A terminal sire breeding programme based on screening for hogget liveweight

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ABSTRACT

A large-scale screening operation over two seasons by Landcorp Farming Ltd has established a terminal sire-breeding programme for sheep. Within the North and South Islands, screened hoggets were transferred to Huirimu Station and Kepler Station respectively. In 1989, 2,046 ewe hoggets (0.8%) were screened on liveweight from 248,500 animals in 114 flocks. Mean pooled population weight (adjusted to 18 December) was 43.2 ± 0.5 kg; screened hoggets averaged 52.7 ± 0.6 kg (P<0.001). In 1990, 1,819 hoggets (0.7%) were screened from 252,500 animals in 102 flocks. Mean pooled population weight was 42.6 ± 0.6 kg; screened hoggets averaged 52.1 ± 0.7 kg (P<0.001). Progeny out of ewes screened in 1989 were sired by Dorset, Synthetic, Romney or Wiltshire rams on Huirimu Station, and by unrelated Dorset (two sources), Romney or Coopworth rams on Kepler Station. Within stations, Dorset-sired lambs were heavier than those by the other sire groups at weaning (19.6 *vs* 17.6, 17.9 and 18.0 kg respectively on Huirimu; 19.9 and 19.6 *vs* 18.1 and 17.8 kg respectively on Kepler; P<0.001). Sire group effects on progeny weights in July showed similar trends (38.6 *vs* 34.6, 34.0 and 35.4 kg on Huirimu; 40.6 and 40.0 *vs* 36.7 and 35.9 kg on Kepler; P<0.05). On Huirimu, Dorset- and Synthetic-sired hoggets had greater weight-adjusted muscle depths than Romney- or Wiltshire-sired hoggets (22.3 and 22.1 *vs* 21.4 and 21.7 mm respectively, P<0.001). On Kepler, hoggets sired by Source I Dorset rams had greater adjusted muscle depths than those by the other sire groups (25.7 *vs* 25.1, 23.7 and 24.8 mm respectively, P<0.05). Weight-adjusted fat depths were significantly less for Romney-sired hoggets than for the other sire groups on both stations.

Keywords Sheep, screening, liveweight, sire breed.

INTRODUCTION

Landcorp Farming Limited farms some 0.8 million breeding ewes throughout New Zealand. With a population of this size ewes surplus to breeding flock replacements (e.g., 25% of the flock), could total 200,000. Mating these animals to terminal sires selected for lean growth could prove beneficial to the Corporation in its slaughter lamb production enterprises.

In the absence of large numbers of appropriately selected terminal sires able to accommodate such a requirement, Landcorp Farming Ltd ran a large-scale ewe screening operation in 1989 and 1990 to establish a terminal sire breeding programme called the Lamb Supreme Programme. The establishment phase of the Programme involved mating the screened ewes to Romney, Poll Dorset, Synthetic (Wiremu Lean Lamb; Clarke *et al.*, 1991), Wiltshire, Coopworth and Texel rams. All but the Romney rams were purchased on the basis of historical within-flock selection for growth and/or leanness. The Romney rams were chosen from Landcorp's Romney Breeding Programme flocks on the Sheeplan-based breeding value for yearling weight and (in the North Island) Lean Growth Index.

This paper describes the screening process and the performance to the hogget and weaning stages of the first and second crops of Lamb Supreme progeny, respectively.

METHODS

The screening operation involved more than 100 Landcorp Farming Limited properties in the North and South Islands. Screening was conducted in 1989 and again in 1990, and was based on identifying the heaviest ewe hoggets, regardless of breed, weighed in the October - December period in each year. The screened hoggets were transferred to Landcorp's Huirimu and Kepler Stations, (eastern Te Awamutu and Te Anau basin, respectively). In terms of the structure of the Lamb Supreme Programme, the screened ewes were regarded as a temporary sub-nucleus flock, the progeny of which would form the Lamb Supreme nucleus flock.

In 1990, the 1989-screened ewes were mated to either Poll Dorset, Synthetic, Romney or Wiltshire rams on Huirimu Station, and to Poll Dorset (two independently sourced flocks; I and II), Romney or Coopworth rams on Kepler Station. In 1991, the Poll Dorset and Wiltshire rams were used again at Huirimu, together with Texel rams and 1990-born Lamb Supreme ram lambs. At Kepler, the same Poll Dorset, Romney and Coopworth rams were used again together with Texel rams.

Ewes were allocated to mating groups at random within source flock in 1990, and within age and source flock in 1991. Each mating group consisted of some two to eight rams of the same breed-source (Tables 2 and 3). No rams were common between the two Stations, hence analyses were confined to within-Station comparisons.

In addition to birth details, data recorded on the 1990-born progeny included liveweights at weaning (1,185 and 727 records on Huirimu and Kepler Stations respectively), in the autumn (1,132 and 714 records), and at ultrasound scanning in July (923 and 681 records), as well as ultrasound measures of fat and muscle depths using an Aloka real time ultrasound unit (Model SSD-210DXII). Fat depth was measured at the last rib, at a point above the lateral side of the eye muscle. Muscle depth was measured at

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the same rib, recording the greatest depth visible at that site. Fat and muscle depth measurements were adjusted for differences in liveweight at scanning in the REML analyses of sire breed effects.

Weaning weights were recorded on 1,854 and 1,459 progeny born in 1991 on Huirimu and Kepler Stations respectively.

RESULTS AND DISCUSSION

The diverse nature of the hogget base populations screened in both years precluded weight adjustments for such effects as birth date and age of dam. Screening was therefore conducted within base flocks using unadjusted weights expressed relative to the flock mean. Sample weighing within flocks determined the flock mean, which was used with an estimated phenotypic standard deviation to calculate a cut-off weight from which the screened hoggets were identified within the flock. The aim was to identify the heaviest 1% of hoggets.

In 1989, 2,046 ewe hoggets were screened from a total national population of some 248,500 hoggets weighed; representing a selection rate of 0.8%. Corresponding numbers in 1990 were 1,819 (0.7%) screened from around 252,500 hoggets weighed. Pooled over years, 3,865 ewe hoggets were screened from 501,000 animals, a selection rate of 0.77%, or a selection intensity of 1.88.

Table 1 summarises the numbers and weights of animals screened in 1989 and 1990. Mean liveweights of the base and screened animals from each flock were adjusted to a common weighing date of 18 December, using regression coefficients of weight on weigh date calculated within the North (0.043 ± 0.021 kg/day) and South (0.094 ± 0.028 kg/day) Islands. Date-adjusted liveweights were similar between years (43.2 ± 0.5 and 42.6 ± 0.6 kg for 1989 and 1990 respectively), and between Islands. In both years the phenotypic selection differential was 9.5 kg.

Assuming a heritability for hogget liveweight of 0.3, the genetic lift from screening was estimated to be 2.9 kg (0.3 x 9.5 kg). This lift represents the equivalent of 9.7 years of selection for hogget liveweight in a flock selecting the top 4% of rams and 60% of ewes ($h^2 = 0.3, \sigma_p = 4.3$ kg, generation interval = 3 years), with an expected 50% selection efficiency (Dodd and Delahunty, 1983).

TABLE 1 Summary of ewe hogget screening on liveweight in 1989 and 1990. (Liveweight adjusted to a weigh date 18 December each year).

	North Island	South Island	National
1989			
No. flocks	68	46	114
Mean flock weight	43.4 ± 0.7	43.0 ± 0.8	43.2 ± 0.5
Mean screened weight	51.9 ± 0.8	53.5 ± 0.9	52.7 ± 0.6
Mean advantage	+ 8.5	+ 10.5	+ 9.5
(sed)	(1.0***)	(1.2***)	(0.8***)
No. hoggets screened	1,186	860	2,046
1990			
No. flocks	59	43	102
Mean flock weight	42.1 ± 0.7	43.2 ± 1.0	42.6 ± 0.6
Mean screened weight	51.6 ± 0.8	52.6 ± 1.1	52.1 ± 0.7
Mean advantage	+ 9.5	+ 9.4	+ 9.5
(sed)	(1.1***)	(1.5***)	(0.9***)
No. hoggets screened	1,080	739	1,819

Table 2 presents the liveweights and ultrasound fat and muscle depths of the 1990-born Lamb Supreme progeny on Huirimu and Kepler Stations. Poll Dorset-sired lambs on Huirimu were heavier than Synthetic-, Romney- and Wiltshire-sired lambs at weaning by 2.0, 1.7 and 1.6 kg respectively ($P<0.001$). In autumn, and at ultrasound scanning in July, Dorset-sired hoggets were significantly heavier than the progeny of the other sire groups ($P<0.001$), with the Wiltshire-sired progeny being heavier than the Synthetic- and Romney-sired animals ($P<0.05$).

Romney-sired progeny had a significantly smaller weight-adjusted fat depth (2.3 mm) than those sired by the Dorset, Synthetic and Wiltshire rams (2.5, 2.5 and 2.6 mm respectively; $P<0.01$). Conversely, Dorset- and Synthetic-sired hoggets had greater adjusted muscle depths than Wiltshire-sired hoggets, which in turn had a greater muscle depth than Romney-sired animals (22.3, 22.1, 21.7 and 21.4 mm respectively; $P<0.001$).

TABLE 2 Liveweights and ultrasound fat and muscle depths of Lamb Supreme 1990-born progeny by sire group.[1]

Station	Sire group	No. Rams per group	Weaning weight (kg)	Autumn weight (kg)	Scanning weight (kg)	Fat depth (mm)[2]	Muscle depth (mm)[2]
Huirimu							
	Poll Dorset	3	19.6^a	35.3^a	38.6^a	2.5^a	22.3^a
	Synthetic	3	17.6^b	30.5^c	34.6^b	2.5^a	22.1^a
	Romney	3	17.9^b	30.6^c	34.0^b	2.3^b	21.4^b
	Wiltshire	3	18.0^b	32.9^b	35.4^c	2.6^a	21.7^c
	Mean		18.28	32.32	35.64	2.47	21.84
	(sed)		(0.25)	(0.35)	(0.36)	(0.07)	(0.15)
	Age(d)		77	180	315		
Kepler							
	Poll Dorset I	4	19.9^x	35.5^x	40.6^x	4.0^x	25.7^x
	Poll Dorset II	4	19.6^x	34.9^x	40.0^x	4.0^x	25.1^y
	Romney	2	18.1^y	32.2^y	36.7^y	3.4^y	23.7^w
	Coopworth	2	17.8^y	30.8^z	35.9^y	3.6^{xy}	24.8^z
	Mean		18.86	33.33	38.28	3.70	24.80
	(sed)		(0.36)	(0.52)	(0.55)	(0.20)	(0.30)
	Age(d)		75	164	289		

[1] Within a trait (within stations), values with different superscripts differ significantly ($P<0.05$).

[2] Adjusted for liveweight at scanning.

On Kepler Station, progeny sired by Poll Dorset rams from both source I and II, were heavier than the Romney- and Coopworth-sired animals at weaning (19.9, 19.6, 18.1 and 17.8 kg respectively; P<0.001), in the autumn (35.5, 34.9, 32.2 and 30.8 kg; P<0.01) and at scanning (40.6, 40.0, 36.7 and 35.9 kg; P<0.001). Romney-sired hoggets had a significantly lower adjusted fat depth than Dorset-sired animals (3.4 *vs* 4.0 and 4.0 mm; P<0.05), but did not differ significantly from Coopworth-sired progeny (3.6 mm). All sire groups differed in adjusted muscle depth (P<0.05), with Dorset I-sired progeny measuring 25.7 mm, followed by progeny sired by Dorset II (25.1 mm), Coopworth (24.8 mm) and Romney rams (23.7 mm).

Sire group analyses of the weaning weights of the 1991-born Lamb Supreme progeny are shown in Table 3. On Huirimu Station, lambs by Dorset sires were 1.1, 0.7 and 1.0 kg heavier than those by Wiltshire, Lamb Supreme and Texel sires respectively (P<0.001). On Kepler, Dorset I-, Dorset II- and Texel-sired lambs were respectively 1.0, 1.5 and 1.2 kg heavier than either Romney- or Coopworth-sired lambs (P<0.001).

TABLE 3 Weaning weights of Lamb Supreme 1991-born progeny by sire group[1]

Station	Sire group	No. Rams per group	Weaning weight (kg)
Huirimu			
	Poll Dorset	3	16.5[a]
	Wiltshire	3	15.4[b]
	Lamb Supreme	5	15.8[b]
	Texel	8	15.5[b]
	Mean		15.79
	(sed)		(0.20)
	Age(d)		71
Kepler			
	Poll Dorset I	3	19.5[x]
	Poll Dorset II	4	20.0[x]
	Romney	2	18.5[y]
	Coopworth	2	18.5[y]
	Texel	5	19.7[x]
	Mean		19.25
	(sed)		(0.28)
	Age(d)		70

[1] Within stations, values with different superscripts differ significantly (P<0.05).

Clearly Dorset-sired animals had heavier liveweights, greater adjusted muscle depths, but greater adjusted fat depths compared with the progeny of the other sire breeds. The liveweight and muscle depth superiority of the Dorset sire groups probably reflected (either independently or in combination), advantages of the breed *per se* (Geenty *et al.*, 1979), of past selection history in the rams used, as well as some advantages due to heterosis.

Exploitation of the liveweight/muscle depth advantages in the Dorset-sired progeny in future selection decisions in the Lamb Supreme Programme will depend on the selection strategies adopted. It may well be necessary, as Clarke *et al.*, (1991) have noted, to use appropriately robust selection indexes to reduce increases in weight of fat at the expense of some of the genetic improvement in lean growth rate.

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