RESEARCH COMPARING THE TRANGIE ANGUS SELECTION LINES: IMPLICATIONS OF SELECTION FOR GROWTH

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INTRODUCTION

During the last two decades beef producers have placed considerable emphasis on selection for growth rate and size. Growth rate is easy to measure, it responds to genetic selection and is closely related to the value of individual animals. Whilst it is known that selection for increased growth rate will result in faster growing animals which are heavier at all ages, little is known on the associated changes in other components of herd profitability. In particular a serious limitation of selection for increased growth rate may be the associated increase in mature cow size, and hence in the feed costs of the breeding herd (Barlow 1984).

The Trangie project was designed to provide information on the effects of selection for growth on each of the major components of herd profitability. This has included the investigation of the responses in reproductive performance; maternal ability; herd feed requirements; carcase yield and composition; and structural soundness. Data on the changes to these components have been used in a detailed economic analysis of the impact of selection for growth on overall herd profitability.

MATERIALS AND METHODS

The project began in 1974 with the establishment of three closed selection lines from the Angus herd at the Trangie Agricultural Research Centre. Of the 220 breeding cows in the herd, a group of 50 were randomly chosen to form a Control line (C). Of the remaining cows, 85 were allocated to the High line (H) and 85 to the Low line (L), based on their individual yearling growth performance. This design was chosen to provide a rapid divergence in growth rate between the H and L selection lines, with the C line providing a base for the measurement of selection responses (Barlow 1979).

Since 1974 the three lines have remained closed. All replacement bulls and heifers for the H and L lines were selected solely on their own yearling gain (adjusted for age of dam). The C line was maintained with all replacements chosen at random. Replacement bulls and heifers were joined at 14 months of age, and bulls were used for only one breeding season. Cows were culled only if they failed to calve in two consecutive years. Animals from each line were run together throughout the year, except during mating. From 1974 to 1982 the H and L lines were each maintained with approximately 85 breeding females and 5 sires used per year. The C line had approximately 50 breeding females and 10 sires used per year. From 1983 to 1988 the herd was expanded in size by retaining all potential breeding females to enable the establishment of satellite herds at Glen Innes and Hamilton. Sires used each year at Trangie were subsequently used at Glen Innes and Hamilton to maintain the genetic links between the selection lines at each location. At Glen Innes cows and calves from each line were divided into groups run at three different levels of pasture availability, representing good, medium and poor levels of nutrition. The cattle at Hamilton were divided into groups run on pasture plots at different set stocking rates.

RESULTS AND DISCUSSION

Responses in growth and size

Since 1974 there has been a rapid divergence in growth rate between the selection lines. For calves born in 1989 the average difference between the H and L lines in adjusted yearling gain was 30%, and the average difference between the H and C lines was 15% (Figure 1). The responses in growth rate were positively associated with correlated responses in size and weight of calves at all ages. On average the H calves were larger and heavier at all ages than C calves, and L calves were smaller and lighter. Selection for increased growth rate resulted in an increase in the average size and weight of mature cows in the H line. There was a corresponding reduction in the size and weight of cows in the L line. Analyses of data collected so far from calves sired by bulls from each line at Trangie and Glen Innes indicate that the responses to selection in growth to weaning were consistent across the environments.

Responses in maternal ability

The changes in weaning weight resulting from selection for growth rate could be partly attributed to responses in the genetic potential of calves for growth and partly to responses in the maternal ability of their dams. The changes in calf growth potential and cow milk production were measured by cross-mothering samples of H and L calves between cows from each line. The growth of these cross-mothered calves was then compared with that of their naturally-mothered contemporaries. The milk production of cows was also estimated at strategic intervals during lactation using the calf weigh-suckle-weigh technique.

H calves reared by their natural H dams were heavier at weaning than L calves reared by their natural L dams. When cross-mothered to L cows, the H calves were slightly lighter at weaning than naturally reared H calves. Conversely, when L calves were cross-mothered to H dams they were slightly heavier than naturally-reared L calves. The results indicated that 82% of the difference in weaning weight between the H and L calves was due to difference in their genetic potential for growth. The other 18% was due to differences in the maternal ability of their dams. The differences in maternal ability could be explained by differences in estimated milk production between the selection lines. H cows produced more milk than C cows and L cows produced less milk (Herd 1990).

Responses in reproductive performance

Data collected on the average number of days from mating to calving, and the average overall calving percentages, show that H heifers had a slightly improved reproductive performance compared to C heifers. There was no significant difference in these indicators of reproductive performance for mature cows in the H and C lines. In contrast, the net reproductive performance has declined in L heifers and cows. The incidence of calving difficulties was lower among heifers in both the H and L lines (about 10% average), than in the C line (about 15%).

Observations using teaser bulls indicated substantial variation in the age of puberty of heifers within the selection lines. On average H heifers tended to exhibit first oestrus at a slightly younger age than C heifers. L heifers were slightly older at first oestrus. On average H bull calves had larger scrotal sizes at yearling age compared to C calves. L calves had a smaller average scrotal size. Studies of libido and semen quality of yearling bulls showed no differences between the three lines.

Responses in carcase composition

Steers from each line have been grown out in a feedlot at Trangie. Individual steers were slaughtered at a range of ages from birth to maturity to enable estimation of carcase composition across a range of turn-off ages and target market weights. Results to date have shown that at the same age there were no significant differences between the lines in the percentage of subcutaneous fat, intermuscular fat, muscle or bone. Hence, the percentage lean meat yield was the same for all lines. At the same weight there was a trend for the H steers to be slightly leaner than the C steers, which in turn were slightly leaner than the L steers. At a carcase weight of 250 kilograms there was only a 2% difference in percentage subcutaneous fat and a 2 mm difference in subcutaneous fat depth between the H and L steers. There was no difference between the lines in the percentage of carcase muscle and bone.

Steers from each line born at Glen Innes have been grown out on pasture and slaughtered at 22 months of age. For these steers there was no difference between the lines in carcase fat depth. Average eye muscle area, adjusted for carcase weight, was slightly smaller in the H steers than in the C or L steers. However, there were no differences between the lines in dressing percentage or lean meat yield.

Responses in herd feed requirements & efficiency

Studies have been conducted in an automated feedlot to examine the differences between the lines in feed consumption and efficiency of cows and calves, and growing steers. Further studies of the feed intake and efficiency of cows maintained at different levels of pasture availability are being conducted at Glen Innes. In addition, direct measures of the profitability per hectare obtained from each selection line are being determined in stocking rate experiments at Hamilton.

The cow/calf efficiency study involved the recording of total feed intake of cows from when they entered the feedlot prior to calving until they left following weaning. Feed intake of calves was measured from birth to weaning. Cows and calves from the H line consumed more feed than those from the C line or L line. However, when calf weaning weight was considered the H cows and calves were more efficient in converting feed energy into calf growth. There was a large variation in the efficiency between individual cows in each of the selection lines.

A detailed study is still underway in the automated feedlot to determine the feed requirements of steers from each selection line as they grow from birth to maturity. When completed this study will provide data to enable comparisons of the efficiency of growth of steers to any specified age or market weight, or to the same degree of carcase maturity.

Responses in overall herd profitability

The key objective of the Trangie project was to determine the effect of selection for growth rate on herd profitability. In order to determine this, growth, reproduction and feed efficiency data collected from each selection line was used to compare the expected economic returns across a range of production systems.

As expected, the H line returned the highest gross margin per cow (income minus variable costs) in all production systems examined. The overall gross margin per unit of feed consumed was also greatest for the H line, despite a necessary reduction in the number of cows in the herd relative to the C line. For example, 98 H cows, turning off progeny at 18 months of age, would eat about the same amount of feed as a 100 C cows, but would return $4,800 (about 18%) more per year (Parnell et al. 1990).

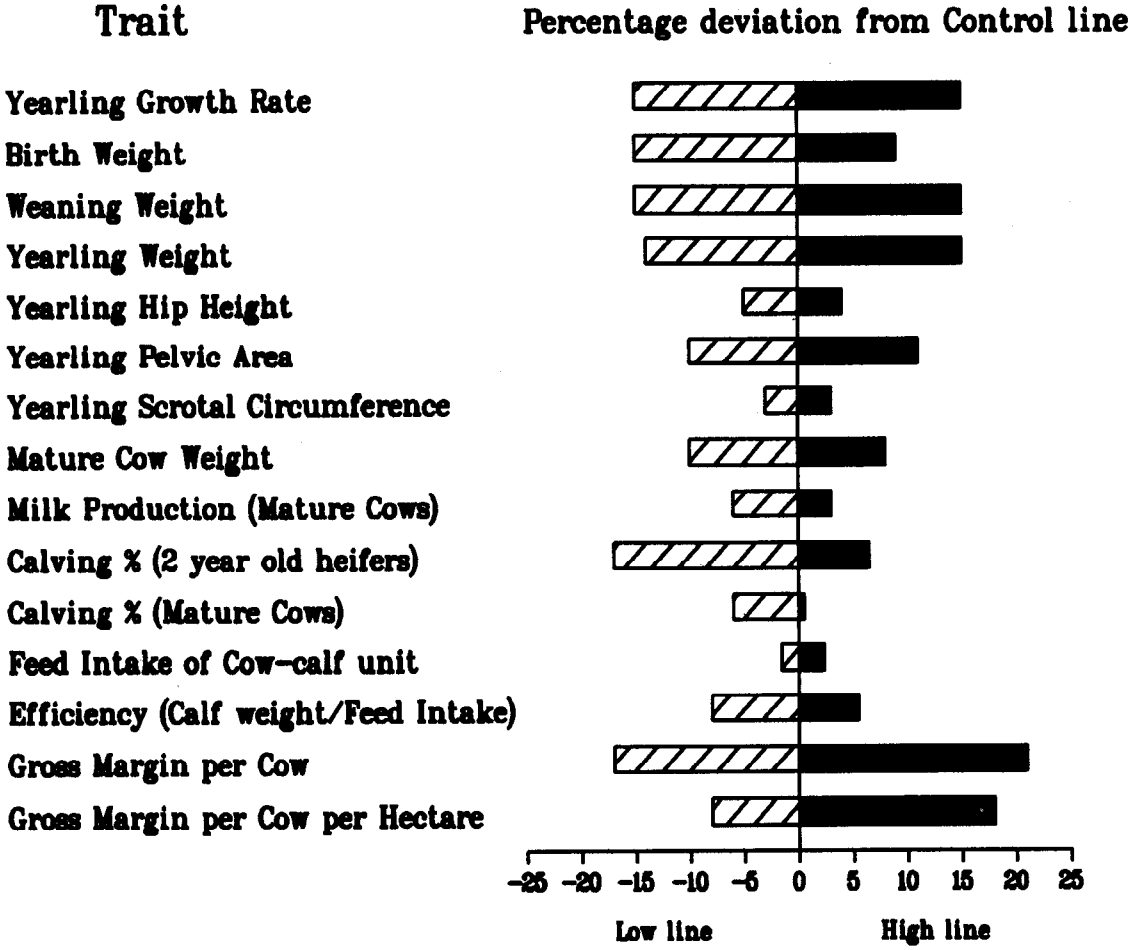

Figure 1. Summary of responses following 15 years of selection for increased yearling growth rate (H line) or decreased yearling growth rate (L line), expressed as % deviation from the unselected C line.

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