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Nebraska Beef Cattle Reports

Animal Science Department

2019

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Summary with Implications

May-calving dams in late gestation grazed either sub-irrigated meadow with or without supplement or upland range with or without supplement. Supplementation was 1 lb/d of a 33% CP (DM) supplement. Heifer progeny from these dams were followed through their first and second breeding seasons. Both dam grazing and supplement treatment affected heifer progeny BW and BCS. Heifers born to dams who grazed meadow in late gestation attained a greater percentage of mature BW at the start of their first breeding season and increased pregnancy rates as primiparous cows. Grazing of meadow by May-calving dams in late gestation may increase stayability of heifer progeny. Although supplementing the dam during late gestation tended to increase heifer progeny BW at first breeding, the increased risk of dystocia at heifer's first parturition may negate the benefit.

Introduction

Late gestation for a May-calving herd occurs during early grass growth, which allows forage CP and TDN to meet or exceed dam requirements. Rapid growth of the fetus occurs in late gestation and is particularly sensitive to imbalances in maternal nutrition. Data examining maternal overconsumption of protein on progeny postnatal development is limited and largely inconclusive. Differences in forage species and consequent protein and energy levels can affect heifer progeny postnatal growth and reproductive performance. Previous research (*2006 Nebraska Beef Cattle Report*, pp. 10–12) with March-born heifer progeny demonstrated increased pregnancy rates if their dam was protein supplemented in late gestation. This may have been a result of increasing dam dietary protein to adequate levels, as forage is dormant during late gestation of a March-calving herd. Early research (*2018 Nebraska Beef Cattle Report*, pp. 24–27) on this study indicated May-born heifer progeny whose dams grazed upland range without supplement tended to have decreased birth and weaning BW. The objective of the current study was to evaluate the effect of maternal grazing system and supplementation on heifer progeny through their first and second breeding seasons, as well as heifer progeny's first calf BW.

Table 1. Predicted[1] composition of diets offered to May-calving dams in late gestation[2]

	Meadow		Range	
	NS	S	NS	S
January				
CP, % mid-gestation req.[3]	85.9	95.8	70.4	80.3
NEm, % mid-gestation req.[4]	96.9	99.0	118.4	120.4
February				
CP, % late gestation req.[5]	139.2	146.8	73.8	82.3
NEm, % late gestation req.[6]	76.4	79.1	104.5	106.4
March				
CP, % late gestation req.	251.9	255.7	153.2	159.5
NEm, % late gestation req.	143.6	143.6	143.6	143.6
April				
CP, % late gestation req.	320.7	322.8	160.3	167.1
NEm, % late gestation req.	144.5	144.5	156.4	156.4

[1]Diet composition predicted using a computer model based on NRC, 2000 equations.

[2] May-calving dams were arranged in a 2 × 2 factorial at weaning in January and were assigned to 1 of 2 grazing treatments: sub-irrigated meadow (M) or upland range (R) for 116 d and then to 1 of 2 supplementation treatments: 1 lb/d of 33% CP (DM) supplement (S) or no supplement (NS) for 85 d.

[3]CP expressed as a percentage of requirement for mid-gestation multiparous dams (7.1% CP, DM; NRC, 2000).

[4]NEm expressed as a percentage of the requirement for mid-gestation multiparous dams (0.45 Mcal/lb; NRC, 2000).

[5]CP expressed as a percentage of requirement for late gestation multiparous dams (7.9% CP, DM; NRC, 2000).

[6]NEm expressed as a percentage of the requirement for late gestation multiparous dams (0.50 Mcal/lb; NRC, 2000).

Procedure

Dam Management

Dam management has been reported in detail (*2019 Nebraska Beef Cattle Report*, pp. 9–11). For 6 years, dams were arranged in a 2 × 2 factorial on approximately d 160 of gestation. Dams were assigned to graze either upland range (R) or sub-irrigated meadow (M), and then assigned to receive either no supplement (NS) or 1 lb/d (S) of a 33% CP (DM) supplement. Grazing treatment continued for approximately 116 ± 2 d (mean ± SD) while supplementation treatment continued for approximately 85 ± 2 d (mean ± SD). Predicted dietary CP and TDN values are presented in Table 1 for each treatment combination. Dams were managed as a single herd the remainder of the year.

Heifer Progeny Management

Heifers (n = 310) were weaned at 8 mo of age and assigned to 1 of 2 development treatments from January to May (*2018 Nebraska Beef Cattle Report*, pp. 24–27). At 14 mo of age, heifers entered their first breeding season. On d-10 and 0 of the breeding season, blood samples (5 mL)

Table 3. Effect of grand-dam late gestation nutrition[1] on May-born calf BW

	M		R			*P*-value[2]		
	NS	S	NS	S	SEM	Graze	Supp	G × S
n	44	45	40	46				
Birth	64	66	64	66	2	0.38	0.08	0.86
2 mo	194	192	194	198	4	0.21	0.74	0.19
Wean (6 mo)	351	359	353	366	9	0.59	0.17	0.80

[1]May-calving grand-dams were arranged in a 2 × 2 factorial at weaning in January and were assigned to 1 of 2 grazing treatments: sub-irrigated meadow (**M**) or upland range (**R**) for 116 d and then to 1 of 2 supplementation treatments: 1 lb/d of 33% CP (DM) supplement (**S**) or no supplement (**NS**) for 85 d.

[2] Graze = grazing treatment, Supp = supplementation treatment, and G × S = grazing and supplement interaction.

season were affected ($P \geq 0.12$) by dam treatment. Conversely, heifers born to supplemented dams tended ($P = 0.06$) to attain a higher percentage of mature BW at the start of the breeding season (60 vs. 59 ± 0.5%, S vs. NS). Furthermore, heifers whose dams grazed meadow in late gestation also had increased ($P = 0.01$) percentage of mature BW attained by start of their first breeding season (60 vs. 59 ± 0.5%, M vs. R). In late gestation, the bovine fetus is undergoing hypertrophy of muscle fibers and hyperplasia of adipocyte tissue. Both meadow grazing and supplementation of the dam resulted in an increased percentage of mature BW attained at start of the heifer's first breeding season, suggesting these treatments may have altered development of muscle or adipose tissue. In this study, there does not appear to be a correlation between percentage of mature BW attained by the start of their first breeding season and pubertal attainment ($r^2 = 0.04$). Leptin, a key regulator in pubertal attainment, has been shown to be altered by developmental programming, and may have affected pubertal attainment. Although leptin was not measured in the current study, it is possible leptin concentrations were altered by dam treatments and further research is warranted.

At pregnancy diagnosis in mid-October, heifers had a similar ($P \geq 0.13$) BW and BCS. Heifer pregnancy rate was also similar ($P \geq 0.29$) among dam treatments, in contrast to what Martin et al. (*2006 Nebraska Beef Cattle Report*, pp. 10–12) observed with March-born heifer progeny born to protein-supplemented dams. Prepartum BW and BCS were also similar ($P \geq 0.13$). At calving, dystocia was increased ($P = 0.02$) for heifers if their dams were supplemented in late gestation (9 vs. 20 ± 5%, NS vs. S); however, dam grazing treatment had no effect ($P = 0.54$).

At the beginning of the subsequent breeding season, heifer BW was not different ($P \geq 0.10$) between treatments; however, there was a pasture × supplement interaction ($P = 0.04$) for BCS. Second prebreeding BCS was greatest for heifers born to MS dams, intermediate for MNS and RNS, and least for RS. Late gestation maternal treatments may have altered fetal tissue development, leading to differences in apparent fatness of heifer progeny. Postpartum interval was decreased ($P = 0.03$) in heifers whose dams grazed meadow (89 vs. 95 ± 2 d, M vs. R), while supplementation had no effect ($P = 0.99$). At second pregnancy diagnosis in November, dam supplementation tended ($P = 0.06$) to increase heifer BW (899 vs. 877 ± 7 lb, S vs. NS). Furthermore, a grazing × supplement interaction ($P = 0.01$) was detected for heifer BCS at second pregnancy diagnosis, with MS again having the highest BCS, RNS and RS intermediate, and MNS lowest. Additionally, the percentage of primiparous cows diagnosed pregnant with their second calf was increased ($P = 0.02$) if their dam grazed meadow in late gestation (91 vs. 76 ± 5%, M vs. R).

Previous work with developmental programming has suggested differences in late gestation maternal nutrition may alter progeny postnatal muscle or adipose cell growth and proliferation. This may explain the differences in heifer progeny BW and BCS, particularly during prebreeding and pregnancy diagnosis as a primiparous cow. Furthermore, heifers whose dams grazed meadow in late gestation had a decreased PPI and increased rebreed pregnancy rates as primiparous cows. Throughout all of these physiological processes, regulation of the hypothalamic-pituitary-gonadal axis is key. Leptin is a key mediator in all these processes, as well as in conceptus implantation.

Performance of Heifer Progeny First Calf

First calf BW from heifer progeny is presented in Table 3. Grand dam grazing treatment did not affect ($P \geq 0.21$) calf BW at birth, prebreeding, or wean. Alternately, grand dam supplementation treatment tended ($P = 0.08$) to increase calf birth BW (66 vs. 64 ± 2 lb, S vs. NS), but did not affect ($P \geq 0.17$) any other measurement. This may have contributed to the calving difficulties previously described.

Conclusions

Dams who grazed meadow in late gestation gave birth to heifer progeny who attained an increased percentage of mature BW by their first breeding season, decreased PPI, and increased pregnancy rates as primiparous cows. Dam supplementation in late gestation resulted in heifer progeny who gave birth to heavier calves and experienced increased dystocia rates. Although the level of dietary CP offered to the dam found in this study is unlikely in confined operations fed a constant ration, forage-based operations have little control over plant growth. Differences in forage growth during gestation may have long-term implications for the beef cattle production system.

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