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A. L. Gyles
University of New England

W. H. Upton
University of New England

K. Hammond
University of New England

J. M. Thompson
University of New England

B. Tier
University of New England

HETEROSIS FOR PREWEANING TRAITS IN DEVON-HEREFORD CROSSES

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A.L. GYLES[1], W.H. UPTON[1], K. HAMMOND[1], J.M. THOMPSON[2] and B. TIER[1]

SUMMARY

Heterosis for gestation length, birth weight, suckling stimulus, weaning weight and preweaning growth was estimated from the first years data of a complete two-breed diallel with the Devon and Hereford breeds, involving 119 calves by 29 sires grown together under temperate grazing conditions at Gunnedah, New South Wales, Australia.

Estimates of heterosis (and average mid-parent values) for gestation length were 0.2% (282.9 days); birth weight 6.5% (32.6kg); suckling stimulus 22.9% (3.51/day); weaning weight 5.9% (155.1kg); and average daily gain to weaning 7.0% (0.6kg/day).

INTRODUCTION

Heterosis for production characters has been estimated utilising reciprocal crosses of British breeds in commercial beef cattle herds, by Gregory et al. (1965), Gaines et al. (1966), Long and Gregory (1974), and Gray et al. (1978). These authors reported heterosis levels of 0-3.8% for birth weight, 2.8-7.2% for weaning weight and 4.2-8.2% for average daily gain to weaning.

Expression of heterosis may interact with the environment (Barlow 1981), hence there is a need to conduct specific breed-cross evaluations in the main production environments. Devon-Hereford crossing is used in Australia, but there are no reported estimates of heterosis for the cross under any of the Australian production environments.

The primary objectives of this trial were to estimate heterosis for preweaning traits in Devon-Hereford crosses under Australian temperate range conditions and to investigate the relationship between calf genotype and dam milk yield.

MATERIALS AND METHODS

The field site is located at Gunnedah, on the Liverpool Plains in north western New South Wales, 31°S 153°15'E. Soils are primarily alluvial, with altitude ranging from 260 to 300m. The climate is characterised by hot summers and mild winters. The annual median rainfall of 550 to 600mm is often ineffective due to variability and high evapotranspiration rates in summer. The herd grazed together at all times on a mixture of natural pasture (Stipa

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[1] Animal Genetics and Breeding Unit, NSW Department of Agriculture - University of New England, Armidale, NSW, 2351, Australia.
[2] Department of Animal Science, University of New England.

aristiglumis based), improved irrigated pasture (Medicago sativa), summer fodder crop (Sorghum spp. hybrid) and winter fodder crop (Hordeum vulgare).

The design was a complete two-breed diallel, the base herd consisting of 63 Devon and 56 Hereford cows collected from several locations, with all but 13 being over 5 years of age. Mating was by artificial insemination, with semen from 15 Devon and 14 Hereford bulls, to produce both straightbred and reciprocally crossed calves (see Table 1). Calving took place from December 1984 to January 1985. Calf weights were measured at birth, post-calving (70 days after average birth date) and at weaning (185 days after the average birth date). Bull calves were castrated post-calving. Cows were weighed and condition scored pre-calving, post-calving, and at weaning.

Milk production was measured during mid-lactation on a subset of 40 cows using the oxytocin technique of Butson et al. (1980). Milk composition was measured by procedures of Shipe (1972) and Grappin et al, 1980.

Data were analysed by least squares procedures for the traits: gestation length, birth weight, weaning weight, average daily gain to weaning, and 24 hour milk production. The general model included effects for calf breed, calf sex, calf date of birth, cow weight, cow condition score, cow age, sires-within-breed and selected interactions. Non-significant effects were sequentially deleted to produce the final model for each trait. Results from preliminary analyses for birth weight and gestation length were reported by Gyles et al. (1985).

RESULTS AND DISCUSSION

The means, standard errors and estimates of heterosis for all traits are given in Table 1. Cow breed comparisons were considered of little value due to the variation in previous environment.

Heterosis for gestation length was estimated at $0.2 \pm 0.5\%$, or 0.6 ± 1.6 days. In studies reviewed by Long (1980), heterosis estimates for gestation length were close to zero. Whilst there was no difference in gestation length between the reciprocal crosses, the straightbred calves differed by 5 days (P<0.05), with the Devons having longer gestations.

Birth weight was higher for the crossbred calves (P<0.10) with the two straightbreds being similar and little difference between the reciprocal crosses. These results suggest maternal environment was similar in each dam breed. Barlow and O'Neil (1978) and Smith et al. (1976) found that differences between crosses in birth weight were largely accounted for by differences in gestation length. However when we adjusted birth weights for gestation length the ranking and magnitude of the breed means did not change. Heterosis for birth weight was 1.2 ± 1.1 kg or $6.5 \pm 3.4\%$; similar to the estimates by Gregory et al. (1965), Gaines et al. (1966), Gray et al. (1978), and Long (1980).

Crossbred calves suckled an average of 4.3 litres per day from their dams during mid-lactation, which was 0.8 ± 0.3 litres per day more than straightbred calves (P<0.05). Hence, heterosis for suckling stimulus on milk yield was $22.9 \pm 0.9\%$. This is similar to that (20%) reported by Reynolds et al. (1978) for crossbred versus straightbred calves on Angus dams, but twice that reported by Jeffery et al. (1971) for Hereford dams. The

energetic content of milk produced was calculated, using the equation $Y = -236 + 386BF + 205SNF$, where Y, BF and SNF are energetic content, butterfat and solids-non-fat percentages, respectively (Wickes 1983). Crossbred calves stimulated the production of 25% more energy than the straightbreds during their dam's mid-lactation period. This difference in energy production was largely due to milk yield and not differences in composition.

TABLE 1: Means (SE) for preweaning growth traits of straighbred Devon and Hereford calves and their reciprocal crosses and heterosis.

TRAIT	BREED OF CALF				HETEROSIS	
	DD*	HH	HD	DH	ABSOLUTE	PERCENT
Number of Calves	31	26	32	30		
Gestation Length[1] (days)	285.3 (0.8)	280.5 (0.8)	286.6 (0.9)	283.4 (0.8)	0.6 (1.6)	0.2 (0.5)
Birth Weight[2] (kg)	32.4 (1.0)	32.8 (1.4)	35.1 (1.1)	34.3 (1.1)	2.1 (1.1)	6.5 (3.4)
Milk Yield[3] (litres/day)	3.9 (0.4)	3.0 (0.3)	4.8 (0.4)	3.8 (0.3)	0.8 (0.03)	22.9 (0.9)
Weaning Weight[4] (kg)	156.0 (4.5)	154.3 (5.2)	162.0 (4.6)	166.5 (4.8)	9.1 (4.8)	5.9 (3.1)
Average Daily Gain[5] (kg/day) to Weaning	0.65 (0.02)	0.63 (0.03)	0.67 (0.02)	0.70 (0.02)	0.04 (0.02)	7.0 (3.7)

* D=Devon, H=Hereford, with breed of bull listed first for each genotype.

1.Gestation length was adjusted for birth weight, sex, day of calving, cow condition score (cs), cow age, sires within breed, and sex X cow cs interaction.
2.Birth weight was adjusted for sex, day of calving, cow cs, cow weight, cow age, sires within breed and calf breed X cows cs interaction.
3.Milk production was adjusted for sex.
4.Weaning weight was adjusted for sex, day of calving, cow cs, cow weight, cow age and sires within breed.
5.Average daily gain was adjusted for sex, cow cs, cow weight, cow age and sires within breed.

At weaning the crossbred calves weighed 9.1 ± 4.6 kg (P<0.10) more than the straightbreds, the latter averaging 155.1 kg. The resulting heterosis for weaning weight was $5.9 \pm 3.1\%$, which is similar to other reports for British Breed crosses (Gregory et al., 1965, Gaines et al., 1966, Long and Gregory, 1974, Gray et al., 1978 and Long 1980). The difference between the straightbreds (1.7 kg) was not significant.

Crossbred calves gained 0.04 ± 0.02 kg/day to weaning more (P<0.10) than the straightbreds which averaged 0.64 kg/day. The difference between the straightbreds was not significant. Heterosis for preweaning gain was $7 \pm 3.7\%$, which is within the range of 3 to 8% reported for studies of British

Breed crosses, as reviewed by Long (1980). Heterosis for average daily gain over the later preweaning period (70-185 days) was 6.5 ± 5.9%, and this was higher than for an earlier growth period (birth-70 days) when it was 3.7 ± 4.1%. The higher heterosis exhibited for late preweaning growth may reflect the ability of the crossbred calves to stimulate higher milk production in their dams. In a study of Hereford cows with crossbred and straightbred calves, it was found that cows with crossbreds produced less milk early in lactation and 10% more milk in later lactation (Jeffery et al., 1971).

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