

BIOLOGICAL AND ECONOMICAL ASPECTS OF AN ACCELERATED, VALUE-ADDED COW-CALF PRODUCTION SYSTEM UTILIZING IMPROVED, IRRIGATED PASTURES

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ABSTRACT: The major objective of the study was to determine the biological and economical aspects of an accelerated, value-added cow-calf, production system. This system contains three major components, which are grazing, feedlot and wintering periods. Thirty-two mature, crossbred, beef cows (700 kg) with superior milking ability (10 kg/d) were selected and mated to bulls known for exceptionally rapid growth EPD. From May through October, cow-calf pairs grazed improved, irrigated pastures using management intensive grazing practices. On September 1, calves were stratified into early weaned (EW) and normal weaned (NW) groups. The EW were weaned from their dams and placed back on pasture September 1, while the NW remained with their dams on pasture until weaning on November 1. On November 1, all calves were placed in a feedlot and stepped up to an 80% concentrate finishing diet in 21 d. Cows were wintered December through April, on either ammoniated wheat straw (AWS) supplemented with alfalfa hay (AH) or the cows grazed standing corn plants (GSCP). Feed inputs were monitored daily during each period. Calves and cows were weighed on a monthly basis and cows were body condition scored at the same time. All economic inputs and outputs were analyzed using actual market data. Profits were estimated when ownership of calves were retained through the feedlot period. With cows wintered on AWS/AH, profits of \$83.59 and \$91.08/cow were estimated for EW and NW calves, respectively. With cows wintered on GSCP, profits of \$119.64 and \$127.94/cow were estimated, respectively. Regardless of weaning strategy (EW vs. NW), carcasses were of acceptable size (498 kg vs. 506 kg, $P = 0.25$) and finish (USDA high-select, $P = 0.60$)

Key words: Cow-calf, Irrigated pastures, Value-added

Introduction

Large portions of the landmass in the western United States are managed by state and federal government agencies. The following percentages of land are under government management: Nevada, 87.6; Utah, 75.2; Idaho, 70.4; Arizona, 56.8; Wyoming, 55.9; New Mexico, 47.4; and Colorado, 43.3. In most of these states, the cow-calf industry is dependant on the leasing of public lands for grazing. For example, it is estimated that 70% of the cow-calf producers in Utah are heavily dependent on grazing public-land (Utah Ag Statistics, 2002).

One of the standard arguments of groups favoring the removal of livestock from public lands is that such a removal would have minimal impact on the U.S. beef cattle industry due to the low proportion of the U.S. beef cow herd utilizing these lands. However, many rural economies and societies would be devastated by such curtailments. Such groups counter that lost revenues could easily be regenerated from other public land uses such as recreation. A detailed study of such a proposal indicated that this would not likely be the case in Utah (Snyder, 1995).

Cow-calf producers are receiving pressure from groups favoring the curtailment and/or elimination of livestock grazing on public lands. A coalition of nearly 100 such groups are supporting legislation that would propose the buyout of public land grazing permits using government funding (WLJ, 2002). Ranchers in southeastern Utah have recently experienced the creation of a national monument. Although the creation of this monument did not preclude existing grazing permits, the critical scrutiny of ranchers utilizing those permits increased significantly.

Most ranchers that utilize public lands for grazing also own parcels of irrigated land usually used for the production of hay to winter cow herds. This study describes the biological and economical aspects of an accelerated, value-added cow-calf production system using such lands as improved, irrigated pastures as an alternative to public land grazing.

Materials and Methods

To match the relatively high available nutrient density of improved, irrigated pastures, large framed cows (frame score 6-7)(700 kg, BCS 5) with superior milking ability (10 kg/d) were selected for the study. Cows were mature (5-8 yr), commercial crossbreds resulting from a rotational crossbreeding program involving Angus, Hereford, Gelbvieh and Tarentaise.

Cows were bred for calving in March and April. Estrus was synchronized using two injections of PGF_{2α} 10 d apart. Following the second injection, cows were artificially inseminated 12 h after exhibiting standing heat. Cows primarily of Angus breeding were mated to a high-growth Hereford bull (Blazer, AHA19248097) with a yearling weight EPD of + 39.5 kg. Cows lacking substantial Angus breeding were mated to a high-growth Angus bull (GT Maximum, AAA11160685) with a

yearling weight EPD of + 47.7 kg. This breeding management was instituted to: 1) stack pedigrees for rapid growth capability, 2) maintain a high level of heterosis, and 3) insure a high degree of Angus breeding for early marbling in the resultant calves. Any cows not conceiving to artificial insemination within 45 d were excluded from the study. Extra cows were managed in this manner to insure that 32 cow-calf pairs were available for the study. Resultant calves were terminal steers and heifers managed for harvest. Anabolic implants were not used.

During November of the wintering period, cows grazed in common on grass hay aftermath (11.6% CP, 1.1 Mcal NE_m/kg). Cows were allowed controlled access to approximately 11 Mcal NE_m/cow/d (10 kg DM/cow/d) using the New Zealand electric polywire fencing system. Cows were then stratified by body weight and breed type into eight groups of four cows each and placed in eight adjacent wintering pens (December through April). The diet consisted of ad-libitum access to ammoniated wheat straw (AWS) (8.9% CP, 76.4% NDF) supplemented with alfalfa hay (AH) (18.1% CP, 41.1% NDF). Straw was ammoniated using the stack method (Sunstøl and Coxworth, 1984), with the injection of anhydrous ammonia at 3% of DM in baled straw. A vitamin-mineral supplement designed to rectify deficiency associated with the AWS/AH diet was offered at a rate of 204 g DM/cow/d. The amount of AH offered was gradually increased throughout the wintering period to meet the increasing nutritional demands of late gestation, early lactation and winter weather.

May through October, cow-calf pairs grazed improved, irrigated pastures consisting of a mixture of “Ambassador” orchard grass (*Dactylis glomerata*) and “Regar” meadow brome (*Bromus biebersteinii*). Cow-calf pairs were allowed ad-libitum access to pasture forage using management intensive grazing practices with pairs receiving a new paddock allotment each 24 h at 1500 h using the New Zealand electric polywire fencing system. Forage consumed by the pairs was estimated daily using a corrected visual appraisal method (Stockdale, 1984) with the paddock size adjusted daily to accommodate ad-libitum intake.

Pasture sprinkler irrigation water and ammonium nitrate application management was designed for low rates and more frequent intervals than normally applied for hay production. Water and ammonium nitrate were applied to paddocks as soon as could be managed after cow-calf pairs grazed. Ammonium nitrate was applied at a rate of 112.3 kg/ha at the beginning of each month (June through October). Irrigation was applied at a rate of 9.3 cm/ha (May), 16.4 cm/ha (June), 20.0 cm/ha (July), 19.7 cm/ha (August), 19.4 cm/ha (September) and 11.5 cm/ha (October).

On September 1, calves were stratified into four groups of eight calves each based on BW, sex and breed type. Two groups were weaned September 1 (EW), while the other two groups remained with their dams until November 1

(NW). The EW calves were placed back on improved, irrigated pasture with intakes measured daily as described above. Their dams were also placed on improved, irrigated pasture with intake limited to maintain a BCS of 5-6. The NW calves remained with their dams on improved, irrigated pasture with intakes measured daily.

On November 1, all calves were placed in the feedlot and rapidly stepped up to a high-energy finishing diet. Calves remained in groups into which they were originally stratified when on pasture. Diet/nutrient intake of each group was measured daily through the finishing period. As the calves approached an acceptable harvest weight, USDA quality and yield grades were estimated using ultrasound analysis (Aloka SSD – 500V, Model US1-115C, Aloka Co., LTD., 6-22-1 Mure, Mitaka-shi, Tokyo, 181 Japan). Calves that were estimated to be USDA high select or low choice were marketed through a commercial packer. Carcasses were subjected to standard USDA quality and yield grading procedures by professional graders.

After the calves were weaned, sixteen of the cows were selected to graze standing silage-type corn plants (DK662RR) from November 1 to February 11 as an economical and biological comparison to cows being wintered on the AWS/AH program. Cows weighed 645 kg (BCS 4.8) and were 150 d in gestation at the beginning of the study. The paddock was 1.11 ha, with the spacing between rows at 76.2 cm. Grazing was controlled using the New Zealand electric polywire fencing system.

Cows were allowed access to two rows at a time. The first row remained standing and the second row was laid down using an all-terrain vehicle. The electric polywire was stretched over the laying row. After the cows grazed the standing row, the cattle pulled the laying row of corn from under the electric polywire fence. When utilization was complete, the polywire was moved to the next two-row set.

Yield and consumption of DM was measured each d over a 10 d period. The number of stalks per row was estimated by counting stalks in a 1 m section at 20 m intervals linearly down the row. One stalk was cut to grazing height from each 20 m interval. Stalks were then chopped and individually dried in a forced-air oven for 72 h at 60°C. Thus, DM was estimated by stalks/row x DM/stalk. Cows were allowed ad-libitum access to a vitamin-mineral supplement designed to rectify nutrient deficiencies associated with grazed corn plants.

During the entire production cycle associated with this study, all cows and calves were weighed and cows received a BCS the first week of each month. Feed intakes were measured daily. Feed and non-feed costs associated with this production system were estimated from local 10-yr average market values. Data were analyzed using E Views 4 (Quantitative Micro Software, LLC, 4521 Campus Drive, #336, Irvine, CA 92612-2699).

Results and Discussion

Cow Wintering Period

Cows were in acceptable BW and BCS at the beginning of the wintering period November 1 (671 kg and 5.3, respectively). Consequently, intake of grass hay crop aftermath was limited to approximately 10 kg DM/cow/d, which was estimated to provide 11.7 Mcal NE_m. The value of the hay crop aftermath was estimated to be \$0.0396/kg DM.

Cows performed acceptably during the wintering period from December through April while consuming the AWS/AH diets. Cows began the period weighing 692 kg in BCS 5.5 and ended the period weighing 688 kg in BCS 5.4 with calf at side. The cost of the AWS, AH and supplement used during this period were estimated to be \$0.044/kg, \$0.088/kg and \$0.11/kg, respectively. Total feed cost was \$126.57 for the 181 d period or an average of \$0.70/cow/d. Non-feed cost estimates/cow/year are presented in Table 1, which are based on 10-yr averages and include costs associated with the feedlot period.

The estimated average NE_m requirement of the cows was 16.89 Mcal/d while in the pens. The average DMI during this period was about 12.7 kg/cow/d, so the NE_m concentration of the diets was 1.33 Mcal/kg DM.

Irrigated Pasture Grazing Period

Cows remained in acceptable BW and BCS during the pre-weaning grazing period on improved, irrigated pastures. The period began May 1, with cows weighing 688 kg in a BCS of 5.4 and ended September 1, weighing 688 kg in a BCS of 5.5. Milk production through the period was consistent and averaged 9.9 kg/d, attesting to the superior milking ability of the cows. Calves weighed 105 kg at the beginning of the period and 262 at the end (ADG = 1.27 kg). Average age of the calves at the end of the period was 157 d. Estimated DMI/ cow-calf pair during this period was 2548 kg. The value of the pasture forage, based on agronomic inputs (irrigation and fertilization) and land assessment, was estimated to be \$0.0396/kg DM. The estimated feed cost was \$100.90/pair or \$0.82/pair/d for the 123 d period.

On September 1, the cow-calf pairs were stratified into four groups. Two groups were weaned from their dams and placed back on a separate pasture during post-weaning (EW). The other two groups remained as pairs on pasture (NW). All groups remained on pasture until November 1, when remaining calves were weaned. Cows with EW calves remained in acceptable BW and BCS during this post-weaning period (September 1 through November 1). Cows began the period weighing an average of 700 kg in a BCS of 5.6 and ended weighing an average of 701 kg in a BCS of 5.5. Cows with NW calves remained in acceptable BW and BCS, averaging 676 kg in a BCS of 5.4 initially and ended the period weighing 680 kg in BCS 5.3. There was a difference in calf performance as well. The EW calves averaged 261 kg

initially and ended the period averaging 315 kg. The NW calves averaged 260 kg initially and ended the period averaging 341 kg. Calves in the EW groups gained 0.45 kg/d less than NW calves (P = 0.053).

Pasture DMI during the post-weaning period is reported in Table 2. As expected, cattle in NW groups consumed more total DM than those in EW groups (1416 vs. 1111 kg) during the 62 d period. Most of the difference can be accounted to milk production in cows with NW calves. Average milk production during this period was 8.65 kg/d. At 0.9 Mcal NE_m/kg milk produced, 7.79 Mcal NE_m would be required. It was estimated that the pasture DM produced during this period contained 1.57 Mcal NE_m/kg. Thus, 7.79 Mcal of NE_m would require 4.96 kg DM/d or about 308 kg DM for the 62 d period. With the cost of the pasture grass estimated to be \$0.0396/kg DM, feed costs during the grazing period were \$56.06 and \$43.98/pair for NW and EW groups, respectively.

Feedlot Period

Data associated with the feedlot period were analyzed with regard to when calves reached slaughter weight (Table 3)(February 11, March 22 or April 3). The NW calves that reached slaughter weight by February 11 weighed an average of 27 kg more than the EW calves that finished at the same time. By the end of the period, there were no differences in BW between NW and EW calves. However, EW calves exhibited a higher ADG (1.46 vs. 1.38 kg/d, P = 0.07). This may have been due to compensatory factors as EW calves also exhibited a slight improvement in feed efficiency. Little difference in the performance of EW or NW calves that reach slaughter weight by March 22 or April 3 was observed.

Total feed cost and cost/kg DM were substantially lower for calves reaching slaughter weight by February 11, due to: 1) fewer days on feed, and 2) a higher proportion of the overall diet coming from cheaper grower diets in the step-up series. Since there were no differences in feed inputs or costs between EW or NW calves during the feedlot period, the major point of interest is the economic importance of the calves reaching slaughter weight early (February 11) in this accelerated production system. Calves reaching slaughter weight early, required \$45.61 and \$58.43 less in feed input costs than calves reaching slaughter by March 22 or April 3, respectively.

Management of calves had no effect on carcass characteristics or age at harvest (Table 4). All carcasses were within acceptable range regarding size, quality and yield grade. Average USDA quality grade of carcasses was high-select as would be expected with an average age at harvest of 356 d.

Table 5 summarizes profit/loss associated with this accelerated, value-added cow-calf production system with regard to the weaning management of the calves and to the wintering method of the cows. All alternatives were estimated to be profitable. Weaning management of calves affected profitability only slightly with NW calves

increasing return by about 9% compared to EW calves (\$91.08 vs. \$83.59/cow/yr, respectively). This was likely due to the fact that a higher proportion of NW calves reached finish in February. The method of wintering the cows had a major impact on the profitability of this system. Even though the AWS/AH diet is usually less costly than traditional all-hay feeding systems, allowing the cows to graze standing corn plants during the wintering period reduced winter feed costs by about 28% (\$126.55 vs. \$90.50/cow/yr, respectively). This resulted in an improvement in overall profitability of about 40%. In addition, cow performance was improved with GSCP system compared to the AWS/AH diet. Cows wintered on the AWS/AH diet maintained BW and BCS, while those wintered on GSCP improved in BCS. The winter the cows were wintered on GSCP was challenging environmentally. Snow depth on the paddock averaged 31.4 cm and there were a record number of days below -18°C. Carrying capacity of the GSCP system was high, requiring only 0.1222 ha/cow/yr.

Implications

The results of this study indicate that a beef cattle production system with the following characteristics: 1) management intensive grazing on improved, irrigated pastures 2) wintering cows by grazing standing corn plants, and 3) managing the genetics, nutrition, and health of calves such that they are capable of reaching an acceptable market finish by 330 d of age is highly profitable with an estimated net profit of \$127.94/cow/year. Early versus normal weaning time of calves had little affect on profitability. This production system required 0.1222 hectare/cow/year for winter grazing of standing corn plants and 0.3414 hectare/cow-calf pair/year of improved, irrigated pasture for a total of 0.4636 hectare/cow-calf pair/year. This indicates that a family unit may consist of 250 well-matched cows and 101 hectares of irrigated land.

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Table 1. Estimated non-feed costs*cow⁻¹*year⁻¹ for the accelerated cow-calf production system

Item	\$*hd ⁻¹ *yr ⁻¹
Operating costs	
Checkoff/brand inspection	1.84
Commissions	2.68
Yardage	15.40
Veterinary medicine	14.45
Machinery (fuel, lub., repair)	7.74
Vehicles (fuel, repair)	16.13
Equipment (repair)	1.53
Housing & improvements (repair)	2.74
Hired labor	70.00
Owner labor	18.13
Interest on operating capital	16.59
Total operating cost	167.23
Allocated Costs	
Purchased livestock	22.44
Housing & improvements	21.83
Machinery	8.47
Equipment	5.60
Vehicles	18.87
Interest on retained livestock	61.66
Taxes & insurance	5.24
Overhead	10.00
Total allocated costs	154.11
Total costs excluding feed	321.34

Table 2. Dry matter intake of cows, calves and cow-calf pairs during the post-weaning grazing period on improved, irrigated pastures

Item	Avg ^a Cow BW, kg	Avg Calf ^b BW, kg	DMI ^c Cow, kg/d	DMI Calf, kg/d	DMI Pair, kg/d	Total DMI, kg	\$/Pair ^d
September							
Early weaned ^e	700	275	9.2	8.7	0.0	537	21.27
Normal weaned ^f	676	280	0.0	0.0	22.9	687	27.21
October							
Early weaned	700	302	9.2	9.3	0.0	574	22.71
Normal weaned	678	321	0.0	0.0	23.5	729	28.85
Total							
Early weaned						1111	43.98
Normal weaned						1416	56.06

^a Average monthly body weight of cow

^b Average monthly body weight of calf

^c Dry matter intake

^d \$0.0396/kg dry matter

^e Early weaned calves, September 1

^f Normal weaned calves, November 1

Table 3. Performance of calves and the economic aspects of feed inputs during the feedlot period

Item	ADG ^a , kg	DMI ^b , kg	Gain/Feed ^c	\$/kg DM ^d	\$/Calf
February finish ^e					
Early weaned ^f	1.46	884	0.167	0.0857	75.78
Normal weaned ^g	1.38	875	0.160	0.0857	74.99
P ^h	0.07				
March finish ⁱ					
Early weaned	1.42	1290	0.155	0.0950	122.55
Normal weaned	1.29	1259	0.145	0.0950	119.61
P	0.21				
April finish ^j					
Early weaned	1.33	1335	0.152	0.1016	135.64
Normal weaned	1.28	1299	0.150	0.1016	131.99
P	0.77				

^a Average daily gain

^b Dry matter intake

^c kg gain/kg dry matter intake

^d \$/kg of dry matter

^e Calves reaching finish by February 11, 330 days of age

^f Early weaned calves, September 1

^g Normal weaned calves, November 1

^h Probability greater than F score

ⁱ Calves reaching finish by March 22, 365 days of age

^j Calves reaching finish by April 3, 377 days of age

Table 4. Harvest characteristics of calves after feedlot period

Item	Early weaned ^a	Normal weaned ^b	P ^c
Age at harvest, d	360	353	0.86
Harvest weight, kg	505	498	0.25
Hot carcass weight, kg	305	308	0.09
Kidney, heart, pelvic fat, %	2.12	2.13	0.39
Ribeye area, cm ²	82.56	81.78	0.85
Backfat thickness, cm	0.72	0.73	0.16
USDA quality grade ^d	2.56	2.43	0.64
USDA yield grade ^e	2.08	2.15	0.90
BCTRC ^f , %	52.1	51.9	0.14

^a Early weaned calves, September 1

^b Normal weaned calves, November 1

^c Probability greater than F score

^d 1.5 = low-select, 2.0 = select, 2.5 = high-select, 3.0 = low-choice, 3.5 = choice, 4.0 = high-choice, 4.5 = prime

^e 1 = high-yielding carcass, 5 = low-yielding carcass

^f Boneless, closely trimmed retail cuts

Table 5. Estimated profit/loss associated with retained ownership of calves through the feedlot period compared with cows wintered on either ammoniated wheat straw/alfalfa hay or grazed standing corn plants

Item	Cow wintering method			
	AWS/AH ^a		GSCP ^b	
	EW ^c	NW ^d	EW	NW
Feed inputs, \$/head				
Wintering of cows	126.55	126.55	90.50	90.50
Grazing period ^e				
May-August	100.90	100.90	100.90	100.90
September	21.27	27.21	21.27	27.21
October	22.71	28.85	22.71	28.85
Feedlot ^f	105.94	95.59	105.94	95.59
Total feed	377.37	379.91	341.32	343.05
Non-feed cost ^g , \$/head	321.34	321.34	321.34	321.34
Ranch value, \$/head	698.71	701.25	662.66	664.39
Market value ^h , \$/head	782.30	792.33	782.30	792.33
Profit/loss, \$/head	83.59	91.08	119.64	127.94

^a November, haycrop aftermath (\$0.0396/kg DM); December-April, ammoniated wheat straw 71.23% (\$0.044/kg DM) plus alfalfa hay 28.77% (\$0.088/kg DM)

^b Grazed standing corn plants (\$0.0357/kg DM), November-April

^c Early weaned calves, September 1

^d Normal weaned calves, November 1

^e Pasture grass valued at \$0.095/kg DM

^f DM consumed x \$0.095/kg DM

^g Operating costs + allocated costs

^h Based on a 10-year historical average price for 455-545 kg finished cattle, \$1.58/kg (Salina, Utah)