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Progeny performance of industry and index selected Angus bulls

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ABSTRACT

The Department of Lands and Survey (LS) introduced an objective-based, open nucleus Angus breeding programme in 1976 to produce bulls for its commercial properties. Previously, commercial sires were purchased from numerous industry sources (IND). To determine performance differences between the two sire sources, 600 mature Angus cows and heifer replacements were randomly mated to either LS or IND bulls beginning in 1976. Replacement female offspring from these matings were then randomly mated to either LS or IND bulls to produce second generation offspring (GEN2). Herd size was maintained and matings continued through 1986. Growth performance of all GEN2 animals was recorded through weaning. After weaning, only female performance was recorded. Least-squares methodology was used to determine differences between the two genetic sources (IND or LS). Traits measured were weaning weight (WW); cow ratio (CR; calf weaning weight per 100 kg of cow weight); yearling weight (YW); and 18 month weight (18M). The statistical model for all traits included year of birth (YOB), sire source of calf (CSS) and dam (DSS), sex (where applicable), age of dam (AOD), age at weighing, and the interactions of YOB and CSS, YOB and DSS, AOD and CSS, AOD and DSS, and CSS and DSS. Calf's sire source was significant ($P < 0.01$) for WW and CR, and approached significance for YW ($P < 0.10$) but was not significant for 18M ($P > 0.10$). Neither dam's sire source nor the interaction of CSS with DSS was significant for any trait ($P > 0.10$). The WW of progeny with LS maternal grandsires and LS sires was 4.6 ± 1.7 kg greater than progeny with IND sires and IND maternal grandsires ($P < 0.01$). Differences in weights taken subsequently were smaller ($P > 0.10$). Although not statistically important, in a production scenario where all male progeny were sold at weaning, benefits of the introduction of an objective-based, breeding scheme were evident.

Keywords: Beef cattle; Angus; sire source; index selection; liveweights.

INTRODUCTION

Since 1970, the New Zealand Department of Lands and Survey (LS), now known as Landcorp Farming Ltd, has been using an open nucleus breeding scheme for its Angus herds. The Angus Breeding Scheme was established to produce male offspring for use as sires in the Rotorua Land Development District's commercial beef cow herds (Gibson and Dalton, 1973; Dalton and Gibson, 1974).

In 1976 index selection (to predict a breeding objective defined by C.A. Morris, R.L. Baker and D.L. Johnson, unpublished), was introduced to the breeding scheme. The principles in the index of combining animal weights and net reproduction have been described by Morris (1980). The objective and selection criteria in the indexes used in selecting nucleus herd replacements have been described by Nicoll *et al.* (1979). At the same time as index selection was introduced into the Angus Breeding Scheme, an experiment was established in an independent LS herd to compare direct and maternal performance levels of progeny sired by LS-bred bulls selected on index from the Angus Breeding Scheme, and by bulls normally available to the Departmental herds from industry sources (IND). The results presented here represent the culmination of this study. Preliminary results were reported by Nicoll and Johnson (1986).

MATERIALS AND METHODS

Management and Selection Procedures

In 1976, a population of 600 commercial cows and heifer replacements were randomly mated to either LS or IND sires. The resultant offspring were generation 1 animals (GEN1). Generation 2 animals (GEN2) were produced from the random mating of GEN1 females to either LS or IND sires. Matings from 1976 through 1981 were conducted on the Tihoi Land Settlement Block of the Rotorua Land Development District, and thereafter on the Wairakei Land Settlement Block of the same District. Matings were discontinued after the 1986 breeding season. All female offspring, regardless of parentage, were eligible for selection based on the Yearling Index (YI) as used in the nucleus herd. The limited culling of cows was based on the same breeding objective, using the nucleus herd's Cow Index.

The 105 IND bulls used in the experiment were chosen at random from all bulls purchased annually by independent personnel of the Te Kuiti Land Development District. LS bulls were selected on YI from all Angus Breeding Scheme nucleus-bred bulls distributed to commercial herds. Average index values of the 103 LS bulls used and the overall Scheme sire pool were $\$10.96 \pm 1.02$ and $\$9.95 \pm 0.89$, respectively ($P > 0.10$). All IND and LS bulls were used for one year only.

Herd management and production policies in the experimental herd were typical of those in the Rotorua Land

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Development District during the study period. Male offspring were castrated at birth and sold as weaners. All female offspring were kept until yearling age at which time they were selected as replacements or sold. In contrast to normal procedures at the time however, heifers were bred to calve at 2 years of age. Data were collected on weaning weight (WW), cow ratio (CR; kg of calf weaned per 100 kg cow live weight at weaning), yearling weight (YW), and 18 month weight (18M). Because males were sold at weaning, only performance of females was recorded after weaning.

Data in this study were from GEN2 individuals. GEN2 data allowed estimation of total group differences made up of maternal effects due to the maternal grandsire source and direct effects due to the sire source of the GEN2 individual. Numbers of observations for each trait by sire and maternal grandsire source are listed in Table 1.

TABLE 1: Number of observations by trait^a.

Calf sire	Dam sire (maternal grandsire)							
	Lands and Survey				Industry			
	WW	CR	YW	18M	WW	CR	YW	18M
Lands and Survey	369	350	176	142	350	335	165	143
Industry	382	372	175	135	356	343	157	126

^aWW=weaning weight, CR=ratio of WW per 100 kg cow live weight at weaning, YW=yearling weight, 18M=18 month weight.

Statistical analysis

Least-squares methodology was used to determine progeny performance differences between LS and IND sire sources (GENSTAT 5, 1987). The lack of pedigree information and therefore genetic “connectedness” between bulls used in the study precluded the use of BLUP methodology.

The statistical model for all traits contained the fixed effects of year of birth, sex (where applicable), age of dam, calf’s sire source (CSS; LS or IND), dam’s sire source, or maternal grandsire (DSS; LS or IND), and the interactions of year of birth with CSS or DSS, age of dam with CSS or DSS, and CSS with DSS. For each trait, a covariate for age of the individual at measure was included.

RESULTS

Calf sire source was a significant source of variation for WW and CR (P<0.01), and approached significance for YW (P<0.10). Neither DSS nor its interaction with CSS was significant for any trait.

Least-squares means by CSS and DSS are shown in Table 2 for WW and Table 3 for CR. The mean WW for LS-sired calves out of LS-sired dams was 4.6±1.7kg greater than that for IND-sired calves out of IND-sired dams (Table 2). The corresponding difference for CR was 0.9±0.5kg/100kg (Table 3), but the differences were small for YW (1.8±2.1kg) and 18M (0.6±2.9kg).

TABLE 2: Least-squares means (kg) for weaning weight (WW) and associated standard errors (se) by calf and dam sire source (Lands and Survey or Industry).

Calf sire	Dam sire				Average	se
	Lands and Survey		Industry			
	WW	se	WW	se		
Lands and Survey	166.2	1.2	162.7	1.2	164.5	0.9
Industry	164.7	1.2	161.6	1.2	163.2	0.8
Average	165.4	0.8	162.2	0.9		

TABLE 3: Least-squares means for weight of calf weaned (kg) per 100 kg cow live weight at weaning (CR) and associated standard errors (se) by calf and dam sire source (Lands and Survey or Industry).

Calf sire	Dam sire				Average	se
	Lands and Survey		Industry			
	CR	se	CR	se		
Lands and Survey	38.7	0.3	38.0	0.3	38.3	0.2
Industry	38.4	0.3	37.8	0.3	38.1	0.2
Average	38.5	0.2	37.9	0.2		

For all traits except 18M, individuals with any degree of LS breeding, whether through a sire or maternal grandsire, had higher levels of performance than individuals that had both a maternal grandsire and a sire from IND sources.

DISCUSSION

The study was designed to determine the advantages of “LS-directed” genetic improvement as opposed to reliance on IND breeding for genetic improvement of the LS commercial beef cattle herds.

Although the CSS x DSS interaction was not significant, the results indicated that weaning weight increased due to the LS selection scheme beyond that which would have been achieved had IND bull purchasing continued. Benefits were +4.6 kg for WW and +0.9kg/100kg for CR, for those individuals with a LS sire and maternal grandsire over those animals with an IND sire and maternal grandsire. These differences are similar to the preliminary results of Nicoll and Johnson (1986; 4.2kg and 1.1 kg/100kg, respectively; noting that their estimates were sire differences in contrast to this study’s estimates being progeny differences).

The Lands and Survey Department’s production system during the period of study (1976 to 1987), involved selling steer calves at weaning, making WW the trait of primary interest. In the 1987 calving season, the Rotorua Land Development District marked over 11,300 calves. Assuming that 50% of these calves were sold at weaning, a difference in WW of +4.6kg per head translates into approximately 26,000 kg of additional product for sale per year. At a price in 1987 of \$1.25/kg weaning weight (\$249/head average weaner steer price, NZMWBES, 1989; arbitrary 200kg weaning weight assumed), an additional

26,000kg weaning weight earned a potential additional \$32,500 per year. Savings in bull purchase costs would also contribute to the value of the Department's bull breeding programme. There would have been a requirement of some 115 new bulls per year to sire 11,300 calves. This would amount to a net saving of \$118,400 at an average price of \$1160 per bull, and allowing \$15,000 for labour and recording costs (Te Kuiti Land Development District mean bull purchase price for 681 bulls from 1976 through 1986 = \$1162±\$110). The combined benefits of additional weaning weight and savings in bull purchase costs (\$150,900), and accounting for the scale of the Lands and Survey Department's beef enterprise at the time, gives some indication of the potential commercial significance, if not the statistical significance, of breeding herd sires for economic merit through formal breeding objective definition and index selection.

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