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Economics of early weaning in northern great plains beef cattle production system

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ABSTRACT

Early removal of the calf from its dam reduces forage needs of the cow-calf enterprise and has been found to improve BW gain and pregnancy rates in the cow herd. However, early weaning may not always be economically viable for producers and the risk should be considered carefully. This study was conducted to evaluate the effect of early and normal weaning of steer and heifer calves on net income at weaning. Calves from Angus × Hereford dams were randomly assigned to one of two weaning treatments. Calves were either early weaned (EW) at 80-d of age or remained with their dams until normal weaning (NW) at 213-d of age. Calves assigned to EW treatment received a 17.5% crude protein and 0.82 Mcal/kg net energy diet for approximately 130-d in a drylot. All economic analyses were conducted at normal weaning for both NW and EW calves. At normal weaning, price of steers ($US/kg) was lower ($P = 0.003$) and weaned steer value ($US/steer) was greater ($P < 0.01$) for EW steers; however, no difference ($P = 0.18$) was found in price of heifers ($US/kg) and weaned heifer value ($US/heifer) between NW and EW heifers. Feed cost was increased ($P < 0.001$) in EW steers and heifers compared to NW calves. Net revenue for both weaned steers and heifers was reduced ($P < 0.001$) in EW calves due to the feed cost of the growing diet. This study indicates that early weaning calves at 80-d of age decrease weaned calf value and net revenue for the cow-calf segment.

Keywords: Age at Weaning; Beef Cattle; Production Economics

1. INTRODUCTION

In extensive arid and semi-arid environments, inter-annual precipitation is highly variable and drought situations can commonly occur. During these drought situations, forage supply is reduced, pressuring cow-calf management to consider appropriate stocking rates and their effect on acceptable reproductive and calf weaning performance. As precipitation declines, reduced forage quality and quantity can negatively influence livestock production [1,2], which will impact milk production and calf gains [3,4]. Therefore, weaning calves early can result in improved animal performance by increasing pregnancy rates, cow body condition scores [5], and increased steer carcass quality [6]; while reducing forage needs of the cow-calf enterprise. Furthermore, early weaning has been reported to improve overall calf gain, efficiency, and quality grades of steers [7].

Simulation economic modeling has indicated that weaning calves at 6 mo of age results in the greatest present value for gross income in a cow-calf enterprise [8]. Blanco *et al.* [9] reported that income received for early weaned calves may be greater than traditionally weaned calves. Therefore, the objectives of this study were to evaluate the effect of early (approx. 80-d) and normal (approx. 215-d) weaning of steer and heifer calves on net income at weaning and total cost of heifer development.

2. MATERIALS AND METHODS

The study was conducted in the Northern Great Plains at the USDA-ARS, Fort Keogh Livestock and Range Research Laboratory (LARRL), located approximately 1.6 km west of Miles City, MT (46˚22'N 105˚5'W), USA at an average elevation of 730 m. Native vegetation on the 22,500-ha research laboratory consists of a grama-needlegrass-wheatgrass (*Bouteloua-Stipa-Agropyron*) mix. The long-term average precipitation is 343 mm with about 65% occurring during the mid-April through mid-

September growing season. The average annual forage standing crop at the study site is 870 ± 14 kg/ha [10].

The LARRL Institutional Animal Care and Use Committee approved all animal handling and experimental procedures utilized in the present studies.

A complete description of the materials and methods used were reported by [11-13]. Crossbred cows (predominantly Angus × Hereford) were stratified within cow age by calf sex and age, and then randomly assigned within strata to one of two weaning treatments at the start of breeding. Calves were removed from cows at the start of breeding (EW; 80-d postpartum) or at normal weaning (NW; approximately 213-d postpartum). Early weaning diets differed from NW diets only in amounts of ruminally degradable and undegradable protein (RDP and RUP, respectively). Calves assigned to EW treatments received: 1) 33:67 forage: concentrate diet containing 17.5% CP (31% RUP) and 0.82 Mcal/kg NEm (EW-69); or 2) 33:67 forage: concentrate diet containing 17.5% CP (43% RUP) and 0.84 Mcal/kg NEm (EW-57). Early weaning diet did not affect EW calf performance, so data were pooled and EW treatments were analyzed together for the economic analysis. Steer and heifer calves were allocated to 3 pens within each early weaning treatment, with diets fed ad libitum and adjusted daily by previous day's intake. At time of normal weaning, all calves were co-mingled in lots. Steer calves that were normal weaned were preconditioned in drylots with EW calves for 22 or 28 d after weaning before being shipped to a commercial feedlot.

The economic analyses of weaning performance of the two calf weaning strategies were conducted using the data and results from [11-13]. In addition, the economic analysis evaluated performance based on market prices and weaning weights. All calves were valued at time of normal weaning using a 10-yr live weight average (Livestock Marketing Information Center, 2002-2011). A grazing fee was assigned to NW calves based on average leased price ($16.20/animal unit month, AUM) of private rangeland in Montana (National Agricultural Statistics Service, 2008). Animal unit equivalents used for calves was suggested by [14]. Early weaned calves were charged yardage at $0.25/calf/d. Net revenue was calculated from weaned calf value minus feed costs.

An evaluation of potential revenue from three 100-cow herds was conducted with a 2-yr partial budget of 3 weaning scenarios using the data and results found in **Tables 1** and **2**. The 3 weaning scenarios were NW, EW,

Table 1. Economic returns of early weaning or normal weaning steer calves at Fort Keogh Livestock and Range Research Laboratory, Miles City, MT, USA.

	Treatment[1]			
Measurement	NW	EW	SEM	*P*-value
Feed cost, $US/steer	23.56	148.99	0.89	<0.001
Price of calves, $US/45 kg	118	114	2	0.003
Weaning BW, kg	256	269	6	--
Weaned calf value, $US/steer	665.52	673.74	7.67	0.004
Net revenue, $US/steer	641.96	532.05	16.87	<0.001

[1]NW = steer calves remained on their dams at time normal weaning (215-d of age); EW = calves weaned approx. d 80 postpartum and received a weaning diet consisting of 33:67 forage:concentrate diet containing 17.5% CP and 0.82 Mcal/kg NEm.

Table 2. Economic returns of early weaning or normal weaning heifer calves at Fort Keogh Livestock and Range Research Laboratory, Miles City, MT, USA.

	Treatment[1]			
Measurement	NW	EW	SEM	P-value
Feed cost, $US/heifer	21.48	150.22	0.91	<0.001
Price of calves, $US/45 kg	106	106	1	0.58
Weaning BW, kg	252	256	5	--
Weaned calf value, $US/heifer	587.44	597.64	7.40	0.18
Net Revenue, $US/heifer	565.96	447.41	12.62	<0.001

[1]NW = heifer calves remained on their dams at time normal weaning (215-d of age); EW = calves weaned approx. d 80 postpartum and received a weaning diet consisting of 33:67 forage:concentrate diet containing 17.5% CP and 0.82 Mcal/kg NEm.

and the economic analysis of selling calves (SEW) at EW instead of developing them in a drylot. Live weight prices, weaned calf value, and net weaning revenue for both heifers and steers were conducted separately. Total revenue for each cow herd was calculated with 50% of the calves being steers and 50% being heifers. The second year of the partial budget was utilized to analyze any difference in revenue due to pregnancy rates. Calves were not early weaned in yr 2 of the model; therefore, weaning calf BW was estimated from the previous year's NW group.

Statistical Analysis

Normality of data distribution was evaluated using PROC UNIVARIATE procedure of SAS (SAS Inst. Inc., Cary, NC). Economic data for normal and early weaned calves were analyzed using the MIXED procedure in SAS (SAS Inst. Inc., Cary, NC, USA) with a model that included weaning treatment (NW or EW) with pen and year included in the RANDOM statement. Least squares means were used to compare differences between significant variables at $P \leq 0.05$. Differences between means were tested by PDIFF with the Tukey adjustment.

3. RESULTS AND DISCUSSION

3.1. Early Weaning Steer Calves

Weaning net income per calf was calculated using the feed and performance data measured by [11-13]. At time of normal weaning, price ($US/45 kg) of steers were greater ($P = 0.003$; **Table 1**) for NW steer compared to EW steers. Thus, price differences were due to greater weaning BW for EW steers as found by [13]. However, precipitation was near normal average with good quality and quantity of forage as shown by [11]; which did not result in large differences in weaning BW. Weaned steer value ($US/steer) at normal weaning was greater ($P = 0.004$) for EW steers. Net revenue increased ($P < 0.001$) after deducting weaning feed costs in NW steers relative to EW steers. Therefore, the lack of finding large differences in weaning BW between NW and EW calves and the increased cost of weaning in EW calves resulted in decreased weaning revenue by early weaning in years of good forage conditions. Although the economic analysis in the current study was up to weaning, Barker-Neef *et al.* [15] suggested that early weaning results in reduced returns to a cow-calf enterprise if ownership of calves was retained through harvest due to substantially lighter carcass weights. Peterson *et al.* [16] reported that early weaning resulted in $(US) 95.26 less on net income than for normal weaned cow-calf pairs. This benefit reported by [16] was primarily due to shifting costs from cow winter feed costs to the early-weaned calf.

3.2. Early Weaning Heifer Calves and Heifer Development

At time of normal weaning, price ($US/45 kg) of heifer and weaned heifer value ($US/heifer) were not different ($P \geq 0.18$; **Table 2**) between NW and EW heifers calves due to similar BW. However, net revenue was greater ($P < 0.001$) for NW heifers, due to decreased weaning feed costs.

3.3. Hypothetical Partial Budget

An evaluation of potential revenue from three 100-cow herds was conducted with a 2-yr partial budget (**Table 3**) of 3 weaning scenarios using the data and results from [11-13]. The 3 weaning scenarios were NW, EW, and the economic analysis of selling calves at EW (SEW) instead of developing them in a dry lot. The number of days associated with feed costs was 130 and 0 for EW and SEW; respectively. Feed costs were greatest with EW and weaned calf values were the greatest with EW steer and heifer calves compared to NW and SEW calves. In yr 1, net revenue was 19% and 40% less for EW and SEW, respectively compared to NW. The increase in net revenue for NW in yr 1 was due to a decrease in feed costs compared to EW and increased calf income compared to SEW. However, early-weaned calves fed a growing diet in a drylot was more economically viable than selling calves immediately after early weaning. Early weaning reduces the nutrient requirements of range cows and enables them to recover BW earlier. This additional BW gain achieved is coupled with a shortened postpartum interval and can improve pregnancy rates [15]. Therefore, an increased profit potential the subsequent year may occur due to the increased reproductive efficiency. Pregnancy rates averaged for the study year were 93%, 95%, and 95% for NW, EW, and SEW, respectively [11]. Consequently, EW and SEW cow herds in yr 1 had an increase in net revenue in yr 2 of 2% more calves compared to the NW cow herd. This increase in revenue is the sum of an increase in pregnancy rates allowing for greater calf crop the following year. However, the increase in revenue did not account for income from cull cows or the cost of developing additional heifers to replace culled open cows.

Sensitivity analysis was conducted to predict performance responses that would generate similar economic outcome for EW compared to NW. With the given calf production assumption, costs of EW supplementation would have to be $(US) 21.88/calf for net revenue to be similar between NW and EW, respectively. Alternatively, pregnancy rates would have to decrease by 19% (*i.e.*, 76% and 95% for NW and EW, respectively) to offset the cost of the early weaning supplement utilized in the experiment.

Table 3. A model results comparing cost and net revenue for 3 calf weaning strategies for three 100-cow herds for 2 consecutive years. Data from the economic analysis at Fort Keogh Livestock and Range Research Laboratory, Miles City, MT, USA were used to construct the 2-yr partial budget.

	Treatment[1]		
Year 1	**NW**	**EW**	**SEW**
No. of cows	100	100	100
Days of weaning supplementation	130	130	0
Early weaning calf feed cost, $US/calf			
Steer	$23.56	$148.99	$0.00
Heifer	$21.48	$150.22	$0.00
Weaning weight, kg			
Steer	256	269	120
Heifer	252	256	115
Price of calves, $US/45 kg			
Steer	$118	$114	$148
Heifer	$106	$106	$133
Weaned calf value, $US/calf			
Steer	$665.52	$673.74	$392.20
Heifer	$587.44	$597.64	$337.82
Net weaning revenue, $US/calf			
Steer	$641.96	$532.05	$392.20
Heifer	$565.96	$447.41	$337.82
Total revenue, $US/100 hd	$60396.00	$48973.00	$36501.00
Difference, $	--	−$11423.00	−$23895.00
%	--	19%	40%
Pregnancy rates, %	93	95	95
Year 2			
Weaning weight, kg			
Steer	256	256	256
Heifer	252	252	252
Price of calves, $US/45 kg			
Steer	$117	$117	$117
Heifer	$106	$106	$106
Weaned calf value, $US/calf			
Steer	$659.88	$659.88	$659.88
Heifer	$587.24	$587.24	$587.24
Total revenue/cow herd, $US	$57991.08	$59238.20	$59238.20
Difference	--	$1247.12	$1247.12

[1]NW = calves remained on their dams at time normal weaning (215-d of age); EW = calves weaned approx. d 80 postpartum and received a weaning diet consisting of 33:67 forage:concentrate diet containing 17.5% CP and 0.82 Mcal/kg NEm; SEW = calves sold immediately after early weaning (approx. d 80).

In conclusion, results suggest that early weaning calves during years of good quality and quantity of forage are not as profitable as normal weaning due to increased production costs. However, during years of drought conditions, early weaning and feeding calves in a drylot could potentially be a cost-effective management decision compared to selling light-weight calves at early weaning. Furthermore, for early weaning to be an economically viable option for producers, improved reproductive efficiency would have to occur to overcome increased production costs. Early weaning can reduce net income in the short term; however, avoiding overgrazing and reducing the need to liquidate the cow herd may have greater long-term financial benefits.

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