January 1999

Predicting Amount of Compensatory Gain

Terry J. Klopfenstein
University of Nebraska-Lincoln, tklopfenstein1@unl.edu

D. J. Jordon
University of Nebraska-Lincoln

Ivan G. Rush
University of Nebraska-Lincoln, irush1@unl.edu

Todd Milton
University of Nebraska-Lincoln

Predicting Amount of Compensatory Gain

Terry Klopfenstein
D. J. Jordon
Ivan Rush
Todd Milton[1]

Compensatory gain is variable, difficult to predict, can be explained by intake of NEg above maintenance and may be reduced by longer restrictions.

Summary

In North American beef production systems, the entire spectrum of restriction and compensation is found. The area of compensatory gain is complex and not well understood, but critically important to the economics of cattle feeding. Several compensatory gain studies from the University of Nebraska have been compiled. The range in compensation observed with cattle grazing season-long is 19-88 percent with a mean of 53 percent. From these grazing studies, days of restriction appear to be related to percentage compensation. In the feedlot, even relatively short restrictions trigger compensatory gain; however, feed efficiency response to compensatory gain is highly variable and difficult to predict.

Introduction

Except for finishing as calf-feds, cattle entering the feedlot usually experience some degree of compensatory gain. How well cattle perform, and how well performance can be predicted, are critically important to the economics of cattle feeding. Compensatory gain is complex and not well understood. Our article is a summary of recent compensatory gain research conducted at University of Nebraska locations.

Compensatory Gain on Grass

In the mid-1980's, a two-year study on compensatory gain was conducted, with objectives to establish three levels of gain over the winter on crop residues and measure steer gains the following summer on grass. The cattle made 88 percent compensation (Table 1). Cattle restricted more in the winter made up 88 percent of the gain they did not make relative to the higher gaining winter calves. All calves were restricted to some degree. Five years of research from the Panhandle Research and Extension Center at Scottsbluff involved calves fed for two rates of winter gain. Slow gaining calves grazed cornstalks and fast gaining calves were limit-fed a high-energy diet. Calves then grazed (summer) for two or four months. Calves grazing season long (four months) made 56.5 percent compensation (Table 2), while those grazing only two months made 41.5 percent compensation (Table 3). During the last two years of the study, British breed steers were compared to Continental cross steers. Compensation was similar (53.9 and 52.8 percent; Table 4), suggesting frame size does not affect degree of compensation.

Over the past two years, three additional trials have been completed. Wet corn gluten feed was used as the supplement on cornstalks to increase winter gain. Wet corn gluten feed as a supplement is of interest because of cost and

Table 1. Rate of winter gain and compensation on grass and in the feedlot.

	Winter gain[a] (lb/d)		
Item	.62	.84	1.10
Grass gain, lb/d[b]	1.41	1.23	1.03
Compensation, %	88	88	—
Feed/gain[c]	7.3	7.09	7.09

[a]40 calves/treatment, 2 years, 106 days, 1989 Nebraska Beef Cattle Report, pp 34-35.
[b]116 days.
[c]112 days.

Table 2. Rate of winter gain and compensation on grass and in the feedlot.

	Winter gain[a] (lb/d)	
Item	.68	1.75
Grass gain, lb/d[b]	1.96	1.27
Compensation, %[c]	56.5	—
Feed/gain[d]	6.63	7.11

[a]200 calves/treatment, 5 years, 137 days, 1996 Nebraska Beef Cattle Report pp 51-53 and 1997 Nebraska Beef Cattle Report pp 52-55.
[b]120 days.
[c]Difference in total pounds of summer gain divided by difference in total pounds of winter gain.
[d]123 days.

Table 3. Rate of winter gain and compensation on grass and in the feedlot.

	Winter gain[a] (lb/d)	
Item	.67	1.75
Grass gain, lb/d[b]	2.46	1.47
Compensation, %	41.5	—
Feed/gain[c]	6.41	7.05

[a]200 calves/treatment, 5 years, 137 days (see Table 2 for references).
[b]62 days.
[c]130 days.

Table 4. Winter gain × breed type effects on grass gain and finishing efficiency.

Item	British[a]		Continental×[b]	
Winter gain: lb/d[c]	.60	1.66	.55	1.49
Summer				
Grass gain lb/d[d]	1.87	1.18	2.03	1.43
Compensation, %	53.9	—	52.8	—
Finishing				
Feed/gain[e]	6.23	6.59	6.27	6.66

[a]56 hd/treatment, 1997 Nebraska Beef Cattle Report pp 52-55..
[b]36 hd/treatment.
[c]145 days.
[d]120 days.
[e]118 days.

Table 5. Steer performance for winter, summer and finishing periods.

Item	Sandhills range		Bromegrass pasture	
Winter gain lb/d[a]:	.70	1.67	.68	1.68
Summer				
Grass gain, lb/d[b]	1.92[c]	1.66[d]	.73[e]	.48[f]
Compensation, %	19.9	—	18.7	—
OM Intake, % BW	2.53	2.14	2.32	1.82
Finishing				
Days	99	71	124	99
ADG, lb/d	4.17[c]	4.57[cd]	4.48[c]	5.03[d]
DMI, lb/d	28.8[c]	31.3[cd]	28.6[c]	31.7[d]
Feed/gain	6.91[c]	6.84[c]	6.40[d]	6.31[d]
Final weight, lb	1262[cd]	1309[cd]	1249[c]	1323[d]

[a]20 hd/treatment, 163 days, 1998 Nebraska Beef Cattle Report pp 63-65.
[b]123 days.
[c,d,e,f]Means with unlike superscripts within a row differ (P<.05).

Table 6. Steer performance for winter, summer and finishing periods.

Item	Sandhills range		Bromegrass pasture	
Winter gain lb/d[a]:	.20	1.50	.18	1.53
Summer				
Grass gain, lb/d[b]	2.01[c]	1.16[d]	1.91[c]	1.14[d]
Compensation, %	49.5	—	53.9	—
Finishing				
Days	99	99	99	99
ADG, lb/d	4.06	4.42	4.37	4.40
DMI, lb/d	28.4	29.7	28.1	29.6
Feed/gain	6.97	6.73	6.43	6.73
Final weight, lb	1236[c]	1375[d]	1259[c]	1371[d]

[a]16 hd/treatment, 163 days.
[b]124 days.
[c,d]Means with unlike superscripts within a row differ (P<.05).

Table 7. Rate of winter gain and compensation on grass and in the feedlot.

	Winter gain, lb/d[a]	
Item	.22	1.52
Grass gain, lb/d[b]	1.92	1.18
Compensation, %	45.0	—
Feed/gain[c]	6.56	6.58
Breakeven, $/100 lb	67.75	64.06

[a]60 hd/treatment, 161 days.
[b]132 days.
[c]99 days.

nutrients it contains. In 1996 and 1997, two similar trials were conducted where yearlings grazed bromegrass or Sandhills range. Year-by-treatment interactions were detected for ADG on grass and final weight. Therefore, data are presented by year (Tables 5 and 6). Yearly variations in grass quality and quantity are believed to be responsible for both interactions. Quality of bromegrass in year one was below average due to abundant rainfall and early season growth. Cattle were unable to consume the forage and it quickly matured. Gains in year two were closer to what is typically observed when cattle graze full season bromegrass. Differences in weight gains over the summer period were carried through the feedlot period, resulting in the interaction with respect to final weight. Although grass gains at each location were markedly different in year one, compensation was similar across the Sandhills and bromegrass locations (19.9 and 18.7 percent; Table 5). In year two, gains and compensation were similar across locations (49.5 and 53.9 percent; Table 6); however, compensation was greater compared to year one. Why degree of compensation differed between years is unclear, as cattle were managed similarly through the winter period both years. However, slow gaining cattle in year one gained more weight compared to slow gaining cattle in year two, which may have affected compensation. The differences in winter gains were due to differences in corn residue quality. Additionally, there were obvious differences in forage quality and quantity within location across the two years. Degrees of compensation from these trials are certainly different from those of trials conducted in the 1980's. In a third trial in 1997, yearlings grazed bromegrass, warm-season grass or Sandhills range. Compensation was 45 percent (Table 7). Some cattle were removed from bromegrass after 53 days. Cattle removed early made 19.5 percent compensation compared to 46.9 percent for animals grazing 130 days (Table 8).

Table 8. Winter gain and length of grazing on compensation and feed efficiency.

	Grazing:	53 days		130 days	
Item	Winter lb/d:	.22	1.52	.22	1.52
Grass gain, lb/day		2.26	1.49	1.84	1.09
Compensation, %		19.5	—	46.9	—
Feed/gain		6.80	6.64	6.42	6.72

The range in compensation for season-long grazing was 19 percent to 88 percent with a mean of 53 percent. Still, the question remains about what factors influence degree of compensation. Some might include days of restriction, rate of gain of faster gaining cattle, rate of gain of slower gaining cattle and degree of restriction. Number of days of restriction appears to be the only variable related to percentage compensation (88 percent, 106 days; 57.6 percent, 137 days; 45 percent, 161 days; 19.9 percent; 163 days).

Based on these data, some generalizations may be drawn:

1) Compensatory gain on grass is variable and difficult to predict.

(Continued on next page)

2) Longer restriction may reduce compensatory gain.
3) Full season grazing gives 50 to 60 percent compensation on average.
4) Most of the compensation on grass can be explained by intake of NE_g above maintenance (Table 5).
5) Partial season grazing reduces percentage of compensation.

Compensatory Gain in the Feedlot

Predicting compensatory gain in the feedlot is even more difficult than predicting it on grass. In fact, gain is probably less important than feed conversions; therefore, feed conversion will be used as the criterion for evaluating compensation in the feedlot in this paper.

A five-year summary of similar cattle finished as yearlings versus calf-feds was compiled. Yearlings entered the feedlot 300 pounds heavier and finished 100 pounds heavier (Table 9). It is estimated they would have been 200 pounds heavier at equal fatness. Yearlings ate more feed and gained faster than calves which would be characteristics of cattle exhibiting compensatory gain. However, yearlings were considerably less efficient (7.33 versus 6.19). As a broad generalization, the heavier cattle are entering the feedlot, the lower the feed conversions. This extreme is shown in Table 10. In this case similar cattle entered the feedlot in September or November. November cattle gained well in the fall and entered the feedlot 150 pounds heavier. Their feed conversions were poorer than cattle that entered in September (8.20 versus 6.73). Most would agree with this generalization: heavier cattle entering the feedlot will be less efficient than lighter cattle with comparable genetic potential.

Table 9. Finishing performance for calves versus yearlings[a].

Item	Calf	Yearling
Initial weight, lb	537	821
Final weight, lb	1103	1199 (1305)[b]
Days on feed	207	108 (139)[b]
Feed intake, lb/d	17.4	24.9
% of weight	2.1	2.5
Daily gain, lb	2.78	3.39
Feed/gain	6.19	7.33
Backfat, inches	.48	.38
Choice, %	76.0	64.9

[a]5 years, 489 head, 48 pens, 1991 Nebraska Beef Cattle Report pp 42-43.
[b]Adjusted to .48 inches fat.

Table 10. Yearling weight (age) effect on finishing performance.

	Entry to feedlot	
Item	September	November
Summer gain, lb/day	1.84	1.55
Fall gain, lb/day	—	2.44
Feedlot wt., lb	840	987
Intake, lb/day	30.8	31.0
Gain, lb/day	4.58	3.78
Feed/gain	6.73	8.20

The problem is predicting the response to previous rates of gain. With the yearlings in the 1980's, cattle made 88 percent compensation on grass and entered the feedlot at essentially equal weights. Feed conversions were similar, even though previous rates of gain differed (Table 1). On the other extreme, the cattle in 1996 made only 19 percent compensation on grass and entered the feedlot 130 pounds different in weight, but still had similar feed conversions (Table 3). Interestingly, cattle on bromegrass pasture gained much less than those on range and had better feed conversions. Steers wintered at 1.68 lb/day and grazed on bromegrass entered the feedlot at about the same weight (830 pounds) as those wintered at .7 lb/day and grazed on range (846 pounds). However, bromegrass grazed steers had better feed conversions (6.31 versus 6.91).

Cattle on experiments at Scottsbluff made 57.6 percent compensation during the summer (Table 2) and had differences in feed conversion. In this case, cattle gaining faster during the summer were more efficient in the feedlot. However, cattle gaining faster in the summer were lighter entering the feedlot because their compensation from lower winter gains was only 57.6 percent.

Two experiments have been conducted where cattle were restricted and placed directly into the feedlot without a subsequent grass phase. In the first experiment (1985 Nebraska Beef Cattle Report, pp 20-24), calves were wintered 137 days on crop residues and placed on grass or into the feedlot. They were compared to calf-feds. As discussed previously, the yearlings were less efficient in the feedlot. However, calves placed in the feedlot after restriction had similar efficiency to calf-feds. They gained faster and ate more feed, but conversions were similar.

In the second experiment (1992 Nebraska Beef Cattle Report, pp 31-34), calves were placed on cornstalks for 74 days before entering the feedlot. Calves grazed at two stocking densities that gave two rates of gain (.45 and .64 lb/d), and were compared to similar cattle finished as calf-feds. Restricted calves ate more feed and gained more rapidly, but were less efficient.

These two experiments, although not completely consistent, give some insight into relatively short restrictions before entering the feedlot. Compensatory gain is definitely triggered. However, calves consume more feed but are not more efficient, perhaps even less efficient. Also, final weights are not increased by restriction.

Following are some generalizations about compensatory gain in the feedlot.

1) Feedlot efficiency response to compensatory gain is variable and very difficult to predict.
2) Even relatively short restrictions produce compensatory gain. This is reflected in increased intake and gain but not increased efficiency.
3) Yearlings gain more, eat more and are less efficient than calf-feds.
4) As a broad generalization, the heavier cattle are entering the feedlot, the lower their feed efficiency will be—there are many exceptions to this generalization.
5) Rapid gain on grass prior to entering the feedlot does not necessarily reduce feed efficiency and often increases it.
6) One hundred fifty-two pounds of extra winter gain produced 71 pounds of extra final weight.

[1]Terry Klopfenstein, professor; D. J. Jordon, research technician, Animal Science, Lincoln; Ivan Rush, professor, Animal Science, Panhandle Research and Extension Center, Scottsbluff; Todd Milton, assistant professor, Animal Science, Lincoln.