RELATIONSHIP BETWEEN POSTWEANING GROWTH, NET FEED INTAKE AND COW PERFORMANCE

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SUMMARY

Net (residual) feed intake (NFI) is the amount of feed eaten net of the requirements for maintenance and production. Data on 4-year old Angus, Hereford, Poll Hereford and Shorthorn cows which were assessed as weaners for NFI were used to study the relationships between postweaning NFI and ADG and cow traits. The cows had been separated into High (HE) and Low Efficiency (LE) herds based on their postweaning NFI, to form the parent generation for divergent selection. Cow traits studied were ADG, liveweight, NFI, feed intake, fat depth, eye muscle area and milk yield. Postweaning NFI was significantly ($P < 0.05$) correlated only with cow NFI ($r = 0.36$) and feed intake ($r = 0.30$), while postweaning ADG was significantly correlated with all the cow traits except NFI. The effect of selection line was significant only for cow NFI and feed intake, with HE cows having lower NFI (more efficient) and consuming less feed and than LE cows. This indicates that females which are efficient in feed utilisation as weaners (HE) required less feed as 4-year old cows for the same level of performance as LE cows.

Keywords: Feed intake, feed efficiency, growth, beef cattle

INTRODUCTION

Selection in beef cattle to date has focused on increasing the quantity and quality of output, with less consideration given to the extra inputs required to achieve these increases. However, providing feed to animals is a major expense in beef production and so it may be beneficial to consider both inputs and outputs when making selection decisions to improve herd efficiency. Net feed intake (NFI) is a measure of feed efficiency defined as the amount of feed eaten net of the requirements for maintenance and production. Results of research at the Trangie Agricultural Research Centre indicate that postweaning NFI is moderately heritable and that selection for postweaning NFI results in progeny which consume less feed at the same level of performance (Herd *et al.* 1997; Archer *et al.* 1998a). Little information is available on the influence of such selection on important performance traits in the breeding female. The objective of this paper is to provide preliminary information on the relationships between postweaning growth and NFI and breeding cow performance traits.

MATERIALS AND METHODS

Animals and data. A total of 284 Angus, Hereford, Poll Hereford and Shorthorn females which were tested as weaners for postweaning NFI at the Trangie Agricultural Research Centre were used. These females were born in the spring of 1993, autumn of 1993 and spring of 1994 (season/year of birth cohort). Details of the postweaning NFI tests were reported by Arthur *et al* (1997). After the postweaning NFI test the females were grouped into High Efficiency (HE) and Low Efficiency (LE) herds to form the parent generation females of divergent selection lines. They were mated to produce their first calves as 2 year olds and their second as 3 year olds. Cows and their calves grazed perennial pastures, with supplementary feed (chopped hay and oats) offered during prolonged periods of limited pasture growth. The cows were not mated as 3 year olds, and approximately 3 months after the weaning of their second calf they were subjected to cow NFI test. Each season/year of birth cohort was tested separately for NFI. The cows were 4 - 4.5 years old at the start of the NFI test. Cows were mated again as 4 year olds. Milk yield of the cow was assessed by the weigh-suckle-weigh method at approximately 75 days after calving. The 1993 spring born cows were assessed for milk yield after their third calving, while the 1994 spring born cows were assessed after their second calving. The 1994 autumn born cows were not assessed for milk yield.

The cow NFI test which was similar to the postweaning NFI test, was conducted using an automated feeding system developed at the Trangie Agricultural Research Centre. A pre-test adjustment period of at least 14 days was allowed for cows to adapt to the feeding system and diet, and was followed by a 70 day test. Cows had *ad libitum* access to a pelleted ration consisting of 70 % lucerne hay and 30 % wheat, with metabolisable energy concentration of 10 to 10.5 MJ/kg dry matter and 15 to 17 % crude protein. Individual feed intake was recorded for each cow. In addition 0.5 kg/head of oaten straw (containing 6.7 MJ/kg dry matter) was fed in open troughs. Cows were weighed weekly during the test. Ultrasonic measurements of subcutaneous fat depth at the 12th/13th rib site and eye muscle area were taken at the start and end of the test.

Derivation of traits. Growth of each animal during the test period was modelled by linear regression of weight against time (SAS 1989) and the regression estimates were used to calculate average daily gain (ADG) and weights at the start and end of the test. Feed intake over 70 days was calculated by adding the energy intake of the straw to the energy intake of the pelleted ration and standardised to a concentration of 10 MJ/kg dry matter. Net (residual) feed intake (NFI) was defined as the difference between actual feed intake and expected feed intake. A linear model of feed intake regressed against ADG and metabolic midweight (mean of the start and end weights, raised to the power of 0.73), fitted separately for each test group (season/year of birth cohort), was used to calculate expected feed intake. Net feed intake was calculated as the residuals from the model.

Statistical Analyses. Least squares analysis of variance was performed for all cow traits using the GLM procedure of SAS (1989). The model fitted included the fixed effects of selection line, season/year of birth cohort and breed. Partial correlations, adjusting for the effects of breed and season/year of birth cohort were calculated using the CORR procedure of SAS (1989).

RESULTS AND DISCUSSION

Phenotypic correlations between postweaning NFI and ADG and cow traits are presented in Table 1. Postweaning NFI was significantly correlated with cow NFI and feed intake, but not significantly correlated with the other cow traits. This indicates that females which are highly efficient (with low NFI values) as weaners are also highly efficient, and will consume less feed as cows with very little effect on other cow traits measured in this study. When the data were analysed in terms of the differences in the parent generation of the selection lines, these results were confirmed. Significant selection line differences were obtained for cow NFI and feed intake but not for the other cow traits, with HE cows consuming less feed (Table 2). In a dairy cattle study, Nieuwhof *et al* (1992) obtained a genetic correlation between NFI of growing heifers and lactating heifers of 0.58. Results from NFI studies in mice showed the genetic and phenotypic correlation coefficients between postweaning and mature mice NFI to be 0.60 and 0.29, respectively (Archer *et al.* 1998c).

Postweaning NFI calculated by regression, is by definition phenotypically independent of ADG and liveweight postweaning, as observed in the postweaning results for these animals (Archer *et al.* 1998a). The results of this study indicate that postweaning NFI may be phenotypically independent of ADG and liveweight at any time in the animal's life. If genetic relationships are similar, then it is expected that selection for postweaning NFI may reduce feed costs in the breeding herd without any major change to other important cow traits. Herd and Bishop (1999) reported a genetic correlation between postweaning NFI and estimated mature cow weight of 0.09, which was not significantly different from zero.

Table 1. Phenotypic correlations between postweaning and cow traits

	Postweaning traits	
Cow traits	Net feed intake	Average daily gain
Average daily gain	0.11	0.39*
Net feed intake	0.36*	-0.03
Feed intake	0.30*	0.28*
Liveweight	0.08	0.36*
12/13th Rib fat depth	0.08	-0.19*
Eye muscle area	0.01	0.20*
Milk yield	-0.03	0.22*

* indicates that the r value is significantly ($P < 0.05$) different from zero.

In contrast to postweaning NFI, postweaning growth (ADG) which is a major selection criterion in current breeding programs, had significant phenotypic correlations with all the cow traits measured except NFI (Table 1). Females with high postweaning growth rate were bigger and consumed more feed as cows. The phenotypic relationship between postweaning growth and growth later in life has been confirmed genetically in experiments that showed that selection for growth early in life results in cows with greater mature size (Morris *et al.* 1992; Archer *et al.* 1998b). The increase in mature size of females results in a correlated increase in feed costs of the breeding herd.

Table 2. Least squares means (± s.e.) of cow traits for the parent generation of High and Low Efficiency lines, measured during a 70-day test

Trait	No.	High Efficiency	Low Efficiency	Significance[a]
Liveweight (kg)[b]	284	551 ± 7	550 ± 7	ns
Average daily gain (kg/day)	284	1.20 ± 0.04	1.21 ± 0.04	ns
Feed intake (kg)	284	1093 ± 16	1144 ± 16	**
Net feed intake (kg)	284	-29.0 ± 11.3	18.3 ± 11.4	**
12/13[th] Rib fat depth (cm)[b]	283	4.9 ± 0.3	5.2 ± 0.3	ns
Eye muscle area (cm^2)[b]	283	73.3 ± 1.0	72.7 ± 1.0	ns
Milk yield (kg/day)[c]	104	4.4 ± 0.2	4.1 ± 0.2	ns

[a]** denotes significant at $P < 0.05$; ns denotes not significant ($P > 0.05$).

[b]At the start of the test.

[c]Measured in the second or third lactation.

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