2009

Post Weaning Management Of Heifer Calves Impacts Average Daily Gain And Feed Efficiency As Pregnant Heifers

D. M. Larson
West Central Research and Extension Center

Tonya L. Meyer
University of Nebraska-Lincoln, tl.meyer@live.com

L. A. Stalker
West Central Research and Extension Center, stalkera@byui.edu

Richard N. Funston
University of Nebraska - Lincoln, rfunston2@unl.edu

Proceedings, Western Section, American Society of Animal Science

Vol. 60, 2009

POST WEANING MANAGEMENT OF HEIFER CALVES IMPACTS AVERAGE DAILY GAIN AND FEED EFFICIENCY AS PREGNANT HEIFERS

D.M. Larson, T.L. Meyer*, L.A. Stalker and R.N. Funston
West Central Research and Extension Center, North Platte, NE

ABSTRACT: Three experiments evaluated replacement heifer development systems and subsequent effects on gain and efficiency of pregnant heifers. In Exp. 1 and 2, were developed grazing corn residue (**CR**; 422 ± 5 kg) or fed in a dry lot (**DL**; 446 ± 5 kg) prior to breeding. In Exp. 1, a subset of pregnant heifers (n = 40) were individually fed a diet composed of 90% grass hay (11.7 % CP; DM basis) and 10% of a wet distillers grains plus solubles/straw mixture (21.8 % CP; DM basis) during late gestation. In Exp. 2, 55 pregnant heifers that grazed CR (437 ± 8 kg) or were fed in a DL (445 ± 8 kg) prior to breeding, or a mixture of the two (435 ± 8 kg), grazed CR with a supplement (0.45 kg/d; 28% CP) during late gestation. In Exp. 3, 49 pregnant heifers that grazed CR (396 ± 7 kg) or dormant winter range (**WR**; 401 ± 7 kg) prior to breeding, or a mixture of the two (396 ± 8 kg), grazed CR with a supplement (0.45 kg/d; 28% CP) during late gestation. In Exp. 1, pregnant heifers developed in the DL had a greater (P = 0.04) DMI than heifers developed grazing CR, however ADG was not different (P = 0.29). Thus, pregnant heifers developed in the DL had a lower (P = 0.08) G:F than heifers developed grazing CR. In Exp. 2, pregnant heifers grazing CR during late gestation that grazed CR during development gained more (P = 0.04), and maintained a greater (P = 0.08) BCS prior to calving, than heifers developed in the DL. The mixture of CR and DL developed pregnant heifers had an intermediate ADG. In Exp. 3, pregnant heifers grazing CR during late gestation that grazed CR during development gained more (P = 0.02) than heifers that grazed WR or the combination of WR or CR developed heifers. Heifer BCS prior to calving was similar (P = 0.81) in Exp. 3. Heifers grazing CR post weaning gain more and are more efficient while grazing CR as pregnant heifers. The benefit of grazing CR post weaning is most pronounced compared to heifers developed in the DL. These data provide evidence of an adaptive response to grazing low quality forages and may be beneficial in the critical period leading up to the first calving season.

Key Words: Adaptation, Low quality forage, Primiparous heifer

Introduction

Current recommendations indicate a heifer should reach approximately 65% of mature BW by the first insemination for successful reproduction (Patterson et al., 1992). However, recent data demonstrate heifers reaching less than 58% of mature BW by breeding do not display impaired reproductive performance (Funston and Deutscher, 2004; Martin et al., 2008). Heifers developed on an excessively high plane of nutrition have impaired milk production, which reduces productivity (Ferrell et. al., 1976). Heifers developed grazing corn residue (**CR**) gain less during winter grazing, but compensate during the summer, yet are lighter prior to first calving (Larson et al., 2009). Perhaps cows developed grazing CR are more efficient. Lighter cows may have smaller liver mass (Jenkins et al., 1986) and a smaller liver mass is associated with improved feed efficiency (DiCostanzo et al., 1991). There is also anecdotal evidence of a learning curve associated with grazing CR. It may be that cows grazing CR as virgin heifers are better adapted to graze CR prior to calving.

The objective of the current experiments was to evaluate the effect of replacement heifer development system on subsequent gain and efficiency of pregnant heifers.

Materials and Methods

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

Experiment 1. The effect of heifer development system on ADG and feed efficiency during gestation was evaluated. Following weaning, predominately Angus-based heifers were transported to the West Central Research and Extension Center (**WCREC**), North Platte, NE. After a receiving period, heifers were blocked by initial BW and randomly assigned to graze CR (n = 50) or consume a diet in a dry lot (**DL**; n = 50).

The CR heifers grazed for approximately 88 d and were offered 0.45 kg/d of a 28% CP (DM basis) supplement daily. Following CR grazing, heifers grazed dormant mixed grass upland range with 0.45 kg/d of a 28% CP (DM basis) supplement daily for 60 d. Heifers then entered the DL and were offered a common diet for 47 d until completion of AI. Following weaning, heifers assigned to the DL grazed mixed upland winter range and were offered 0.45 kg/d of a 28% CP (DM basis) supplement daily for 45 d. Heifers then entered the DL and were offered a common diet for 128 d until completion of AI. The DL diet was formulated to achieve an ADG allowing heifers to reach approximately 65% of mature BW (600 kg) prior to AI (NRC, 1996).

Estrus was synchronized using MGA/PGF followed by estrus detection and AI. After AI, heifers were exposed to fertile bulls at a rate of least one bull:50 heifers for 60 d. Approximately 45 d after AI, first service conception was determined via transrectal ultrasonography and final pregnancy rate was determined via transrectal ultrasonography 45 d after bulls were removed. After pregnancy diagnosis, non-pregnant heifers were sold. During the breeding season and until individual feeding began in October, heifers grazed mixed grass upland summer range in a single group.

Primiparous heifers pregnant by AI (n = 40) were blocked by previous development system and BW. Only heifers pregnant by AI were used to remove variation due to period of gestation. Heifers were originally developed grazing CR (422 ± 5 kg; n = 20) or fed in a DL (446 ± 5 kg; n = 20) prior to first breeding. Heifers were individually fed once daily using a Calan Broadbent feeding system. The heifers were trained to use the system for approximately 25 d prior to the beginning of the 70-d test period. Body weight was measured for three consecutive d at the beginning and end of the study to compute an average. Interim BW was measured every 14 d. The pregnant heifers consumed a diet composed of 90% grass hay (11.7 % CP; DM basis) and 10% of a wet distillers grains plus solubles/straw mixture (21.8 % CP; DM basis) during late gestation. Individual feed offered was recorded daily and individual feed refusal was recorded weekly. Data were analyzed using the MIXED procedure of SAS with the fixed effect of development system and pen as random effect.

Experiment 2. Pregnant heifers grazed CR prior to calving with a supplement (0.45 kg/d; 28% CP) to evaluate effect of heifer development system prior to first breeding on gain during late gestation. Heifers utilized in Exp. 2 were from the same herd as heifers in Exp. 1 and were developed following the same protocols through pregnancy diagnosis. However, heifers used in Exp. 2 were pregnant as a result of a combination of either AI or natural mating.

Pregnant heifers (n = 55) were blocked by BW and mating type and sorted into three groups. The treatment groups included: heifers developed prior to breeding in a DL (445 ± 8 kg; n = 18), heifers developed prior to breeding grazing CR (437 ± 8 kg; n = 18), and a mixture of the two development systems (MIX; 435 ± 8 kg; n = 19). Heifers were transported to CR December 1 and returned to WCREC February 18, grazing CR for 80 d. While grazing CR during late gestation, heifers were offered the equivalent of 0.45 kg/d of a 28% CP (DM basis) supplement provided three times per wk. Heifer BW was measured at d 1, 51 and 80. In addition, heifer BCS was assessed at d 80.

Experiment 3. The effect of development system prior to breeding on gain during late gestation while grazing CR was evaluated. Composite Red Angus × Simmental heifer calves (n = 90) from the Gudmundsen Sandhills Laboratory (**GSL**) near Whitman, NE were assigned randomly by initial BW (225 ± 2 kg) to graze CR or winter range (**WR**) between weaning and the breeding season. Grazing treatments were initiated approximately 30 d after weaning, beginning in mid-November, and continuing through mid-May. Heifers either grazed WR pastures at GSL or were transported to CR fields and grazed for 88 d. A daily supplement was offered (0.45 kg/d; 28% CP) while grazing. Subsequently, all heifers grazed WR for 100 d until breeding with a daily supplement (0.45 kg/d; 28 % CP). Estrus was synchronized with a single i.m. injection of $PGF_{2\alpha}$ administered 108 hr after bulls were turned in with the heifers. Heifers were exposed to fertile bulls (1 bull:25 heifers) for 45 d. Pregnancy diagnosis was performed via transrectal ultrasonography approximately 45 d following completion of the breeding season. After pregnancy diagnosis, non-pregnant heifers were sold. During the breeding season and until grazing CR, heifers grazed upland Sandhills range.

A subset of the pregnant heifers (n = 49) were blocked by BW and sorted into three groups: heifers developed prior to breeding grazing WR (401 ± 7 kg; n = 17), heifers developed prior to breeding grazing CR (396 ± 7 kg; n = 17), and a mixture of the two development systems (MIX; 396 ± 8 kg; n = 15). Pregnant heifers grazed CR during late gestation with a supplement (0.45 kg/d; 28% CP) provided three times per wk in late gestation. Heifers were transported to CR fields December 1 and returned to GSL February 18, grazing CR for 80 d. Heifer BW was measured at d 1, 51, and 80. In addition, heifer BCS was assessed at d 80.

Statistical analysis (Exp. 2 and 3). The corn residue fields were of differing acreage and corn yield. According to the data of Wilson et al. (2004), corn yield influences the carrying capacity of a corn residue field. The relationship between yield and carrying capacity is mass of leaf and husk per acre = ([bushels/acre corn yield x 38.2] + 429) x 0.39. Assuming the forage mass to support 1 AUM is equal to 311 kg of biomass and a 50% utilization rate, then the carrying capacity of a corn residue field may be calculated. The number of AU represented by each individual heifer and the number of AUM supported by the acreage of the field was utilized to adjust the gain data. Subsequently, data were analyzed with MIXED procedure of SAS (SAS Inst. Inc., Cary, NC). The model included the fixed effects of previous winter development treatment and AUM per field per animal.

Results and Discussion

Heifer gain data for Exp. 1 is summarized in Table 1. In Exp. 1, pregnant heifers developed prior to breeding in the DL had a greater ($P = 0.04$) DMI than heifers developed grazing CR, however ADG was not different ($P = 0.29$). Thus, pregnant heifers developed in the DL had a lower ($P = 0.08$) G:F than heifers developed grazing CR. Previous data indicated heifers developed to a greater weight prior to breeding had a greater liver mass at 72 months of age (Arnett et al., 1971). DiCostanzo et al. (1991) found that cows with a greater liver mass consumed more DM, and were less efficient, than cows with less liver mass. Heifers developed grazing CR were lighter prior to calving than heifers developed in the DL (Larson et al., 2009). Perhaps these lower BW heifers were more efficient due to differences in metabolism. The CR developed heifers may also have experienced compensatory gain, linked to alterations in metabolic hormones such as IGF-1 and T3/T4 (Yambayamba et al., 1996).

Heifer gain data for Exp. 2 is summarized in Table 2. Pregnant heifers grazing CR during late gestation that grazed CR during development gained more ($P = 0.04$), and tended to maintain a greater (P = 0.08) BCS prior to calving, than heifers developed in the DL. The mixture of CR and DL developed pregnant heifers had an intermediate ADG but were not different from CR or DL. Heifer gain data for Exp. 3 is summarized in Table 3. In Exp. 3, pregnant heifers grazing CR during late gestation that grazed CR during development gained more (P = 0.02) than heifers that grazed WR or the combination of WR or CR developed heifers. Heifer BCS prior to calving was similar (P = 0.81) in Exp. 3.

Heifers that previously grazed CR were more efficient (DiConstanzo et al., 1991) or experienced more compensatory gain (Yambayamba et al., 1996) than heifers developed in the DL. Heifers developed grazing CR also gained more than heifers developed grazing WR, although precalving BW was not different (Larson et al., 2009). It seems likely a mechanism other than a change in efficiency is partially responsible for the difference in gain.

Previous data has suggested cattle require an acclimation period to grazing corn residue. Research conducted by Fernandez-Rivera and Klopfenstein (1989 a and b) determined that naïve cattle require a learning period when grazing corn residue. Dietary starch content indicated younger cattle consumed less starch in the first 3 wks of grazing compared to older, experienced cattle (Fernandez-Rivera and Klopfenstein, 1989a). Thus, naïve cattle gained less weight early in the grazing season and may lose weight early in the grazing season (Fernandez-Rivera and Klopfenstein, 1989b). Perhaps heifers originally grazing CR during development were better prepared to graze as pregnant heifers, leading to selection of higher quality nutrients and greater gain. Moreover, heifers developed in the DL, grazing CR during the first pregnancy combined with heifers developed grazing CR, gained more than DL developed heifers grazing separately. Although heifers developed grazing CR had a greater BCS prior to calving than heifers developed in the DL, there was no precalving BCS difference between WR and CR developed heifers. Thus, it appears exposing heifers to low quality forage during development better prepares them for grazing CR during the first pregnancy.

Implications

These data provide evidence of an adaptive response to grazing low quality forages and may be beneficial in the critical period leading up to the first calving season. Not only does grazing CR during development improve feed efficiency, but also prepares heifers for grazing CR during pregnancy. Grazing low quality forage during development may produce a heifer better adapted to a lifelong grazing system.

Literature Cited

Arnett, D. W., G. L. Holland and R. Totusek. 1971. Some effects of obesity in beef females. J. Anim. Sci. 33:1129-1136.

DiCostanzo, A., J. C. Meiske and S. D. Plegge. 1991. Characterization of energetically efficient and inefficient beef cows. J. Anim. Sci. 69:1337-1348.

Fernandez-Rivera, S. and T. J. Klopfenstein. 1989a. Diet composition and daily gain of growing cattle grazing dryland and irrigated cornstalks at different stocking rates. J. Anim. Sci. 67: 590-596.

Fernandez-Rivera, S., T. J. Klopfenstein and R. A. Britton. 1989b. Growth response to escape protein and forage intake by growing cattle grazing cornstalks. J. Anim. Sci. 67:574-580.

Ferrell, C. L., W. N. Garrett and N. Hinman. 1976. Growth, development and composition of the udder and gravid uterus of beef heifers during pregnancy. J. Anim. Sci. 42:1477-1489.

Funston, R. N. and G. H. Deutscher. 2004. Comparison of target breeding weight and breeding date for replacement beef heifers and effects on subsequent reproduction and calf performance. J. Anim. Sci. 82:3094–3099.

Jenkins, T. G., C. L. Ferrell and L. V. Cundiff. 1986. Relationship of components of the body among mature cows as related to size, lactation potential and possible effects on productivity. Anim. Prod. 43:245.

Larson, D.M. A.S. Cupp and R.N. Funston. 2009. Extending grazing in heifer development systems decreases cost without compromising production. In Proc. West. Sec. Amer. Soc. Anim. Sci. vol. 60.

Martin, J. L., K. W. Creighton, J. A. Musgrave, T. J. Klopfenstein, R. T. Clark, D. C. Adams and R. N. Funston. 2008. Effect of prebreeding body weight or progestin exposure before breeding on beef heifer performance through the second breeding season. J. Anim. Sci. 86:451-459.

NRC. 1996 (2000 update). 2000. Nutrient requirements of beef cattle (7th Ed.). National Academy Press, Washington, DC.

Patterson, D. J., R. C. Perry, G. H. Kiracofe, R. A. Bellows, R. B. Staigmiller and L. R. Corah. 1992. Management considerations in heifer development and puberty. J. Anim. Sci. 70:4018–4035.

Wilson C.B., G.E. Erickson, T.J. Klopfenstein, R.J. Rasby, D.C. Adams and I.G. Rush. 2004. A review of corn stalk grazing on animal performance and crop yield. Nebraska Beef Rep. MP 80-A:13-15.

Yambayamba, E. S. K., M. A. Price and G. R. Foxcroft. 1996. Hormonal status, metabolic changes, and resting metabolic rate in beef heifers undergoing compensatory growth. J. Anim. Sci. 74:57-69.

Table 1. Effect of heifer development system on ADG and feed efficiency of pregnant heifers, Exp. 1

	Treatment[1]			
	DL	CR	SEM	*P*-value
n	20	20		
Initial BW, kg	446	422	5	0.002
Final BW, kg	500	480	6	0.03
DMI, kg	11.7	11.1	0.3	0.04
ADG, kg/d	0.75	0.81	0.04	0.29
G:F, g/ kg	0.065	0.073	0.0	0.08

[1] DL = heifers developed in a dry lot; CR = heifers developed on corn residue.

Table 2. Effect of heifer development system on ADG of pregnant heifers grazing CR, Exp. 2

	Treatment[1]				
	DL	CR	MIX	SEM	*P*-value
n	18	18	19		
Initial BW, kg	445	437	435	8	0.71
Final BW, kg	466	486	469	9	0.27
ADG, kg/d	0.31^{x}	0.58^{y}	0.44^{xy}	0.07	0.04
BCS	5.14	5.47	5.47	0.14	0.08

[1] DL = heifers developed in a dry lot; CR = heifers developed on corn residue; MIX = mixture of heifers from DL and CR treatments.

^{xy} Means without a common superscript differ ($P \leq 0.05$).

Table 3. Effect of heifer development system on ADG of pregnant heifers grazing CR, Exp. 3

	Treatment[1]				
	WR	CR	MIX	SEM	*P*-value
n	17	17	15		
Initial BW, kg	401	396	396	8	0.86
Final BW, kg	434	442	429	8	0.54
ADG, kg/d	0.41^{x}	0.60^{y}	0.43^{x}	0.05	0.02
BCS	5.2	5.27	5.18	0.10	0.81

[1] WR = heifers developed on winter range; CR = heifers developed on corn residue; MIX = mixture of heifers from WR and CR treatments.

^{xy} Means without a common superscript differ ($P \leq 0.05$).