Development of DLS sheep: lamb production of the pure breeds, initial crosses and first generation DLS*

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Introduction

Relative documentations are available on over 500 breeds of sheep in the World (Mason 1969). Each breed is well adapted to the conditions prevailing in its original habitat and seldom perform equally well in different environments. Most of the popular breeds of sheep presently available in Canada are of British origin (Agriculture Canada, 1982). Although, since their importation, the British breeds have been performing satisfactorily under the severe Canadian conditions, they are not suitable for the present trend of intensified sheep production in Eastern Canada. In that region, the sheep are raised in small units and have to be housed during the winter for at least four months, and protected from predators in the summer. Under these unfavourable and relatively expensive operations the need for a prolific breed which can perform well under intensive conditions is apparent.

The wide variation among the existing breeds and the relative ease of importing certain breeds with specific characteristics from other parts of the world made it easy to combine breeds to form composities with desirable traits to suit the conditions for which they were developed, rather than by waiting for a longer period, for the slower response of existing breeds to selection (Turner 1969). The development of Romnelet in Alberta (Peters *et al.* 1961), Arcott lines in Ottawa (Ainsworth *et al.* 1977) Polypay in Idaho (Hulet and Ercanbrack 1979) and now DLS at Lennoxville (Fahmy 1976) are examples of that approach.

The objective of developing DLS has been set at the beginning to "create by means of crossbreeding and selection a prolific ewe with year round breeding ability which produces fast growing lambs with superior carcass quality under semi or total confinement". From the available breeds of sheep which have been in Canada, Border Leicester was chosen to contribute genes of fertility, prolificacy and nursing ability, and Suffolk to contribute genes of fast growth rate and carcass quality. To contribute genes of long breeding season, Dorset breed was imported from Australia (Fahmy and Bailey 1978). The resulting combination of these three breeds has been called "DLS". The objective of this paper, the first in a series on the development and peformance of that population, is to report on the lamb production of the three breeds of origin, their first crosses and the first generation of DLS ewes.

Material and methods

Twenty-five pregnant Australian Dorset ewes (half polled and half horned) were imported from Australia in 1965 and were subsequently mated to Dorset rams already available in Canada (Fahmy and Bailey 1978). Males produced from these matings were distributed in 1966 among Suffolk and Leicester breeders in Quebec. To obtain Dorset x Leicester (DL) and Dorset x Suffolk (DS) crossbreds from a relatively wide sample of each breed, all male and female progeny were purchased back after weaning and transported to the Lennoxville Station. In addition, a flock of about a hundred Leicester ewes was purchased locally and added to a Suffolk flock of about 50 ewes at the Lennoxville Station. These flocks were also mated to Dorset rams to produce Dorset x Leicester and Dorset x Suffold lambs. Starting from 1967, DL yearlings were mated to DS rams and DS yearlings to DL rams produce the first generation of Dorset-Leicester-Suffolk (DLS, Fig. 1). The first DLS ewes were born in 1967 and were bred *inter se* to produce successive generations of DLS starting from 1969. Dorset, Leicester and Suffolk ewes were always bred to Dorset rams whereas the DL ewes were mated to DS rams and DS ewes were mated to DL rams. The DLS ewes resulting from DS x DL were given the subscript 1 to distinguish them from those produced by mating DL rams to DS ewes (DLS_2). The distribution of the lambing records used in the present study is presented in Table 1.

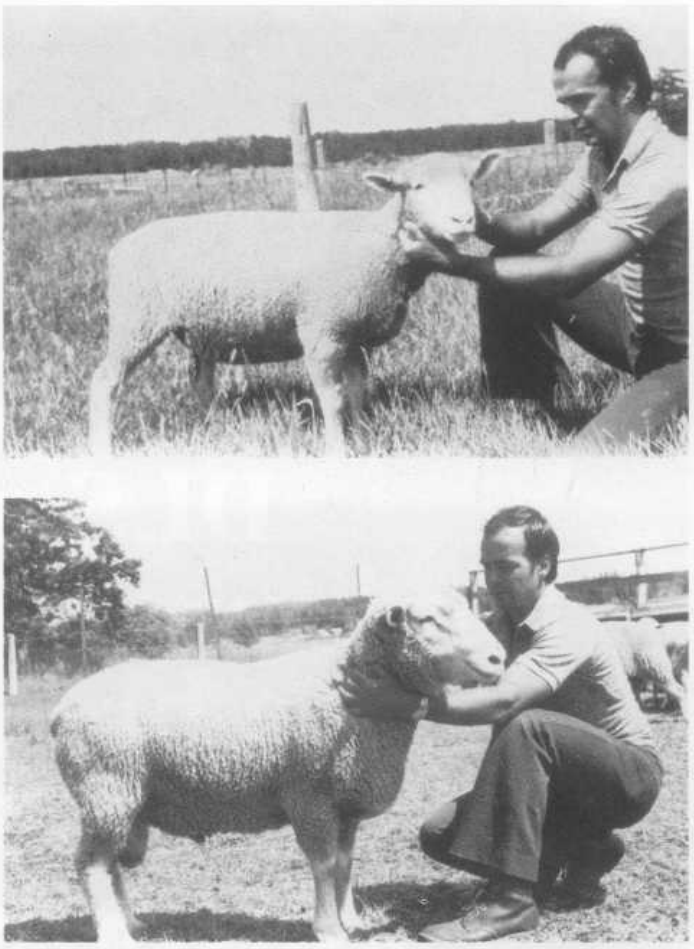
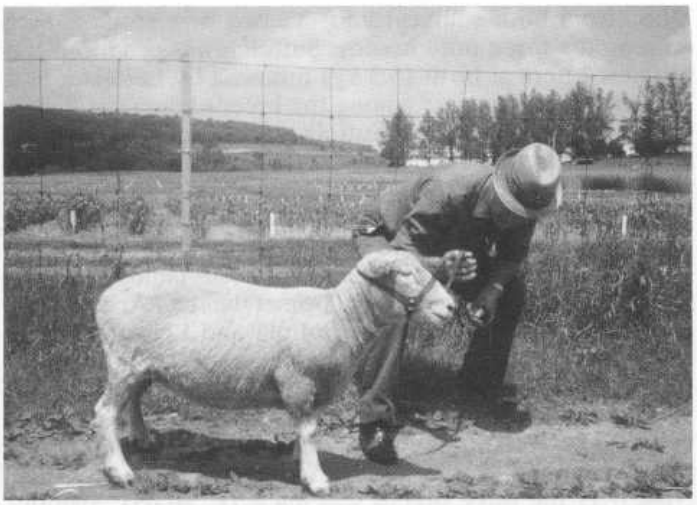
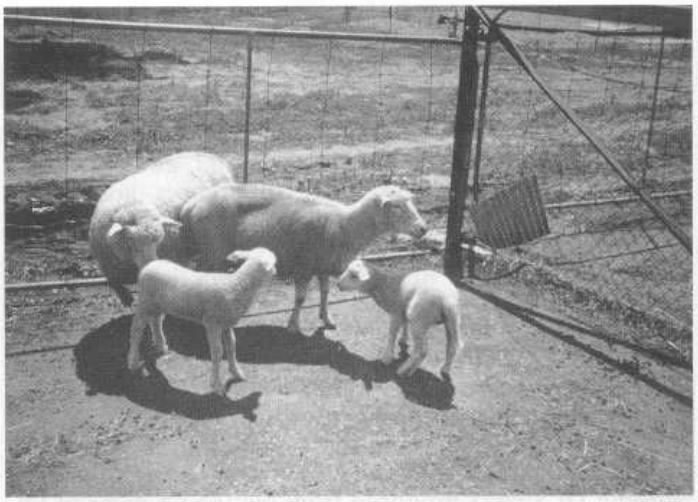


Figure 1. Typical DLS ram and DLS ewe from generation 4.

The sheep were kept in a barn with adjacent paddock during winter and on pasture during summer. Sheep on pasture were supplemented in the fall with 225 g of grain per day. During the winter they were fed hay free choice supplemented with 340 g per day of a concentrate mixture. After lambing, the concentrate mixture was increased to 450 g per day. The lambs were weaned at 70 days of age and were fed grain and roughages *ad libitum* until they weighed 25 kg. The ewes were deprived of grain for 2 wk following weaning to reduce milk production, then were fed from 225 to 450 g of grain/day until they were sent on pasture.



Australia Dorset, contributed 50% of DLS genes.



Two lambings per year, possible with DLS ewes.

The ewes of all genetic groups were bred as yearlings starting in the first week of September of each year except the DLS group which was bred in the first week of June at 15 mo of age. The reason for exposing the DLS group in June was to test their ability to conceive during the summer period and subsequently base selection on that ability. Rams were placed with ewes in pens for 4 to 6 weeks (16 wk for the DLS). In general, the ratio of rams to ewes was about 1:20 and the rams were used only once. However, DLS ewes lambing before 25 December were exluded from the analysis to avoid the confounding effect of early mating of the DLS group.

The traits studied were litter size (total number of lambs born), litter weight at birth, lamb birth weight, lamb weaning weight and average daily gain. Weaning weights were adjusted to 70 days of age for the lambs which were not weaned at that age by extrapolation using birth and weaning weights and actual weaning age. It must be mentioned that weaning was in effect carried out on one day during the week. Accordingly, weaning ages varied from 67 to 73 days.

The data were analyzed by least squares method of fitting constants (Harvey 1960). The model used to analyze litter size and weight at birth included the effects of year, breed of ewe, ewes within breed of ewe (error term for breed of ewe) and age of ewe. The model used to analyze lamb weights at birth and weaning and average daily gain included the effects of year, breed of lamb, sex, type of birth and age of dam. Significance among subclasses was detected using "t" test.

TABLE 1 - Distribution of number of records and ewes according to genetic group, year, and age of dam

	Years					Age of dam (yr)					No of ewes	No of records
	67	68	69	70	71	1	2	3	4	5		
Genetic groups:												
Dorset† (D)	26	27	40	51	50	4	49	42	35	64	76	194
Leicester† (L)	95	119	77	100	—	95	119	77	100	—	147	391
Suffolk† (S)	49	44	—	—	—	—	16	25	23	29	54	93
DL‡	31	118	305	432	174	203	434	280	127	16	501	1060
DS‡	15	27	41	66	—	33	66	35	15	—	81	149
DLS $	—	—	13	56	179	2	188	54	4	—	195	248
DLS_2 $	—	—	4	16	30	—	32	15	3	—	31	50
Age of dam:												
1 year	141	81	109	5	1							337
2 years	22	189	227	312	154							904
3 years	12	20	125	239	132							528
4 years	23	14	6	150	114							307
5 years	18	31	13	15	32							109
Totals:	216	335	480	721	433	337	904	528	307	109	1085	2185

† Mated to Dorset rams
‡ DL mated to DS rams, DS mated to DL rams
$ DLS_1 = DS × DL, DLS_2 = DL × DS; both mated to DLS rams

Results

Litter Size and Weight at Birth

Among the three pure breeds, Leicester ewes gave the largest litters (1.43 lambs), the differences among the three pure breeds were however, nonsignificant (Table 2). The prolificacy of the DL ewes was 7.8% higher than that of the DS ewes and showed a 9.8% superiority over the two parental breeds, Dorset and Leicester, these differences being significant (Table 3). DS ewes produced 0.07 more lambs (4.7%) than the average of its parental breeds, the Dorset and Suffolk ($P>0.05$). The average litter size of the ewes of the first crosses (DL and DS) was 7.2% ($P<0.05$) higher than the average of the three pure breeds. No marked differences in litter size were observed between DLS ewes produced from mating DS rams to DL ewes and those produced from mating DL rams to DS ewes. There was a negative heterosis of – 6.8% between DLS (from both sources) and the two first crosses.

Among the three pure breeds, Suffolk ewes produced the heaviest litters at birth (6.3 kg) followed by Leicester and Dorset, the differences among the breeds being significant (Table 2). Lambs born to Suffolk ewes weighed on the average 4.6 kg compared to 4.0 kg for Leicester and 3.2 kg for Dorset, which explains the heavier weights of Suffolk litters even though they were not the largest at birth. It must be mentioned however, that both Suffolk and Leicester ewes gave birth to crossbred lambs whereas Dorset ewes produced pure Dorset lambs. Accordingly part of the superiority of the Suffolk and Leicester litters can be attributed to the genetic makeup of the embryos.

Litter weight at birth of DL ewes was 5.9 kg which was 19.5% heavier than the average of the two parental breeds (Table 3). DS ewes were intermediate in litter weight between Dorset and Suffolk, the advantage of the cross over the three breeds was 6.4% ($P>0.05$). Significant differences were observed between DL and DS ewes and also between DL and DS on one hand and D, L and

TABLE 2 - Least squares means for litter size and weight at birth, lamb weight at birth and at weaning

	Litter size at birth		Litter weight at birth (kg)		Lamb birth wt. (kg)		Lamb weaning wt. (kg)	ADG kg
	No	Mean	Mean	No		No		
μ	2185	1.40	5.43	3070	3.64	1635	16.9	.194
± SE		± .02	± .07		± .03		± .36	.005
Genetic groups:		**	**				**	
Dorset (D)	194	1.33	4.21	266	3.02	96	15.9	.179
Leicester (L)	391	1.43	5.72	—	—	—	—	
Suffolk (S)	93	1.35	6.26	—	—	—	—	
DL	1060	1.52	5.93	533	3.90	—	—	
DS	149	1.41	5.57	150	3.99	—	—	
DLS_1 (DS♂× DL♀)	248	1.34	4.98	1736	3.78	1274	18.1	.206
DLS_2 (DL♂× DS♀)	50	1.39	5.34	385	3.49	265	17.0	.197
Years:		**	**		**		**	
1967	216	1.40	5.92	284	3.77	10	19.6	.234
1968	335	1.42	5.38	436	3.71	127	16.6	.188
1969	480	1.34	4.96	627	3.44	356	15.7	.179
1970	721	1.47	5.90	1107	3.78	803	17.1	.194
1971	433	1.35	5.00	616	3.50	339	15.4	.174
Age of dam:		**	**		**		**	
1 year	337	1.11	3.49	371	2.91	174	15.0	.178
2 years	904	1.42	5.08	1224	3.41	744	16.0	.183
3 years	528	1.49	5.92	815	3.79	488	17.9	.205
4 years	307	1.48	6.22	488	4.02	183	18.3	.209
5 years	109	1.48	6.44	172	4.04	46	17.3	.194
Sex of lamb:					**			
Male				1517	3.76	713	17.0	.194
Female				1553	3.51	922	16.8	.193
Type of birth:					**		**	
Single				1164	4.11	613	20.1	.227
Twin				1807	3.55	964	16.4	.189
Triplet				99	2.96	58	14.1	.165

**= Significant effect at 1% level

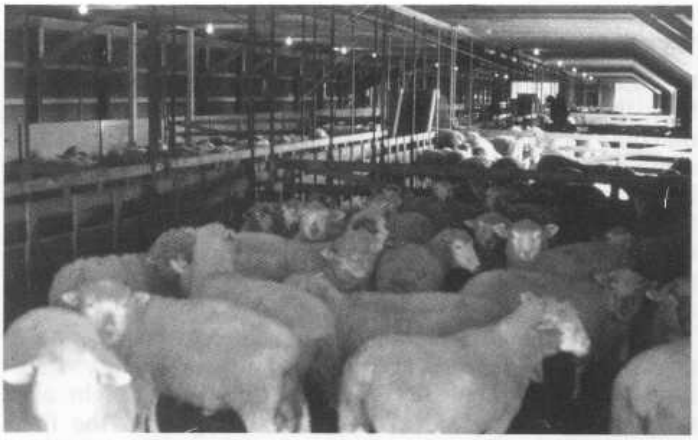
S on the other hand. No significant differences were found between DLS ewes produced by mating DL x DS or DS x DL, also between DLS ewes and the three pure breeds. A highly significant negative heterosis (– 10.3%) was observed between DLS and its parental crosses (DL and DS).

The effects of years and age of dam were highly significant on both litter size and litter weight at birth. Yearlings produced significantly smaller and lighter litters than 2 yr-old ewes which in turn produced smaller and lighter litters than older ewes (Table 2).

Lamb Birth and Weaning Weights and Preweaning Average Daily Gain

Crossbred DL, DS or DLS lambs were significantly heavier at birth and at weaning and grew at a faster rate than Dorset lambs (Table 2). DL and DS lambs were similar in weight at birth and were slightly heavier than DLS lambs (7.9%). DLS_2 ewes (from mating DL rams to DS ewes) produced significantly lighter lambs at birth than DL, DS and DLS_1 ewes (from mating DS rams to DL ewes), at weaning, however, the difference between DLS_1 and DLS_2 was nonsignificant.

Years, age of dam, sex of lamb and type of births had highly significant effects on lamb birth and weaning weights except the effect of sex on weaning weight which was not significant. Lambs born single and those born to mature ewes were the heaviest at birth and weaning compared to twins or triplets and those born to yearlings and 2 yr-old ewes.



DLS ewes during mating in July.

Discussion

Crossing existing breeds to form a new breed for a special purpose has been a frequently used technique. A recent example is the development of the Polypay breed in USA from Dorset, Targhee, Rambouillet and Finnsheep breeds of sheep (Hulet *et al.*, 1981). The objectives for developing the DLS breed have been fundamentally the same as for the Polypay, i.e. a breed with a long breeding season of which the ewes wean two fast growing lambs per litter and two litters per year. The only difference is that while the Polypay was designed as a range breed, the DLS was designed as a breed for total or semi-confinement.

In 1965, when the work on developing the DLS was initiated, the Leicester was then considered the most prolific breed in Canada. For that reason it was included in the gene pool. The results of this study showed, however,

TABLE 3 - Selected differences among genetic groups

Comparisons		Litter size at birth		Litter weight at birth		Lamb birth weight	
		Difference (lamb)	100 (a - b) / b	Difference (kg)	100 (a - b) / b	Difference (kg)	100 (a - b) / b
a	b						
D	–L	–.10		–1.15**			
D	–S	–.02		–2.04**			
L	–S	–.08		–.054*			
DL	–DS	.11*	7.8	0.36*	6.5	–.09	2.3
DL	–½ (D + L)	.13**	9.8	0.97**	19.5		
DS	–½ (D + S)	.06	4.7	0.34	6.4		
½ (DS + DL)	–¼ (2D + L + S)	.10*	7.2	.65**	12.8		
DLS_1	$-DLS_2$	–.05		–.35		–.29**	
½ (DLS_1 + DLS_2)	–¼ (2D + L + S)	.0	0.1	.06	1.2		
½ (DLS_1 + DLS_2)	–½ (DL + DS)	–.10	6.8	– .59**	10.3	–.31**	7.9

D.L.S. = Dorset, Leicester, Suffolk
DLS_1 = DS ♂ × DL ♀
DLS_2 = DL ♂ × DS ♀
*, ** = Significant differences at 5 and 1% respectively

that Leicester was not much better than Dorset and Suffolk, the two other breeds involved in the gene pool. The outcome is that, although the two first crosses showed some improvement in prolificacy, this improvement was lost later when the two crosses were further crossed to form the DLS. Selection for the ability to breed early in the season also affected prolificacy of the DLS adversely since ovulation is known to improve with the advance in the breeding season.

The Suffolk breed was included in the cross to contribute genes for rapid growth and superior carcass quality. Like Leicester, the superiority of Suffolk in litter weight and average lamb weight was manifested largely in the first crosses and was later lost in the final cross. The Suffolk breed has been used intensively in crossing programs to improve size and conformation (Sidwell and Miller 1971; Vesely and Peters 1974; Wiener and Hayter 1975; Levine and Hohenboken 1978; Fahmy 1982). Sidwell and Miller (1971), in crossing Dorset and Suffolk reported 6.6% improvement in litter size in the D x S cross, which compares fairly well with the 4.7% reported in this study.

The effectiveness of combining the three breeds on duration of the breeding season as compared to the three breeds of origin was reported by Dufour (1974). He showed that DLS had the longest breeding season among the four genetic groups. Recent results on the breeding season of DLS ewes indicated that the period of sexual activity is about 8 months (Dufour *et al.*, 1982; Fahmy and Dufour, 1986).

Fahmy and Vesely (1977) reported on the wool production and fibre characteristics on DLS sheep as compared to the three breeds of origin. The results showed that DLS was intermediate in wool production, fibre diameter and fibre length between Leicester on one hand and Dorset and Suffolk on the other hand.

The results of the present study showed that partial backcrossing to Dorset to create DLS resulted in a loss in the performance relative to the first crosses in a manner expected by the theory of genetics (Dickerson 1969).

DLS sheep are presenty exploited successfully on numerous commercial farms in Eastern Canada. A move to register the breed is underway.

Acknowledgements

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