The economics of carcass growth

Darryl Gibb, May 2007

Introduction

It is generally recognized that performance declines and costs of gain and yield grades increase with body weight and days on feed. However, these negative effects can be offset by increasing carcass weight, dressing percent and possibly carcass quality (marbling).

Although growth rates and feed efficiencies of the live animal decline as cattle approach mature weight, carcass gain makes up a higher percentage of live weight gain. Determining when is the best time to sell cattle must consider the magnitude and economic value of these changes. Ultrasound data suggests that there is a $1 loss for each day that actual slaughter date differs from the optimum (Koontz et al., 2000). Although changes in performance and carcass variables are not absolute due to the wide range in genetic expression, general trends are typically observed and understanding these will help determine optimum sale dates.

Understanding mature weight

Before discussing how carcass growth changes with days on feed (DOF) and maturity, it is important to understand "mature weight". Mature weight is the live weight at which growth of lean meat declines to zero. As cattle approach mature weight, fat comprises a larger portion of carcass gain until further gain is all fat. Steers in Owen's summary (1993) reached mature weight at approximately 36% carcass fat (about 1650 lbs). To put this number in perspective, choice (AAA) carcasses are typically near 28% fat. From this summary, fat gain of steers was 550, 575, 630, and 755 g/d for cattle at 60, 70, 80, and 100% of mature weight. Mature weight is affected by many variables including gender, genetics, nutrition, and implants. For example, MW of heifers average about 150 pounds lighter than steers of equivalent genetics. Combination implants increase mature weight by about 75 pounds. Reduced growth rates (back grounding) will increase mature weight by about 1/3 pound for each day of reduced growth. In Canada, we typically sell cattle near 85% of their mature weight.

Dressing percent

As body weight increases, carcass gain makes up a higher percentage of live weight gain resulting in increased dressing percentage. High grain diets (less gut fill) and increased fat content of carcass gain contributes to increased dressing percent with DOF in finishing cattle. This is also due to the digestive tract reaching a mature weight before other body components. Weight of the digestive tract decreased from 15 to 8% of live shrunk weight and, as a fraction of live gain, carcass gain was twice as high in finishing as backgrounding diets (Coleman et al., 1993). In the smaller framed cattle of the 70's, DP increased by as much as 1.5% points for each 100 pounds gained (Zinn et al 1970) with no difference between steers (450 lb in weight) and heifers (450 lb in weight). More recently, Dubeski et al (1997) observed dressing percents of 59.1, 60.6 and 61.6 for heifer calves (490 lb in weight) slaughtered at 500, 590, or 680 kg (0.63% points increase for each 100 lb gain). In the work of Coleman et al (1993), dressing percent of steers increased approximately 1% point for each 100 pounds gained through a 105 day feeding period. Carcass gain as a fraction of live weight gain was almost twice as high during the finishing phase as the backgrounding period. In an Alberta trial, yearling steers (860 lbs in weight) were slaughtered at 2 week intervals from 78 to 162 DOF. DP linearly increased with DOF (0.47% point increase for each 100 pounds gained; Jim et al 2002). Crossbred steers

(725 lb in weight) were fed for either 105, 119, 133, or 147 days in the trial of Van Koevering et al (1995). Dressing percent did not increase above the 65% for the cattle fed 105 days.

From US Benchmark data (Elanco Animal Health), DP of steers (6-700 and 8-900 lb in weight) increased an average of 2.1 % points (3.2%) over the last 100 DOF, or .03%/d. DP of heifers increased 2.3% points (3.5%) the last 100 days, or .045%/d. In summary, DP will increase from 0.5 to 1.5% points for each 100 pounds increase in slaughter weight or .03 to .045% per day. The wide range in DP changes with increasing body weight is likely due to differences in mature weight of animals between trials.

Performance

With increasing maintenance costs and fat deposition, increasing body weight and fat gain generally results in reduced performance. However, even though fat contains almost 7 times more energy than lean meat, efficiency of lean growth is only marginally more efficient due to the energetic costs of protein turnover. As well, it is important to understand the difference between live and carcass performance, especially if you are selling carcasses and not live animals. Carcass gain has ranged from 70 up to 100% of live weight gain late in the feeding period.

Daily Gain

Research with steers often (Van Koevering et al., 1995; Jim et al., 2002) finds little if any effect of DOF on rate of gain. Jim et al fed 860 lb steers up to 1360 lb before any reduction in gain was noticed. This is likely due to the large mature weight and growth potential of these animals. The modest reductions in gain (0.15 lb/d) were removed when expressed on a carcass basis. Unimplanted British heifers on the other hand, had reduced gains past 1300 lb (Dubeski et al 1997) and daily gains were nearly 0 as heifers approached 1500 pounds (436 DOF). Steers also had reduced gains with increasing DOF (Hicks et al., 1987).

In Canadian bench mark data, the decline in ADG ranged from a low of .1%/d or 6.9% for each 100 lb increase in finish weight (SC) to a high of .3%/d or 25.4% reduction the last 100 lb (YS). Heifers were intermediate to these values.

Feed conversion

Feed efficiency of the steers in the trial of Van Koevering et al (1995) did not change for cattle fed 105, 119, 133, or 147 days. Similarly, live feed/gain of steers fed for 78, 92, 106, 120, 134, or 148 d was similar in the trial of Jim et al., (1996) but live efficiency declined from 148 to 162 days (6.14 dropped to 6.69). However, when corrected for dressing % (59%), DOF did not affect feed efficiency. Decreasing feed efficiency in steers has been observed (Hicks et al, 1987)

From Canadian Benchmark data, feed efficiency declines more with increasing days and weight for yearlings (+0.2% / d) than calves (0.1% /d) with little difference between steers and heifers. Reductions of about twice this level are observed in US Benchmark data, possibly a result of smaller framed cattle. Although increased fat content of gain likely contributes to reduced feed efficiency for heavier cattle, Brethour (2006)observed no correlation between backfat thickness and feed conversion.

Marbling

A common misconception is that marbling linearly increases with days on feed. Although increases have been observed in some research, most data indicates marbling is controlled primarily by genetics with only moderate effects of days on feed and animal weight.

Jim et al found that cattle fed for 148 or 162 d had more (> 37%) AAA carcass than those fed 134 d (< 15) or less. Van Koevering et al found that marbling score and % grading choice increased linearly with DOF but at a decreasing rate (33.9 - 68.8% choice). When adjusted for SC fat, no marbling benefit to feeding longer than 119 d was detected. Dubeski et al also found that British breed heifers deposited intramuscular fat most efficiently earlier in life, especially when fed a high plane of nutrition. With the long fed heifers of Dubeski et al (1997), increased days on feed increased backfat more than it did marbling. They concluded that rate of intramuscular fat deposition does not increase as fattening progresses.

From US Benchmark data, % choice increased by about 0.1% per day (ie feeding an additional 50 d would increase number of choice carcasses by 5% (from 40 to 42%)). Yearling steers increased by .6%/d.

Back fat & yield grade

There is almost no correlation between backfat and marbling (Brethour 2004; $R^2 = 0.08$). Unlike marbling, backfat levels consistenly increase with animal weight and days on feed. Jim et al found that steers fed past 134 d had fewer A1 carcasses and feeding for 162 d resulted in increased numbers of A3 carcasses. Van Koevering found that yield grade increased at an increasing rate with DOF. Y4 increased from 1.56% in 105 d cattle to 9.38 in 147 DOF. Dubeski et al found a linear increase from 12.9 up to 16.4 mm of backfat for groups slaughterd at 500 kg up to 680 kg.

US Benchmark data shows that the number of Y4 and 5 increase by about .75 % each day cattle are fed.

Putting it all together

Despite the small increase in choice carcasses with DOF, quality grade premiums are often greater than yield grade discounts with increasing animal weight. Increasing animal and carcass weight provides the greatest returns for increasing days on feed. Optimum sale date is reached when costs of over weight and yield grade discounts and reduced performance exceed carcass weight and quality grade premiums. In a typical scenario, increasing sale weight from 1300 to 1400 lb for steer calves, results in $21 reduction in profitability due to reduced performance but a $40 + net premium for increased carcass weights and quality grade. As described by Doherty et al (1999), premiums and discounts for quality and yield grade are typically not large enough to offset the value of increasing weight. With a positive feed margin (COG less than sale price), it is often beneficial to produce a few over weight carcasses to ensure weight is maximized. A computer program is available to assess these economic impactsp of carcass growth.

Benchmark data

US - change in performance and carcass with increasing DOF.

	Steer (600 lb) 120 - 260 DOF 1088 - 1302 lb 1110230 hd	heifer (600 lb) 110 - 240 DOF 1035 - 1156 lb 1896216	steer (800 lb) 90 - 180 DOF 1207 - 1369 lb 1868785 hd	heifer (800 lb) 80 - 170 DOF 1150 - 1301 lb 644704 hd
ADG	3.47 - 2.6 25% in 120 d .2% / d	3.23-2.08 38% in 70 d, .5% / d	3.72 - 2.82 27% in 90 d .3% / d	3.5 - 2.6 26% in 90 d .28% / d
feed/gain	5.7 - 6.9 21% in 120 d .18% / d	5.86 - 7.45 27% in 70 d, .3% / d	6 - 7.4 23% in 90 d .25% / d	6.16 - 8.3 35% in 90 d .39% / d
Dressing percent	63.12 - 65.2 3.3% in 120 d .03% / d	63.3 - 65.3 3.2% in 70 d .05% / d	63 - 65 3.1% in 90 d .03% / d	62.9 - 65.2 3.6% in 90 d .04% / d
% choice	41 - 46 12% in 120 d .1% / d	46 - 50 8.7% in 70 d .1% / d	23 - 43 54% in 90 d .6% / d	51.8 - 55 6.1% in 90 d .07% / d
% Y4 & Y5	24 - 53 121% in 120 d 1% / d	34 - 55 62% in 70 d .9% / d	25 - 41 64% in 90 d .7% / d	37 - 54 45% in 90 d .5% / d

Canadian Data - less than half of animal numbers had carcass data. Due to low carcass numers, use Canadian performance numbers with US carcass numbers

	Steer (600 lb) 180 - 260 DOF 1270 - 1401 lb 287547 hd	heifer (600 lb) 170 - 250 DOF 1203 - 1307 127264 hd	steer (800 lb) 90 - 180 DOF 1325 - 1410 331074 hd	heifer (800 lb) 80 - 170 DOF 1259 - 1359 383794 hd
ADG	3.2 - 2.9 9% in 80d; 130 lb .1% / d; 6.9%/100lb	3.0 - 2.56 14.6% in 80d;104lb .18% / d; 14%/100lb	3.93 - 3.08 21.6% in 70d; 85 lb .3% /d; 25.4%/100lb	3.38 - 2.61 22.8% in 90d;100lb .25% / d 22.8%/100lb
feed/gain	6.35 - 6.98 9.9% in 80 d .1% / d	6.95 - 7.56 8.7% in 80 d .1% / d	6.19 - 7.34 18.5% in 70 d .27% / d	7.12 - 8.22 15.4% in 90 d .17% / d
dressing %	60.4 - 61 .1% in 80 d .006% / d	60.6 - 61.1 .8% in 80 d .01% / d		
% AAA	31.8 - 47.5 49% in 180 d .27% / d	59 - 50.4		
% A3	6.5 - 8.3 28% in 180 d .15% / d			