Effect of two beef cattle yearling steer production systems on grazing and feedlot performance, carcass measurements and systems economics

Sentürklü Songül[1,2], Douglas Landblom[1], Robert Maddock[3] and Steve Paisley[4]

A three-year study of a retained-ownership, vertically integrated, extended-grazing system for steers that included grazing of native and annual forages prior to feedlot entry was compared with a system in which steers were sent directly to the feedlot for growing and finishing. The results suggest that a long-term extended grazing system consisting of a combination of native range, annual forages and a shortened feedlot residency supports superior steer performance, acceptable meat quality and profitability.

Summary

In western North Dakota, yearling steers graze improved and native pastures and routinely are sold during an August-September time frame. Traditional feedlot finishing is a high-risk, low-profit-margin business in which risk is managed using risk management financial instruments. The research question, integrated into a diverse cropping system, was to determine the impact of a long-term grazing period followed by a short-term feedlot finishing period on yearling steer performance, meat quality and profitability. To answer this question, a three-year study was designed using 288 yearling steers (96 steers/year) originating from two beef cattle herds maintained at the Dickinson Research Extension Center (DREC) that were divided into two frame score groups identified as small frame (SF: average frame score of 3.80) and large frame (LF: average frame score of 5.58) and backgrounded at a modest average daily gain (ADG) of 1.33 pounds/day. On the first week of May each year, the steers were assigned randomly to feedlot (FLOT) or grazing (GRAZ) treatments. Both treatment groups of steers were finished at the University of Wyoming's Sustainable Agriculture Research Extension Center (SAREC) in Lingle. The GRAZ steers grazed native range from the first week of May until mid-August (108 days), field pea-barley (32 days) and unharvested grain corn (71 days) for a total grazing period of 211 days and a finishing period of 82 days. The FLOT control steers were in the feedlot for 218 days. SF steers grew slower in the grazing phase ($P = 0.03$) and feedlot finishing growth phase ($P < 0.001$) in comparison with the LF steers ($P < 0.001$). However, under grazing conditions, grazing cost and cost/pound of gain were less for the SF steers in comparison with the LF steers ($250.27 vs. $300.27/steer; $0.5567 vs. $0.6078/pound of gain). Delaying feedlot entry resulted in improved animal performance and profitability. In the feedlot, GRAZ LF steers had greater starting weight ($P < 0.001$), ending weight ($P =

[1]Dickinson Research Extension Center, NDSU
[2]Animal Science Department, Canakkale Onsekiz Mart Universitesi, BMYO, Canakkale, Turkey
[3]Animal Sciences Department, NDSU
[4]Animal Science Department, University of Wyoming, Laramie

0.003), gain ($P < 0.001$) and ADG ($P < 0.001$). GRAZ steer compensatory feedlot gain for LF and SF steers was 26.8 and 24.0 percent greater, respectively, compared with the LF and SF FLOT treatment steers. GRAZ steer hot carcass weight (HCW) was greater for both frame score groups, compared with the FLOT steers ($P = 0.005$). Dressing percent ($P < 0.001$) and marbling score ($P = 0.02$) were greater for SF steers and rib-eye area was greater for the LF steers ($P = 0.001$). Quality grade did not differ between systems or frame score, and we found no meat tenderness ($P = 0.48$) or cooking loss ($P = 0.43$) differences between treatment groups. In the feedlot finishing phase, comparing the average FLOT and GRAZ systems, the finishing feed cost/pound of gain for the GRAZ system averaged 34.0 percent less ($P < 0.001$). Economic analysis of the vertical integration suggested that greater net return would be realized after delayed feedlot finishing, compared with selling the steers at the end of the 211-day grazing period. Net return from selling at the end of grazing was calculated to be $514.02 and $577.74/steer for the GRAZ LF and SF, respectively. At the end of finishing, the three-year average systems net return/steer was $619.94, $499.90, $896.09 and $756.92 for the FLOT LF and SF, and GRAZ LF and SF, respectively. Regardless of frame score, grazing growing steers for an extended period of time was more profitable than traditional feedlot growing and finishing. The greater profitability among the GRAZ steers was realized from a combination of lower grazing and feedlot expenses, feedlot compensatory growth and greater HCW, resulting in a greater and profitable net return for the GRAZ system.

Introduction

The forage quality of improved and native grass species is highest in the spring and early summer and declines in the summer and into fall and early winter, which is one of the primary reasons yearling stocker cattle routinely are marketed during the August-September time frame in the northern Great Plains. Long-term grazing followed by a short-term feedlot period has the potential to be a profitable enterprise, but forages that provide adequate nutrition during the period when perennial forages have lost substantial nutrient quality are needed.

One potential solution for beef producers is to grow annual forages for grazing within a diverse crop rotation. Strategically planting crop mixes and cover crops in a crop rotation preceding or following higher-value crops improves soil nutrient cycling and can provide for a longer-term forage source for yearling steers before feedlot entry.

In an extensive review article comparing calf-fed with yearling-fed cattle, when body weight (BW) or age increased before feedlot entry, average daily gain (ADG), dry-matter intake (DMI) and hot carcass weight (HCW) increased, whereas gain:feed (G:F) and days on feed (DOF) decreased (Reuter and Beck, 2013). Adams et al. (2004) documented that increasing grazing length among gestating June-calving cows and feeding supplemental protein increased net return of the calf at weaning and at slaughter.

Considering the effect that increased BW and age have on steer performance and carcass weight, the objective of this research was to evaluate, within the context of a retained-ownership, vertically integrated model, the impact of a long-term grazing period made possible by integrating annual forage grazing into a diverse crop rotation followed by a short-term feedlot finishing period to determine the effect on yearling steer performance, meat quality and profitability.

Experimental Procedures

During a three-year period, 288 yearling steers (96 steers/year) from two crossbred beef cattle herds maintained at the Dickinson Research Extension Center were used for this study. Traditional and Lowline sired calves were divided into two frame score groups identified as small frame (SF: average frame score of 3.80) and large frame (LF: average frame score of 5.58).

After weaning each fall (2012, 2013 and 2014), the steers were managed as a single group and backgrounded by grazing unharvested corn that was supplemented with mixed hay (alfalfa, bromegrass, crested wheatgrass) and 2 pounds/steer/day of a 32 percent crude protein supplement until the end of April each year.

During the multiyear backgrounding period, the steers grew at a modest ADG of 1.33 pounds/day. The first week of May each year, the steers were assigned randomly to the feedlot (FLOT) or grazing (GRAZ) treatments.

FLOT treatment steers were shipped directly to the University of Wyoming's Sustainable Agriculture Research Extension Center (SAREC) in Lingle for growing and finishing. The GRAZ steers grazed native range from the first week of May to mid-August (108 days) and then moved into a diverse crop rotation grazing field pea-barley intercrop (32 days) and unharvested corn (71 days).

The grazing season cost/steer for native range was determined using a constant cost/pound of BW of $0.00117 multiplied by the start weight and end weight to arrive at a daily grazing cost. Then, using one-half of the total number of days grazed, the first half and second half grazing charges were added together to arrive at the total grazing charge/steer.

The annual forage grazing cost for the SF steers was reduced by 20.1 percent, based on SF heifer DMI results reported by Senturklu et al. (2015). The overall total grazing period was 211 days before shipment to the University of Wyoming's SAREC feedlot.

The final finishing diet (AF Basis) consisted of 5 percent alfalfa hay, 79 percent whole corn, 14 percent haylage and 2 percent feedlot supplement with Rumensin (200 milligrams/head/day).

Due to system differences, the FLOT control steers were slaughtered in mid-December and GRAZ treatment steers were slaughtered in February-March at the Cargill Meat Solutions packing plant in Ft. Morgan, Colo. Warner-Bratzler shear force tenderness and cooking loss evaluations were conducted at the NDSU Meats Laboratory in Fargo.

Using a vertically integrated economic analysis approach, economics for the two systems and frame scores were evaluated to compare selling the steers at the end of the extended grazing period with selling them at the end of the feedlot finishing period.

Results and Discussion

Farming expenses for the annual forages in the GRAZ system are shown in Table 1. Annual forage enterprise budgets were prepared using actual expenses for seed, fertilizer, chemicals, seed inoculation and crop insurance. All other expenses were adopted from the North Dakota Farm Management education program (Region 4) crop enterprise budgets (2013-2015).

The GRAZ steer performance is shown in Table 2. Feedlot finishing performance is shown in Table 3. Carcass data is shown in Table 4. The effect of the system (GRAZ vs. FLOT) and steer frame score within each system on net return is shown in Table 5.

Results of this systems investigation show that, during the three-year period, the SF steers grew slower under grazing ($P = 0.03$) and during feedlot finishing, compared with the LF steers ($P < 0.001$). Under grazing conditions, grazing cost and cost/pound of gain were lower for the SF steers ($250.27 vs. $300.27/steer; $0.5567 vs. $0.6078/pound of gain).

In the feedlot, LF steers had greater starting weight ($P < 0.001$), ending weight ($P = 0.003$), gain ($P < 0.001$) and ADG ($P < 0.001$). The GRAZ steer compensatory gain in the feedlot for the LF and SF steers was 26.8 and 24 percent greater, respectively, compared with the LF and SF FLOT treatment steers.

Delaying feedlot entry until after 211 days of grazing reduced the finishing period to 82 days on feed (DOF) and associated finishing costs also were reduced for the SF and LF steers. Comparing the average FLOT and GRAZ systems' DM feed cost/pound of gain, the finishing feed cost/pound of gain for the GRAZ system averaged 34 percent less ($P < 0.001$).

Carcass trait measurements collected at Cargill Meat Solutions, Ft. Morgan, Colo., identified economically important differences and similarities. Hot carcass weight (HCW) for the GRAZ system steers was greater than for the FLOT ($P = 0.005$) steers. Dressing percent and marbling score were greater for SF steers in the FLOT and GRAZ treatments ($P < 0.001$; $P = 0.02$).

Rib-eye area was greater for LF steers in the FLOT and GRAZ treatments ($P = 0.001$). Quality grade did

Table 1. Farming input cost per acre for annual forage grazing[1,2].

	Pea Barley	Unharvested Corn
Seed cost/ac, $		
Corn (Pioneer P9690R)	–	58.29
Pea-barley (Perfection pea, Haybet barley)	45.73	–
Machine depreciation/ac, $	6.29	14.88
Fertilizer/ac, $	–	37.60
Fuel and oil/ac	4.81	13.76
Repairs/ac	6.33	16.34
Innoculant/ac, $	4.33	–
Chemical – pea-barley (Glyphosate, AMS, Helfire, Rifle D)/ac	12.50	–
Chemical – corn (Glyphosate, AMS, Helfire)/ac	–	8.60
Crop insurance/ac, $	3.22	11.14
Land rent/ac, $	28.60	35.74
Subtotal	111.81	196.35
Interest, 5%	5.37	9.82
Total crop input cost/ac, $	117.18	206.17
Cost/steer, $ (cost/ac x 4.3 ac fields)/8 steers	62.98	110.81

[1]3-year average crop expenses.

[2]Seed, fertilizer, chemical, inoculant and crop insurance are actual three-year average costs/ac. All other expenses are the three-year average expenses adopted from crop enterprise budgets (Region 4, North Dakota Farm Business Management education program, 2013, 2014, 2015).

not differ between systems and frame score ($P = 0.11$). We found no differences for tenderness ($P = 0.48$) or cooking loss ($P = 0.43$) between treatments.

Economic analysis of the vertical integration suggested that greater net return would be realized after delayed feedlot finishing, compared with selling the steers at the end of the 211-day grazing period. Net return from selling at the end of grazing was calculated to be $514.02 and $577.74/steer for the GRAZ LF and SF, respectively.

At the end of finishing, the three-year average systems net return/steer was $619.94, $499.90, $896.09 and $756.92 for the FLOT LF and SF, and GRAZ LF and SF, respectively. Regardless of frame score, grazing growing steers for an extended period of time was more profitable than traditional feedlot growing and finishing.

The greater profitability among the GRAZ steers was realized from a combination of lower grazing and feedlot expenses, feedlot compensatory growth and greater HCW resulting in a greater and profitable net return for the GRAZ system. During the three-year period of this study, the GRAZ system was consistently more profitable. As with any livestock system, wide changes in feed, pasture, and other production costs could result in smaller profit margins.

The results of this three-year study suggest that a yearling-steer, long-term, extended-grazing system consisting of a combination of native range, annual forages and a shortened feedlot residency produces very acceptable meat quality and favors profitability vs. a traditional feedlot system.

Table 2. Effect of frame score on extended grazing performance and cost[1].

	GRAZ[2] LF[3]	GRAZ[2] SF[3]	SEM[4]	*P*-Value Trt[4]	Yr[4]	Trt x Yr[4]
Number of steers	72	72				
Frame score	5.52	3.77	0.21	<0.001	0.01	0.56
Winter Corn Backgrounding						
Backgrounding days	163	163	0.5889	0.18	<0.001	0.01
Start weight, lb.	566.78	452.67	27.96	0.01	0.001	0.92
End weight, lb.	780.24	674.22	39.09	0.38	0.02	0.86
Gain, lb.	213.46	221.56	16.654	0.75	0.11	0.83
ADG[4], lb.	1.30	1.36	0.098	0.80	0.05	0.95
Overall Total Performance						
Grazed days	211	211				
Start weight, lb.	780.24	674.22	39.092	0.38	0.019	0.86
End weight, lb.	1274.66	1123.82	42.60	0.01	0.002	0.50
Gain, lb.	494.04	449.6	10.96	0.04	0.07	0.27
ADG[4], lb.	2.34	2.13	0.048	0.03	0.40	0.25
Grazing Cost						
Perennial pasture (108 days), $	115.30	100.24				
Field pea-barley (32 days), $[5]	62.98	50.32				
Unharvested corn (71 days), $[5]	110.81	88.53				
32% CP suppl[4]. (0.81 lb/d), $	11.18	11.18				
Grazing cost/head, $	300.27	250.27				
Grazing cost/lb of gain, $	0.6078	0.5567				

[a-b]Means with unlike superscripts differ significantly $P \leq 0.05$.
[1]3-year average.
[2]GRAZ – grazing steers grazed a forage sequence of native range, field pea-barley intercrop and unharvested corn.
[3]SF: small frame; LF: large frame.
[4]SEM: pooled standard error of the mean; Trt: treatment; Yr: year; Trt x Yr: treatment x year; ADG: average daily gain; CP Suppl; crude protein supplement.
[5]SF steer cost reduced by 20.1 percent based on results of Senturklu et al. (2015).

Acknowledgment

This project was supported by a grant from the U.S. Department of Agriculture/Sustainable Agricultural Research and Education program #LNC11-335.

Literature Cited

Adams, D., R. Clark, T. Klopfenstein and J. Volesky. 2004. Use of livestock, forage, and labor resources in beef production systems to reduce production costs, increase profitability, and reduce use of fossil fuels. SARE Annual Report LNC02-206.

North Dakota Farm Management education program. 2013-2015. Region 4. www.ndfarmmanagement.com.

Reuter, R.R., and P.A. Beck. 2013. Southern Section Interdisciplinary Beef Cattle Symposium: Carryover effects of stocker cattle systems on feedlot performance and carcass characteristics. J. Anim. Sci. 91:508-515.

Senturklu, S., D.G. Landblom, G.A. Perry and T. Petry. 2015. Effect of heifer frame score on growth, fertility, and economics. Asian-Australasian J. An. Sci. 28(1):69-78.

Table 3. Effect of steer frame score and extended grazing on feedlot finishing performance, efficiency and economics[1].

	FLOT[2] LF[3]	FLOT[2] SF[3]	GRAZ[2] LF[3]	GRAZ[2] SF[3]	SEM[4]	*P*-Value		
						Trt[4]	Yr[4]	Trt x Yr[4]
Number of steers	24	24	24	24				
Frame score	5.63	3.82	5.53	3.77	0.262	<0.001	0.001	0.56
Growth Performance								
Grazing days	–	–	211	211				
Feedlot days fed	218	218	82	82	3.51	<0.001	0.04	0.01
Start weight, lb.	767.3	671.4	1229.6	1086.4	42.63	<0.001	<0.001	0.85
End weight, lb.	1515.8	1312.1	1609.8	1400.8	51.93	0.003	<0.001	0.51
Gain, lb.	748.6[a]	640.9[b]	381.6[c]	314.8[d]	16.83	<0.001	0.01	0.09
ADG[4], lb.	3.43[c]	2.93[d]	4.65[a]	3.84[b]	0.12	<0.001	0.94	0.46
Feed Intake and Efficiency								
DM[4] feed/steer/day, lb.	26.83	21.93	29.17	25.49	0.99	0.13	<0.01	<0.21
DM feed/lb. of gain, lb.	7.84	7.50	6.23	6.62	0.39	0.72	<0.05	<0.60
Finishing Economics								
DM feed cost/lb. of gain, lb.	0.807[a]	0.786[a]	0.577[b]	0.612[b]	0.02	<0.001	<0.001	0.01

[a-d]Means with different superscripts within a line are significantly different, ($P \leq 0.05$).
[1]3-Year average.
[2]FLOT steers moved directly to the feedlot for growing and finishing and GRAZ steers grazed a sequence of native range, field pea-barley intercrop and unharvested corn before transfer to the feedlot at the University of Wyoming.
[3]SF: small frame; LF: large frame.
[4]SEM: pooled standard error of the mean; Trt: treatment; Yr: year; Trt x Yr: treatment x year; ADG: average daily gain; DM: dry matter.

Table 4. Effect of steer frame score and extended grazing on carcass trait measurements and value[1].

	FLOT[2] LF[3]	FLOT[2] SF[3]	GRAZ[2] LF[3]	GRAZ[2] SF[3]	SEM[4]	*P*-Value		
						Trt[4]	Yr[4]	Trt x Yr[4]
Hot carcass weight, lb.	875.70[a]	770.06[b]	931.68[c]	822.89d	29.64	0.01	<0.001	0.01
Dressing percent, %	60.22[a]	61.09[b]	60.19[a]	60.84[b]	0.211	<0.001	<0.001	<0.001
Fat depth, in.	0.48[a]	0.50[a]	0.40[b]	0.46[a]	0.204	0.031	<0.001	0.30
Rib-eye area, sq. in.	13.13[a]	11.95[b]	13.93[b]	13.00[c]	0.247	0.001	<0.001	<0.001
USDA yield grade	2.52	2.70	2.23	2.41	0.103	0.72	<0.001	0.95
Marbling score	611.97[a]	640.68[b]	583.44[b]	631.36[b]	10.21	0.02	0.01	0.21
Percent choice, %	93.06	94.24	91.67	97.22	2.73	0.10	0.04	0.19
Carcass value/steer, $	2042.47	1753.88	2243.61	2017.51	91.81	0.79	0.038	0.90
Warner-Bratzler shear force, lb.	5.36	5.32	5.81	5.81	0.14	0.48	<0.001	0.29
Cooking loss, %	17.85	17.61	17.50	15.40	1.17	0.43	<0.001	0.12

[a-d]Means with different superscripts within a line are significantly different, ($P \leq 0.05$).
[1]Three-year average.
[2]Steers were slaughtered at the Cargill Meat Solutions packing plant, Ft. Morgan, Colo.
[2]FLOT steers moved directly to the feedlot for growing and finishing, and GRAZ steers grazed a sequence of native range, field pea-barley intercrop and unharvested corn before transfer to the feedlot at the University of Wyoming.
[3]SF: small frame; LF: large frame.
[4]SEM: pooled standard error of the mean; Trt: treatment; Yr: year; Trt x Yr: treatment x year.

Table 5. Effect of steer frame score, extended grazing and retained ownership vertical integration on system net return at the end of grazing and at feedlot closeout[1].

	FLOT[2] LF[3]	FLOT[2] SF[3]	GRAZ[2] LF[3]	GRAZ[2] SF[3]	SEM[4]	*P*-Value Trt[4]	Yr[4]	Trt x Yr[4]
Cow-calf and Backgrounding Cost								
Annual cow cost, $[5]	602.84	602.84	602.84	602.84				
Winter backgrounding cost, $[6]	153.32	122.50	153.32	122.50				
Total cost, $	756.16	725.34	756.16	725.34				
Grazing Cost								
Grazing cost/steer, $[7]			300.27	250.27				
Total expense, $			1,056.43	975.61				
End grazing Steer value, $			1,570.45	1,553.35	7.37	0.01	<0.001	0.31
Net Return, $			514.02	577.74				
Feedlot Closeout								
Expenses								
Steer cost, $	756.16	725.34	756.16	725.34				
Feedlot cost/steer, $	674.98[a]	572.84[b]	247.56[c]	218.05[d]	11.71	<0.001	0.001	<0.001
Transportation to packing plant, $[8]	22.25	22.25	23.86	23.86				
Total system expense/steer, $	1,453.23	1,320.09	1,327.42	1,216.91				
Income								
Carcass value/steer, $[8]	2,073.33[b]	1,820.33[d]	2,223.67[a]	1,974.17[c]	77.78	0.001	<0.001	0.02
System net return/steer, $	619.94	499.90	896.09	756.92				

[a-d]Means with different superscripts within a line are significantly different, ($P \leq 0.05$).

[1]3-Year average.

[2]FLOT steers moved directly to the feedlot for growing and finishing, and GRAZ steers grazed a sequence of native range, field pea-barley intercrop and unharvested corn before transfer to the feedlot at the University of Wyoming.

[3]SF: small frame; LF: large frame.

[4]SEM: pooled standard error of the mean: Trt: treatment: Yr: year; Trt x Yr: treatment x year.

[5]Expenses are the three-year average expenses adopted from Beef Cow-Calf Enterprise Analysis (Region 4, North Dakota Farm Management education program, 2013, 2014, 2015).

[6]Expenses are the three-year average expenses adopted from Beef Backgrounding Enterprise Analysis (Region 4, North Dakota Farm Management education program, 2013, 2014, 2015).

[7]From Table 2.

[8]Steers were slaughtered at the Cargill Meat Solutions, Ft. Morgan, Colo.