REALISED RESPONSES TO DIVERGENT SELECTION FOR YEARLING GROWTH RATE IN ANGUS CATTLE

P.F. PARNELL[1], R. BARLOW[2], and B. TIER[3], AUSTRALIA

[1] Agricultural Research Centre, Trangie, NSW,
[2] Agricultural Research and Advisory Station, Grafton, NSW
[3] University of New England, Armidale, NSW

SUMMARY

Realised responses are presented for growth traits following divergent selection for yearling growth rate since 1974 in closed lines of Angus cattle. Selection was for high or low average daily gain from birth to yearling (adjusted for age of dam) with a random bred control line maintained. Following 10 years of selection the difference between the high and low lines in yearling growth rate was greater than 25 percent for both bulls and heifers. The high line was heavier at birth, 200-day and yearling age than the control line, with the opposite the case for the low line. The divergence between the lines is considered to be sufficient for commencement of a detailed evaluation of the consequences of selection for growth rate on total herd productivity.

INTRODUCTION

Selection for increased growth rate, or weight at a given age, has received much emphasis in beef cattle breeding programs. It is well established that growth rate is moderately heritable and responds to selection. Growth rate is relatively easy to measure and is often assumed to be directly related to economic returns.

The basis for the belief that faster growing animals are more profitable lies in the observation that they reach a target weight more quickly. Nevertheless, a limitation of faster growth rate as a selection criteria is the associated increase in mature cow size and hence in the maintenance costs of the cow herd (Barlow, 1984). In addition, whilst selection for increased growth rate will result in faster growing animals little is known of the associated changes in other commercially important traits such as feed intake, reproductive performance, milk production, carcase quality, structural soundness or other traits which may affect net profitability.

A study is being conducted at the Agricultural Research Centre, Trangie to evaluate the effect of selection for growth rate on total herd productivity. This paper describes the realised responses in growth traits achieved following 10 years of divergent selection.

MATERIALS AND METHODS

The Angus herd at Trangie was established in 1929 and maintained as a 'conventional' stud until 1962. Over this period importations were made from Canada, USA, Scotland and several NSW herds. In 1963 the herd of 120

breeding females was closed and a selection program implemented which gave equal emphasis to yearling growth rate and conformation score. From 1971 to 1973 a trial was conducted in the herd to compare the progress made from selection based on weight gain with that achieved by a panel of experienced stud breeders using visual appraisal.

Design

The current study was initiated in 1974 with the establishment of three lines. Of the 220 breeding cows in the herd, 50 were chosen at random to form a control (C) line. Of those remaining, the 85 cows having the highest average daily weight gain from birth to yearling (adjusted for age of dam) were selected to form a high (H) line, whilst the 85 cows with the lowest weight gain formed a low (L) line. All male and female replacements have since been selected from within each line. Replacements for the H and L lines have been selected on their own growth performance from birth to yearling (adjusted for age of dam). The C line has been maintained with no intentional selection for any character, with all replacements chosen at random. Animals from all lines are run together at pasture throughout the year, except during mating (12 weeks).

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. Replacement bulls and heifers were joined at 14 months of age, with bulls used for only one breeding season. Cows were culled only if they failed to calve in two consecutive years or reached seven years of age. Allocation of heifers to bulls was completely at random, except for the avoidance of mating close relatives. From 1977 to 1982 an attempt was made to optimise the age structures in the H and L lines using 'parent selection' procedures outlined by Hopkins and James (1977). Since 1982 the herd has been expanded in size by retaining all heifers in each line with no culling of cows on age.

Analysis

Birth, 200-day and yearling weight records collected from 1974 to 1984 in each line were collectively analysed using within-herd Best Linear Unbiased Prediction procedures described by Graser and Tier (1986). Data collected on 'base' animals recorded from 1963 to 1973 were also included in the analysis. A single-trait Reduced Animal Model (RAM) was used for birth weight and a multi-trait RAM for 200-day (direct and maternal effects) and yearling weight.

Genetic relationships among all animals were incorporated into the analysis through the numerator relationship matrix. All weights were adjusted for age of dam effects prior to the analysis using standard multiplicative adjustment factors adopted for Angus cattle by the Australian National Beef Recording Scheme. Bull and heifer calves born each year were considered as seperate management groups.

Genetic trends were predicted from changes in mean Estimated Breeding Value (EBV) of progeny over time. EBV's were expressed as kilograms of liveweight, relative to the average of the first 200 base animals recorded (1963-64).

RESULTS AND DISCUSSION

Following 10 years of selection, there was a substantial difference in growth rate between the lines. Table 1 shows that the divergence between the high and low lines for the selected character (adjusted yearling weight gain) was greater than 25 percent for both bulls and heifers.

The divergence in yearling weight between the H and L lines was 75kg for bulls and 55kg for heifers. The difference between the H and C lines in average yearling weight was 34kg for bulls and 27kg for heifers. The H line animals were heavier at birth and 200-days than those in the C line, with the opposite the case in the L line.

Table 1 Average performance measurements (and standard errors) for 1984 born bulls and heifers in the High, Low and Control lines.

	Bulls			Heifers		
	High	Control	Low	High	Control	Low
Number born	44	28	37	51	33	53
Adjusted yearling gain (kg/day)	.869 (.009)	.795 (.011)	.688 (.012)	.627 (.006)	.560 (.010)	.496 (.007)
Birth weight (kg)	30 (.63)	28 (.69)	25 (.79)	28 (.56)	27 (.53)	24 (.45)
200-Day weight (kg)	225 (3.5)	200 (4.4)	180 (4.2)	193 (3.3)	174 (4.8)	157 (3.1)
Yearling weight (kg)	348 (4.0)	316 (6.3)	275 (5.9)	257 (3.0)	230 (4.6)	202 (3.2)

Figure 1 shows the mean EBV over time for birth weight, 200-day weight (direct and maternal effects) and yearling weight in each selection line. These trends corresponded well with the observed phenotypic differences between the lines. The mean EBV's for each trait have remained relatively stable in the C line since it was established in 1974. Random fluctuations were apparent in all lines due to the impact of chance.

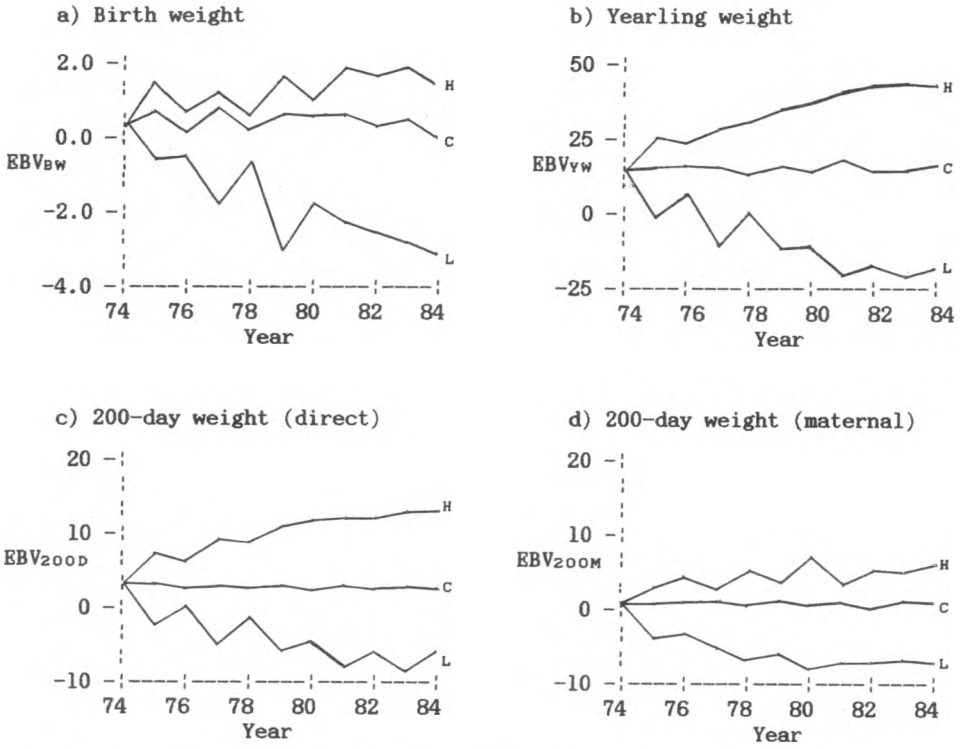

Figure 1 Mean Estimated Breeding Values (EBV's) in kilograms for a) Birth weight (BW), b) Yearling weight (YW), c) 200-day weight direct effects (200D), and d) 200-day weight maternal effects (200M), in High (H), Low (L) and Control (C) lines from 1974 to 1984.

Barlow *et al*. (1978) and Barlow (1980) analysed results of the early years of selection and found substantial differences in growth traits between the selection lines. The divergence in growth rate has continued and sufficient difference now exists to initiate a detailed evaluation of the correlated responses to selection. These studies will include the evaluation of the lines under a range of environments in the nutritional efficiency of the cow-calf unit and the growing animal; the patterns of growth and changes in body composition (carcase quality); milk production; and net reproductive performance.

Once the various input, output and management components which contribute to total herd productivity have been established, they will be integrated into a predictive model for the examination of the economic consequences of weight selection in specific production-market systems.

REFERENCES

BARLOW R. 1980. Short-term responses to selection for high and low yearling gain in Angus cattle. In: Sel. Expt. in Lab and Dom. Anim., Proc. of a Symp. 21-22 July 1979. Ed. by A. Robertson. Com. Agric. Bur. 144-146.

BARLOW R., UPTON W.H. and MURISON R.D. 1978. Selection for yearling gain in cattle. Proc. Aust. Soc. Anim. Prod., 12 : 185.

BARLOW R. 1984. Selection for growth and size in ruminants: is it time for a moratorium? In Proc. 2nd Wld. Cong. Sheep and Beef Cattle Breed., Pretoria, South Africa, 16-19th April 1984.

GRASER H.-U. and TIER B. 1986. Mixed model procedures for the Australian beef industry. II. Single herd evaluation for the National Beef Recording Scheme. (In preparation)

HOPKINS, I.R. and JAMES, J.W. 1977. Some optimum selection strategies and age structures with overlapping generations. Anim. Prod., 25: 111-132.