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Ten years reproduction performance data from Angus and Hereford weight selection herds

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ABSTRACT

Reproduction was compared in 2, 13-month weight-selection herds, Hereford (HS1) and Angus (AS1), in an 18-month weight-selection Angus line (AS2) and in an unselected Angus control (AC0), with ages at first joining in both sexes being 14, 14, 26 and 26 months respectively. Pregnancy rates (all ages, 5453 joinings) averaged 86, 88, 90 and 86% respectively, so that yearling bull mating and/or weight selection have not disadvantaged the AS1 or AS2 lines. Subfertile bulls in the 3 selection lines numbered 5, 1 and 5 out of 59, 59 and 49 respectively. Calf death rates from 2-year-old AS1 heifers were lower than from 3-year-old first-calving AC0 heifers. The AS2 line weaned an adjusted total of 1005 calves (963, before adjusting by proportionally) from all age groups over 10 years, compared with 1239 calves in the AS1 line, a shortfall of 18.9%.

Keywords Cattle yearling weight selection; reproduction; calf survival; dystocia; side-effects

INTRODUCTION

The beef breeding herd at Waikite is run as an experimental selection herd by the Department of Lands and Survey (Rotorua) in collaboration with the Genetics Section, Ruakura. Since 1971 the primary aim of the experiment has been to select for genetic improvement in weight-for-age. Ten years reproduction data are presented: pregnancy rates based on pregnancy diagnosis (PD), numbers of subfertile bulls, calving difficulty, calf survival and some lifetime effects of yearling v 2-year-old first joining in selection herds.

MATERIALS AND HERDS

Details of the foundation stock and the experimental design were given by Baker *et al.* (1980). There are 4 'lines' in the selection experiment:

HS1: Herefords selected for 13-month weight; first joined at 14 months.

AS1: Angus selected and joined as described for HS1.

AS2: Angus selected for 18-month weight; first joined at 26 months.

AC0: Angus random-bred controls; first joined at 26 months.

Both Angus and Hereford cattle originally represented a wide sample of genetic sources. The 3 Angus

herds were initially set up as being comparable in terms of genetic background and, as far as possible, in the distribution of live weight and cow age also. Performance in the Hereford line, relative to the Angus, was originally assessed from a previous breed comparison and crossbreeding trial at Waikite (Baker and Carter, 1976).

Details of herd structure are given in Table 1. Bulls in all lines were used for 1 season only. Females were joined in single-sire groups, cows of all ages including yearling heifers being represented, to avoid confounding with bull effects. Subfertile bulls were defined as those bulls which achieved pregnancy diagnosis (PD) rates of less than 60%.

The objective in the AC0 herd was to have large numbers of sires represented, to minimise genetic drift. The AC0 females were divided into 4 balanced groups and each group joined with a harnessed AC0-bred bull until about a third of the females were marked. The first bull was replaced with another AC0 bull, similarly equipped. Sire pedigrees of calves in this herd were based on dam's mating dates, with records removed in cases of uncertainty over pedigree.

PD rates by rectal palpation are given in the present summary because pre winter culling of cows was based on the PD results. In the early years twice-empty cows were culled and more recently once-empty cows also (apart from yearling heifers or cows joined with a subfertile bull). Cows were culled for age after 7 years and were deemed not to have been joined in that year.

Cow reproduction and calf survival data were sum-

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TABLE 1 Design of the Waikite selection experiment.

	Age(mo) of bulls and heifers at first joining	Numbers of females joined				No. of bulls	Intended generation interval (yr)		
		14mo	26mo	≥ 3yrs	Total		Males	Females	Total
HS1	14	40	34	91	165	6	2	4.0	3.0
AS1	14	40	34	91	165	6	2	4.0	3.0
AS2	26	—	34	91	125	5	3	4.6	3.8
ACO	26	—	34	91	125	10-12	3	4.6	3.8

TABLE 2 Pregnancy rates and numbers of subfertile bulls at Waikite (1971/80 joinings).

	PD rate (%) by age of female at joining				Number of bulls		
	14mo	26mo	≥ 3yr	Total	Subfertile	Fertile	Total ²
HS1	83.5	85.2	87.2	85.9(83.2)	5	54	59
AS1	83.1	83.2	91.8	87.7(87.0)	1	58	59
AS2	—	91.4	90.1	90.4(84.6)	5	44	49
ACO	—	82.1	86.7	85.5(85.5)	(0)	(104)	(104)
Total records ¹	749	1187	3268	5204(5453)			

¹ Excludes females joined with subfertile bulls (except in column 5, bracketed).

² One bull fewer in each of the HS1, AS1 and AS2 lines in the first year.

married separately for each line × year combination and then pooled over years. Tests for line differences were done using contingency chi-squares.

RESULTS

The PD rates in 10 years from 1971 are shown in Table 2. There were no significant differences between HS1 and AS1 yearlings but over all age groups PD rates favoured the AS1 over the HS1 line by 3.8% ($P < 0.01$).

There were differences among the PD rates of the 4 lines following joining at 26 months ($P < 0.01$), with an overall value of 85.3% for all lines at that age, with the highest value being for first-calving weight-

selected heifers (AS2). Among the Angus herds, PD rates of cows joined at 3 years or older favoured the selection lines ($P < 0.01$).

The incidence of subfertile bulls in the 3 selection lines is also shown in Table 2, overall 6/118 (5%) in the yearlings and 5/49 (10%) in the AS2 line ($P > 0.05$). The different mating design of the ACO herd meant that it could not be compared here.

Results in Table 3 show the perinatal calf survival (CBA, calves born alive) and calves weaned (CW) per 100 calves born dead or alive (CB). Overall figures for calves weaned per 100 cows joined are also given. In general, differences among lines in calf survival were small, although the effect of cow age was

TABLE 3 Per cent calves born (CB), calves born alive (CBA) and calves weaned (CW) at Waikite (following 1971/80 joinings).

	CBA/CB by age of dam at joining				CW/CB by age of dam at joining				CW/cows* joined, %
	14mo	26mo	≥ 3yr	Total	14mo	26mo	≥ 3yr	Total	
HS1	92.2	96.7	96.4	95.5	84.3	92.5	94.1	91.3	74.0
AS1	92.2	97.5	98.0	96.5	88.0	93.6	94.7	92.9	78.6
AS2	—	97.9	98.4	98.3	—	94.0	94.6	94.4	81.9
ACO	—	95.6	98.9	98.2	—	87.8	95.8	93.9	76.3
Total records	589	964	2786	4339	589	964	2786	4339	5204

* Excludes females joined with subfertile bulls.

TABLE 4 Pre-weaning death rates (100-CW/CB, %) of calves from first-calving heifers at Waikite (following 1971/80 joinings).

Herd	Age of heifer at calving (yr)	No. of heifers	Deaths from dystocia	Other deaths	Total	
					1971/80	1976/80
HS1	2	281	7.5	8.2	15.7	13.9
AS1	2	308	7.8	4.2	12.0	8.2
AS2	3	248	2.0	4.0	6.0	4.5
AC0	3	205	4.4	7.8	12.2	13.9

important for HS1 and AS1 lines: an increase of 4.9% in the 14- over the 26-month dam groups for perinatal calf survival ($P < 0.01$) and of 7.1% for overall calf survival ($P < 0.01$).

A more complete summary of calf death rates (100-CW/CB, %) from first-calving heifers is given in Table 4. All 10 years' data are summarised, along with those for the second 5 years following joinings in 1976/80. The AC0 results (1971/5 v 1976/80) suggest that calf mortality over a genetically stable population is not changing ($P > 0.05$), whereas the trend in all selection lines together is downwards ($P < 0.05$). The AS2 herd (Table 4) had a 6.2% lower death rate than AC0, with which it can be directly compared ($P < 0.05$). The AS1 and AC0 lines had similar overall death rates although the causes of death differed ($P < 0.05$), with AS1 heifers having more deaths from dystocia and fewer from other causes than AC0. The AS1 heifers were, however, 1 year younger than AC0 heifers. The Hereford heifer line had higher overall calf death rates than AS1, although not significantly so ($P > 0.05$).

Ten-year totals of calves weaned per herd for the AS1 and AS2 lines should indicate mainly the lifetime effect of age at first joining. Ignoring 6 sub-fertile bull groups, there were 1232 and 923 calves weaned respectively; adding the calves from these groups yielded 1239 and 963 calves. Adjusting AS2 calf numbers proportionally for an unintentional difference in numbers of 2-year-olds joined from 1971 to 1980 led to a revised AS2 figure of 1005 calves, i.e., an 18.9% shortfall in AS2 calf numbers compared with AS1.

An alternative approach to the same data showed that 391 AS1 females, joined as yearlings in 1971 to 1980 and followed through subsequent joinings in 1972 to 1980, weaned 271 calves as 2-year-olds and 968 calves subsequently. By contrast, the same number of AS2 yearlings held over unjoined for another year weaned 1005 calves at later ages. For only a 37 calf loss at older calvings (968 v 1005), the AS1 herd weaned a bonus of 271 calves from 2-year-olds.

DISCUSSION

Pregnancy Rates

The difference in PD rate between HS1 and AS1 yearling heifers in this data set (Table 2) was similar to the 1% difference reported by Baker and Carter (1976) in an earlier Waikite trial (AS1 > HS1) and 2% for cows. Morris and Baker (1982) reported a difference of 3% for Angus over Hereford cows in the beef breed evaluation at Goudies.

The difference in mating management in the AC0 line must be borne in mind when interpreting the practical significance of the selection line comparisons, because of smaller AC0 mating group sizes and of within-season replacement of bulls. The PD rates of Angus cows 3 years of age or older showed that the AC0 line was significantly poorer. Analysis using a least squares model which allowed for imbalance in age-of-dam representation across lines showed a PD superiority of 5.3% for AS1 over AC0 and 5.7% for AS2.

For comparison, selection line superiorities in reproduction over the control in the Canadian Shorthorn yearling weight selection experiment (Newman *et al.*, 1973) were as follows (J. A. Newman, 1979, pers. comm.; preliminary analysis of 1975/8 data):

Calves born as a % of cows joined in 42 days of natural service	10.2 ± 2.9
Calves weaned as a % of calves born	0.8 ± 2.8
Calves weaned as a % of cows joined	9.3 ± 3.2

All differences are consistent with Waikite results. In the Trangie Angus weight-selection herd in N.S.W. (Barlow *et al.*, 1978), preliminary analyses of conception rate data also show trends in the same direction.

Although subfertile bull data were not available for the AC0 herd, the other 3 herds averaged between 5 and 10% subfertile bulls, 6.6% overall (Table 2). Carter and Cox's (1973) data on yearlings and virgin 2-year-old Angus bulls at Waikeria gave a similar frequency (4/86 yearlings and 5/80 2-year-olds). The comparison of Waikeria v Waikite Angus 14-month joining weights among bulls, 361 kg (Carter and Cox,

1973; 16 years' data) v 321 kg (1971/81 joinings) respectively, suggests that a 40 kg increase in yearling bull weight may not be the requirement for reducing subfertile bull numbers.

Finally, a least squares analysis which accounted for the unbalanced data with respect to age of dam and line indicated that conception rates were no different for cows at 2 and at 3 years of age, i.e., it was no more difficult to get first-calving 2-year-olds back in calf than to get 3-year-olds back in calf. Four-year-olds had a 3% higher PD rate than either of the previous 2 age groups.

Calf Survival and Calving Difficulty

Table 3 showed a significant effect of 2-year-old dams on calf survival relative to older dams. The effect is probably partly due to primiparous calving rather than age, because a difference between first- and second-calving dams also occurred in the AS2 and AC0 lines, especially the latter. Further partitioning of overall calf survival data by lines (Table 3) showed that 47% of all AC0 calf deaths occurred in those from first-calving dams. Equivalent values for the AS2, AS1 and HS1 lines were 27%, 40% and 45% respectively.

Table 4 showed further details of calf deaths from first-calving heifers. Deaths due to dystocia were less than 8% in calves of 2-year-old AS1 and HS1 dams. This result was in marked contrast to the result reported by Koch *et al.* (1982) for the Hereford yearling weight (FWL) and control lines at Clay Center, Nebraska, where 22 v 16% of male calves from 2-year-old dams died due to difficult births in the FWL and control lines, and 13 v 7% of female calves. At Clay Center 50% of 2-year-old control cows were assisted at calving if carrying male calves and 19% if carrying females.

The AS2 selection line at Waikite can be directly compared with the AC0 line for calving experience. As well as the mean calf death rates being greatly different between Waikite and Clay Center, the selection line ranked better than the control at Waikite (AS2 v AC0) but worse at Clay Center (FWL v control). We believe that the explanation lies in different quantities and qualities of winter feed offered to pregnant cows leading (amongst other factors) to an increase at Clay Center in birth weights of about 27% over Waikite HS1 2-year-olds' calves.

Herd Productivity (AS1 v AS2)

The differences in Table 2 between PD rates of

females joined at 14 months v later ages are very small compared with a value of 69% for calves weaned per 100 AS1 yearlings joined and 66% for HS1 yearlings, noting that the heifers constitute about a quarter of the herd. At 3-year-old and older joinings, AS1 and AS2 PD rates did not differ ($P > 0.05$), indicating no difference in subsequent conception results after yearling v 2-year-old first joining. This corresponds with other published work reviewed (Morris, 1980), where yearling mating led to higher lifetime calf production than delaying first mating for a year.

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