DM basis) of a forage mix including wheat straw and alfalfa hay ground together. In year 3, heifers were allowed *ad libitum* intake of 20% wet corn gluten feed and 80% meadow hay (DM basis). Interim BW and blood samples were collected every 14 days to determine approximate age at puberty. Subsequently, heifers from WR cows in year 1 and a subset of heifers from each treatment in years 2 and 3 were assigned randomly to one of four pens containing Calan gates to evaluate individual feed efficiency.

Following completion of the individual feeding period (minimum 84 days) in early May each year, heifers returned to GSL. Heifers were exposed to bulls (1:25 bull:heifer) for a 45-day breeding season. Pregnancy diagnosis was performed via transrectal ultrasonography approximately 45 days following completion of the breeding season.

Continuous data were evaluated using PROC MIXED of SAS (SAS Inst., Inc., Cary, N.C.). The statistical model included winter grazing system, protein supplementation and the interaction. Cow age was included as a covariate for cow performance traits. Year was included as a random variable in all analyses, and pen-within-year for individually fed heifer data. Binomial data, including reproductive performance and quality grade, were analyzed using Chi-square procedures in PROC GENMOD of SAS.

Results

Cow BW and BCS after the winter grazing period and prior to calving were affected by the winter grazing system and protein supplementation (Table 1). Heavier BW and greater BCS were recorded for PS and cows grazing CR. These results are similar to those of Stalker et al. (*2006 Nebraska Beef Report*, pp. 7-9), who reported cows grazing winter range lost 64 lb and 0.6 BCS if not supplemented, but maintained both if they received 1 lb/day of 42% CP supplement during this period. Calving date also was later with fewer cows calving the first 21 days of the season for NS cows grazing WR but not CR.

Calf birth BW was greater if their dams grazed corn residue rather than winter range and tended ($P = 0.10$) to increase with protein supplementation. This is somewhat surprising because previous research using the

Table 2. Effects of dam grazing system and PS during the last trimester of gestation on gain and carcass merit of steers.

	Treatment[1]					Treatment P-value[2]		
Trait	PS/WR	NS/WR	PS/CR	NS/CR	SEM	Sys	Supp	S*S
Beginning feedlot BW, lb	528[a]	483[b]	516[a]	533[a]	24	0.01	0.06	< 0.001
ADG, lb/day	3.74	3.66	3.74	3.66	0.14	0.98	0.19	0.99
Final live BW, lb	1364	1304	1355	1353	28	0.22	0.06	0.08
HCW, lb	825[a]	789[b]	820[a]	819[a]	17	0.22	0.06	0.08
12[th] rib fat, in	0.50	0.46	0.49	0.47	0.03	0.93	0.14	0.56
REA, in^2	13.7	13.7	13.9	13.9	.30	0.29	1.00	0.56
Yield grade	2.92	2.68	2.82	2.77	0.18	0.93	0.10	0.28
Quality grade, % Choice	82.5	77.8	86.8	64.4	—	0.71	0.05	0.30

[1]PS = dams supplemented with 1 lb/day 28% CP during gestation; NS = dams not supplemented; CR = dams grazed winter corn residue; WR = dams grazed winter range.
[2]Sys = winter system; Supp = supplementation treatment; S*S = winter system by supplementation treatment interaction.
[abc]Within a row, means without a common superscript differ at $P < 0.05$.

same cow herd did not find differences in calf birth BW due to supplementation of dams grazing winter range (*2006 Nebraska Beef Report*, pp. 7-9; *2006 Nebraska Beef Report*, pp. 10-12). Despite a relatively small magnitude of difference, winter grazing system and protein supplementation did affect birth BW of calves in the current study.

Pre-breeding cow BW and BCS were increased by winter grazing of corn residue and protein supplementation (Table 1). The interaction of grazing system and supplementation was no longer significant, but groups ranked nearly the same as they had before calving. Milk production did not differ by treatment in May but was greater in November for cows that previously grazed CR. Calf BW was increased in May by protein supplementation when cows grazed WR but not CR.

At weaning, actual and adjusted calf BWs were greater for calves from PS cows grazing winter range. Similar effects of dam supplementation during winter grazing on calf weaning BW were reported in previous studies (*2006 Nebraska Beef Report*, pp. 7-9; *2006 Nebraska Beef Report*, pp. 10-12). Cow BW and BCS at weaning were not affected by supplementation, but cows that grazed corn residue the previous winter were heavier at weaning than those that grazed winter range, despite similar BCS. Pregnancy rate was not affected by PS or winter system. Stalker et al. (*2006 Nebraska Beef Report*, pp. 7-9) also reported no benefit of PS on winter range on subsequent pregnancy rates.

Effects of dam treatment on steer progeny feedlot performance are shown in Table 2. Feedlot initial BW differed due to the interaction of dam grazing system and supplementation. However, feedlot average daily gain (ADG) was similar between treatments. Steers from cows that were supplemented tended to have heavier final live BW and hot carcass weight. External fat thickness measured over the 12[th] rib was not affected by winter treatment or supplementation of the dam. A greater proportion of steers born to PS cows achieved USDA quality grades of Choice or greater. However, dam grazing system did not affect quality grade. These data suggest a potential fetal programming effect of late gestation cow supplementation on subsequent steer progeny intramuscular fat deposition. Using only cows that grazed winter range, Stalker et al. (*2006 Nebraska Beef Report*, pp. 7-9) were unable to identify any significant differences in steer progeny feedlot or carcass data. However, they did note a tendency for increased proportions of steers grading Choice or higher if their dams were supplemented with protein during late gestation, with a comparable magnitude of difference as observed in the current study.

Heifer progeny from cows in the current study achieved similar ADG from weaning until breeding regardless of dam treatment (Table 3). Heifers born to cows that grazed WR with NS were lighter at breeding and pregnancy diagnosis compared to heifers from all other treatments. Heifers born to PS cows were younger at puberty than progeny of NS cows; weight at puberty was not affected by dam treatment. More heifers were cyclic before breeding from dams receiving PS on WR than from dams on CR. It is important to note heifers from WR cows were individually fed in year 1, while heifers from CR cows were not. In years 2 and 3, heifers from both systems were individually fed. The difference in environment in year 1 may have contributed to apparent differences in age at puberty. Final pregnancy rate was not affected by dam treatment. Previous research indicated a fetal programming effect of late gestation maternal nutrition on heifer progeny fertility, independent of age at puberty and percent cycling before the breeding season (*2006 Nebraska Beef Report*, pp. 10-12).

There were no differences in dry matter intake (DMI) or ADG due to dam protein supplementation. However, heifers from unsupplemented cows gained more efficiently, both in terms of residual feed intake (RFI) and gain-to-feed ratio (G:F), than heifers from supplemented cows. Average daily gain was greater for heifers born to cows that grazed WR than cows that grazed CR, but DMI was similar between grazing systems.

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Table 3. Effects of dam grazing system and PS during the last trimester of gestation on growth and reproduction of heifers.

	Treatment[1]					Treatment P-value[2]		
Trait	PS/WR	NS/WR	PS/CR	NS/CR	SEM	Sys	Supp	S*S
Act. weaning BW, lb	509	480	513	505	13	0.05	0.02	0.17
Adj. 205 day BW, lb	478[a]	454[b]	479[a]	480[a]	10	0.04	0.08	0.04
Gain while on test, lb/day	1.85[a]	1.80[a]	1.54[b]	1.78[a]	0.15	0.02	0.11	0.02
Gain, weaning to breeding, lb/day	1.11	1.07	1.04	1.12	0.12	0.80	0.58	0.20
DMI, lb/day	16.4	16.9	15.8	16.2	0.6	0.74	0.95	0.16
F:G, lb feed/lb gain	8.88[a]	8.90[a]	10.71[b]	9.24[a]	10	0.002	0.03	0.02
RFI	-0.01[a]	-1.03[b]	0.03[a]	0.04[a]	0.33	0.02	0.02	0.02
Pre-breeding BW, lb	712	677	712	716	2	0.14	0.22	0.10
Pubertal prior to breeding, %	91	72	77	81	—	0.47	0.20	0.06
Age at puberty, day	352	372	347	360	8	0.27	0.03	0.65
Pregnancy diagnosis BW, lb	811[ab]	785[a]	817[a]	826[b]	16	0.13	0.58	0.26
Pregnancy diagnosis BCS	5.80	5.82	5.75	5.89	0.04	0.33	0.27	0.06
Pregnancy rate, %	90.5	77.1	87.8	83.3	0.07	0.76	0.12	0.45

[1]PS = dams supplemented with 1 lb/day 28% CP during gestation; NS = dams not supplemented; CR = dams grazed winter corn residue; WR = dams grazed winter range.
[2]Sys = winter system; Supp = supplementation treatment; S*S = winter system by supplementation treatment interaction.
[abc]Within a row, means without a common superscript differ at $P < 0.05$.

Heifers born to cows that grazed WR were more efficient in terms of G:F and RFI than counterparts from CR cows. Specifically, heifers born to cows that grazed CR with PS had a lower G:F than those whose dams received other treatments. Furthermore, RFI was lowest for heifers born to cows that grazed WR and did not receive PS compared to all other treatments. Previously, RFI and DMI appeared to be affected by late gestation supplementation dependent upon postpartum dam treatment *(2006 Nebraska Beef Report*, pp. 10-12).

Grazing corn residue resulted in greater cow BW and BCS throughout the production year and increased steer final BW; PS reduced heifer age at puberty versus NS. Calf weaning BW and percentage of heifers pubertal before breeding increased with PS of WR cows, while PS improved steer quality grade in both systems.

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