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## RECIPROCAL CROSSBREEDING OF FRIESIAN AND ANGUS CATTLE

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### SUMMARY

A progress report is given of a reciprocal crossbreeding trial comparing Friesian  $\times$  Friesian (F  $\times$  F), Friesian  $\times$  Angus (F  $\times$  A), Angus  $\times$  Friesian (A  $\times$  F) and Angus  $\times$  Angus (A  $\times$  A) steers and heifers bred on hill country and killed at approximately 18 months of age. Two years' data on the performance of Friesian and Angus cows to weaning and one year's slaughter data are reported.

Pregnant Friesian cows lost less liveweight than Angus over the winter period, but the Angus gained more during the suckling period. The fertility of the Friesian and Angus cows was similar. Mortality of calves between birth and weaning was slightly greater for A  $\times$  A calves than for the other three groups.

The Friesian calves were, on average, 17 lb heavier at birth, and 80 lb heavier at weaning than A  $\times$  A calves. Significant paternal and maternal breed effects, favouring the Friesians, were present at birth and weaning. The A  $\times$  F calves were 10 lb lighter at weaning than F  $\times$  F, and F  $\times$  A 35 lb heavier than A  $\times$  A.

Maternal effects on final liveweight, carcass weight, and the weights of carcass components were manifest in the slaughter data and significant paternal  $\times$  maternal breed interactions were also found.

The heavier F  $\times$  F animals produced a greater weight of salable meat than the lighter A  $\times$  A, even though the latter had a higher meat yield percentage. Differences in carcass composition were accounted for by differences in carcass weight.

Heterosis estimates for calf weaning weight, final liveweight and carcass weight were 1.9%, 3.6% and 4.9%, respectively.

The results are discussed in relation to the role of Angus and Friesian cattle in the New Zealand beef industry.

FRIESIAN and Friesian  $\times$  Jersey cattle are being increasingly used for beef production in New Zealand and several trials have established the Friesian's superior growth rate in comparison with traditional beef breeds, and their acceptable carcass composition in terms of meat, fat and bone content, fat colour, tenderness and palatability. The

high milk production of dairy cattle is also being exploited in the beef industry through multiple suckling, leading to appreciable improvement in overall efficiency (Everitt, 1970; Everitt *et al.*, 1970).

The attributes of high milk production, low calf mortality, good birth weights, rapid growth rate and late physical maturity, possessed by the Friesian, could also prove of considerable benefit to the traditional beef industry. Trials comparing Friesian with Angus cattle at the Whatawhata Hill Country Research Station (Hight, 1968, 1969) have shown that Friesian cows gain more weight than Angus over the post-weaning autumn and winter period, but gain less while suckling their larger calves. Friesian calves have been heavier at birth, and 66 to 94 lb heavier at weaning (4½ months of age) than Angus calves. Steers have been up to 200 lb liveweight heavier than Angus when slaughtered at about 18 months of age. Friesian heifers retained on hill country have maintained or increased their liveweight advantage at weaning over Angus heifers, and about 20% more Friesians than Angus have calved as two-year-olds. The available evidence indicates that Friesian cows have a comparable fertility to Angus, and the onset of oestrus after calving in the two breeds is similar. More recently, at Tara Hills Research Station (Barry, 1969), Friesian cows have produced heavier calves at birth and weaning than Angus cows. The liveweight of Friesian cows did not exceed that of Angus by more than 50 lb at calving or weaning.

These results do not indicate whether the maternal environment and/or the genetic potential of the calves were limiting the growth of the Angus calves before and after weaning. This paper is a *progress* report of a reciprocal crossbreeding trial aimed at elucidating these aspects. Data on the performance of cows in the first two years of trial and the first crop of slaughtered cattle are presented.

## MATERIALS AND METHODS

### MATING

A crossbreeding experiment was initiated at Whatawhata at the 1967-8 mating, with Friesian and Angus cows mated to either Friesian or Angus bulls. These matings produced four groups of calves, namely: Friesian × Friesian (F × F), Angus × Friesian (A × F), Friesian × Angus (F × A), and Angus × Angus (A × A). Friesian

and Angus cows were re-randomized to either Friesian or Angus bulls at the 1968-9 mating, and some were artificially inseminated. Four bulls of each breed were used in each year, bulls used in the second year being different from those in the first.

#### MANAGEMENT

All the Friesian and Angus cows grazed together or in randomly allocated grazing groups. About 8 weeks before expected calving dates those cows close to calving were drafted off and fed autumn-saved pasture and hay. Cows and calves were weighed within 24 hours of calving, and at regular intervals to weaning. The mating period extended from late October or early November to the end of January or mid-February, at which time the calves were weaned. Male calves were castrated in late November. All cows were combined into one group at weaning, except in the second year when the three-year-olds were grazed separately.

At weaning the 1968-born steer and heifer calves were transferred to the Horotiu farm of the Auckland Farmers' Freezing Co-operative Ltd., and leniently grazed within sex groups until slaughter in late April, 1970.

#### SLAUGHTER AND PROCESSING

Cattle were slaughtered at the Horotiu Freezing Works. Individual carcasses were weighed, graded for export, and subsequently fabricated into primal boneless, fat-trimmed cuts, bone, and excess fat (including subcutaneous and kidney/channel fat) as described by Everitt (1961). Primal cuts have been collated into a high-priced group (inside, outside, knuckle, eye round, top sirloin, bottom sirloin, flank steak, tender loin and cube roll).

#### BIOMETRICAL PROCEDURES

Where appropriate, least squares estimates of cow and calf liveweights were adjusted for age of cow, year, calf sex and sire of calf.

Paternal (sire) breed variation was tested for significance against variation between sires within breeds. This is a stringent test, especially for carcass data, where only 4 sires of each breed are represented at this stage of the experiment.

TABLE 1: COW AND CALF PERFORMANCE  
(Data for 1967-8 and 1968-9)

<i>Paternal breed</i>	<i>F</i>	<i>A</i>	<i>F</i>	<i>A</i>	<i>Significance of</i>			
<i>Maternal breed</i>	<i>F</i>	<i>F</i>	<i>A</i>	<i>A</i>	<i>S.D.</i>	<i>Paternal</i>	<i>Maternal</i>	<i>Paternal</i> <i>×</i> <i>Maternal</i>
No. cows calving	40	46	45	68				
No. calves weaned	36	45	42	58				
Cow liveweight (lb):								
April	973	970	918	904	106	ns	***	ns
Post-calving	922	923	811	786	97	ns	***	ns
Weaning	966	973	899	899	92	ns	***	ns
Calf liveweight (lb):								
Birth	75	72	66	58	12	*	***	ns
Weaning (age corrected)	399	389	343	319	43	**	***	ns

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ ; ns = not significant.

F = Friesian; A = Angus; S.D. = Standard deviation.

## RESULTS

Calving performance to weaning in the 1967-8 and 1968-9 seasons are summarized in Table 1.

Friesian cows were aged 3-, 4-, and 5-year-old, and Angus cows 4- and 5-year-old in 1967-8. In 1968-9, 2-, 3, 4-, and 5-year-old Friesian cows and 2-, 3-, 4-, 5-, and 6-year-old Angus cows were used.

The Friesian cows were heavier than Angus in April (mid-pregnancy), but Angus cows lost more body weight over the winter period before calving. Angus cows lost on average 0.44 lb/day more between April and post-calving than the Friesians. Between calving in the spring and weaning (4½ months later), the suckled Angus cows gained appreciably more liveweight than Friesian cows.

Mean calving date was September 16 and did not differ significantly between groups. More A × A calves died between calving and weaning than calves of the other three groups but the numbers involved were small.

Friesian calves were, on average, 17 lb heavier at birth, and 80 lb heavier at weaning than A × A calves. Significant paternal and maternal breed effects, favouring the Friesian, were recorded at both birth and weaning. The maternal effect of the Friesian breed was approximately twice as great as the paternal effect at both times. A × F calves were 10 lb lighter at weaning than F × F calves, but F × A calves were 24 lb heavier than A × A calves; no significant paternal × maternal breed interaction was detected.

Least squares means for final liveweight and carcass data are given in Table 2 for animals born in 1968.

Maternal effects on final liveweight, carcass weight, and the weights of carcass components were significant, and the breed interaction also attained significance for carcass weight, total meat and fat.

Friesian cattle were 140 lb heavier in final liveweight, and 79 lb heavier in carcass weight than A × A cattle. F × A cattle achieved a considerably heavier carcass weight than A × A, while A × F cattle were only 9 lb lighter than F × F. The average carcass weights of the progeny from each of the 4 Friesian sires were 480, 469, 455 and 424 lb; while the progeny of the 4 Angus sires weighed 431, 430, 427 and 421 lb. Thus, the progeny of one Friesian sire were comparable in carcass weight to the progeny of Angus sires.

The total weight of salable meat produced by F × F cattle exceeded, by 42 lb on average, the meat produced by

TABLE 2: SLAUGHTER DATA FOR CATTLE BORN IN 1968

<i>Paternal breed</i>	<i>F</i>	<i>A</i>	<i>F</i>	<i>A</i>	<i>Significance of</i>			<i>Paternal</i>
<i>Maternal breed</i>	<i>F</i>	<i>F</i>	<i>A</i>	<i>A</i>	<i>S.D.</i>	<i>Paternal</i>	<i>Maternal</i>	<i>×</i> <i>Maternal</i>
No. of animals	19	17	20	28				
Final liveweight (lb)	901	876	846	761	69	ns	***	ns
Frozen carcass weight (lb)	471	462	443	392	38	ns	***	*
Total meat (lb)	313	311	299	271	26	ns	*	*
bone (lb)	118	112	107	94	9.3	ns	***	ns
fat (lb)	49	50	48	39	8.4	ns	**	*
Percentage meat	65.2	65.8	66.0	67.1	1.4	ns	**	ns
bone	24.6	23.7	23.5	23.4	1.3	ns	*	ns
fat	10.2	10.5	10.5	9.5	1.4	ns	ns	ns
High-priced cuts as % of total meat	40.7	40.7	40.6	40.9	0.8	ns	ns	ns

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ ; ns = not significant.

F = Friesian; A = Angus; S.D. = standard deviation.

the straightbred Angus, the lower percentage meat yield of the former being more than compensated for by the heavier carcass weight. The  $F \times A$  produced 28 lb more meat than the  $A \times A$ , and the  $A \times F$  only 2 lb less than the  $F \times F$  animals. Less excess fat and bone were produced by the relatively light  $A \times A$  cattle.

Although these four groups of cattle differed markedly in carcass weight and conformation at the same age, the proportion of high-priced cuts did not differ significantly.

After adjustment to a constant carcass weight, the differences in weights and proportions of carcass components were not significant.

#### DISCUSSION

Estimating heterosis as

$$\frac{[(F \times A) + (A \times F)] - [(F \times F) + (A \times A)]}{[(F \times F) + (A \times A)]} \times \frac{100}{1}$$

provides a value of 1.9% for calf weaning weight. Calves out of Friesian cows were on average 53 lb heavier than those from Angus cows. This, with the statistical analyses of paternal and maternal effects, suggests the superior maternal environment of the Friesian is the main contributing factor resulting in heavier calves, rather than the inability of Angus calves to grow pre-weaning. Part of the superior maternal ability of the Friesian cow is likely to be due to higher milk production, and this is now being investigated.

Heterosis estimates for final liveweight and carcass weight were 3.6% and 4.9%, respectively. Overseas reports (Warwick, 1970) indicate that heterosis effects would be reduced with advancing age after weaning, and that carcass characters show virtually no heterosis.

These results support those previously obtained at Whatawhata (Hight, 1969) and more recently at Tara Hills (Barry, 1969) of the superior per-cow performance of Friesians. Results from the United States (Warwick, 1970) also show the superior maternal ability of Holsteins in crossbreeding trials with Angus and Hereford cattle, while the Brown Swiss appears superior to the Angus and Hereford in terms of calf weaning weight. Reports from the United Kingdom (Anon., 1970) have shown calves at 200 days of age out of beef/Friesian cows to be, on average, 47 lb heavier for steers and 33 lb heavier for heifers than other breeds or crosses, although the advantage was substantially reduced in hill compared with lowland herds.

In all comparisons reported, the Angus breed, the predominant beef breed in New Zealand, ranked poorly in maternal performance.

Hight (1969) has suggested that beef breeding cows could be mated to high-growth-rate Friesian bulls in a grading up programme, or that straightbred Friesians be more widely used as beef cows. The results available raise doubts about the desirability of persisting with straightbred Angus cows, and present performance improvement programmes with this breed, unless large-scale performance testing and/or integrated beef breeding schemes become more widespread.

A ready supply of Friesian bulls is available in New Zealand, and increasing numbers of these could be performance tested. Calves of high-growth-rate capacity are required to exploit the milking potential of the Friesian, as well as increases in efficiency of food conversion from high post-weaning growth rates.

Friesians need to be tested as beef breeding cows in a wide range of New Zealand farming conditions. Ultimately, a basic cattle breeding population of Friesian cows might be envisaged, mated, if necessary, to different breeds of beef or dairy bulls to meet any particular market specifications.

The second phase of this project involves a comparison of Friesian, Angus, Friesian  $\times$  Angus and Friesian  $\times$  (Friesian  $\times$  Jersey) cattle as beef breeding cows on hill country.

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