VOL 1 (1)
July 1976

THE STORY OF DLS

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We all know that the Canadian sheep industry has been declining at a rate of about 3% per year for the last few years, and that last year's decline was even sharper. Unless we do something to reverse this declining trend (or at least arrest it) it will not be long before Canadian-produced lamb and mutton disappear completely from the supermarket. One of the main causes of trouble in our sheep industry is low prolificacy associated with high seasonality, that is, small numbers of lambs per ewe, and sheep that will breed only at certain times of the year. The latter problem is almost unheard of in sheep-producing countries where sheep can reproduce at any time of the year. In the tropics, for example, the choice of the breeding season lies with the breeder – he can change the breeding season according to market demand and feed availability.

In Canada, however, to increase sheep prolificacy and make sheep raising economically rewarding, systems of intensifying sheep production must be developed. Any of these systems would eventually concentrate on increasing the number of lambs per ewe each year. This would lead automatically to the subjects of early-weaned lambs, increased litter size, and year-round breeding. At the present time, early weaning of lambs and increasing litter size of ewes are both under investigation at various institutions across Canada and around the world, and the improved techniques that have been achieved in these fields are very promising. What has yet to be achieved is extending the breeding season of sheep to make them fertile all year round.

Year-round breeding, like any other trait, is the result of both genetic factors and environmental effects. It shares with other reproductive traits a relatively low hereditary component (about 25%) and a great sensitivity to environmental elements.

Environmentally, the breeding season in sheep is influenced by many factors, but the two most important are the amount of normal daylight and the ambient temperature. In the temperate zones of the world, where there are great differences between seasons in the amount of daylight, sheep are infertile during the summer months and begin breeding in the fall as the temperature drops and the hours of daylight decrease. These changes in the environment seem to affect the pituitary gland causing the secretion of the right balance of gonadotrophic hormones. These hormones in turn activate the ovaries and testes, and thus start the breeding season.

It is, however, possible to interfere with this process. By simulating fall conditions, we can confuse the sheep—by keeping them in confinement and controlling the amount of light and temperature they are exposed to, we can cause sheep to start breeding at any time of the year. It is also possible to synchronize estrus and ovulation by hormone treatment. Unfortunately, these artificial methods are costly, sensitive, and sometimes impractical. In our present situation, when we want to make sheep operations as economical as possible, such methods are obviously not easily recommended. By using genetic methods and available resources, however, it may be possible to develop sheep with a built-in potential for extended year-round breeding at a reasonable cost.

Genetic studies have shown the following:

1) In domestic sheep we encounter continuous breeding, prolonged breeding seasons, and very short breeding seasons. Some breeds, such as the Dorset and Merino, start breeding earlier than others, but even within breeds there are great differences between individuals in this regard. This means that within the existing sheep populations, there is considerable genetic diversity, and genetic improvement is thus possible.

2) Hereditary factors responsible for breeding season are transmitted additively, so that breed crosses are intermediate between the two parent breeds in performance. The evidence also indicates that an appreciable amount of heterosis* may be expected.

3) Research work in the USA and France shows that the breeding season responds to selection for both length and earliness.

4) Sheep breeds of relatively short breeding season from the temperate zones exhibit longer seasons when transferred toward the tropics. (Unfortunately, the performance of sheep breeds transplanted from the tropical areas to temperate zones is not known).

When considering these documented findings, we can visualize the possibility of improving our sheep in Canada to become year-round breeders by means of designed crossbreeding and careful selection.

An attempt to extend the breeding season in sheep has been carried out at the USDA Agricultural Research Service at Beltsville, where a new strain of sheep called "Morlam" is being developed by selective breeding. The objective of the project is to obtain ewes that can produce two lambs per pregnancy at eight-month intervals (six lambs every two years). The Morlam ewes are now bred in April, August, and December, to lamb in September, January, and May. The results reported on that project are promising. Another selection experiment, based on the fertility of dams at June and February matings, is being carried out on the Limousin and Rava breeds in France. Daughters had a sexual season longer than their respective breed average by 21 and 55 days, indicating a good response to selection.

A similar attempt to extend the breeding season in Canadian sheep by crossbreeding and selection is currently underway at La Pocatiere, Quebec. The project was initiated in 1965 when 40 pregnant Dorset ewes were purchased from Australia. The male lambs out of these ewes, along with seven Dorset rams purchased from Ontario, were distributed among Leicester and Suffolk breeders in Quebec. All female lambs, and a certain number of male lambs, were obtained from these breeders and moved to the Station. Male lambs were subjected to a gain test and the highest-performing ones were selected for breeding.

For four years, Dorset-Leicester rams were mated to Dorset-Suffolk ewes, and Dorset-Suffolk rams to Dorset-Leicester ewes to produce the first generation of DLS (Dorset-Leicester-Suffolk) sheep. The DLS line was then interbred to produce successive generations. So far, five generations have been obtained.

The flock at La Pocatiere is composed of about 500 breeding ewes; 200 lambing for the first time, 200 lambing for the second time, and 100 lambing for the third time. This last 100 are the ewes with the highest index, kept to produce superior progeny. Two hundred young females are

*Heterosis (hybrid vigour) refers to the increase in production characteristics (such as fertility and milk production) in the offspring of two purebred strains crossed with one another.

raised every year for replacement, and each year 200 ewes are removed from the flock (100 culled after the second lambing and 100 after the third lambing). Ewes failing to lamb are removed automatically from the flock. Since 1968, over 2000 ewes have been tested (Table 1).

The breeding season starts on June 1st each year. The ewes are divided into groups of 25, and each is kept in a pen with a ram. The breeding season lasts until November or until all the ewes are successfully bred.

The rams, which are selected in two steps, are replaced every year. Each year, the first 120 males born are kept for further selection. They are subjected to a feeding test during their growth period, and a final selection of 20 to 25 rams (based on date of birth, record of mother, performance on test, and twinning) is made before the breeding season.

Females are selected according to an index which combines their performance in two consecutive lambings. The only criterion used is date of lambing. January 1st is Day 1, and ewes are given plus or minus values according to the number of days between their lambing date and January 1st.

In a pilot study, the first-generation DLS group was compared with the three parent breeds (Dorset, Leicester and Suffolk) according to date of onset and length of the breeding season. The means for the onset of the breeding season were as follows: Dorset, August 7; Leicester, September 12; Suffolk, September 14; and DLS, July 27. Means for the length of the breeding season were: Dorset, 206 days; Leicester, 157 days; Suffolk, 131 days; DLS, 226 days. Keeping in mind that this was the first generation of DLS sheep (before any selection had taken place), these results indicated a great potential for that population.

YEAR OF BIRTH	YEAR OF LAMBING									
	1968 69	1969 70	1970 71	1971 72	1972 73	1973 74	1974 75	1975 76	(1976) (77)	(1977) (78)
Generation 1										
1966-1967	17	13	8	8						
1967-1968		61	60	27	5					
1968-1969			152	150	63					
1970-1971				277	246	79				
Generation 2										
1968-1969			12	12	5					
1969-1970				31	31	15				
1970-1971					80	51	43			
1971-1972						174	136	130	50	
1972-1973							115	100	50	
1973-1974								46	46	23
1974-1975										
Generation 3										
1970-1971					2	2	2			
1971-1972						8	8	10	10	
1972-1973							9	7	11	
1973-1974								101	110	60
1974-1975									146	146
1975-1976										154
Generation 4										
1973-1974								8	8	8
1974-1975									44	44
1975-1976										63
Generation 5										
1975-1976										2
Year Total	17	74	232	505	432	329	313	402	475	500

TABLE 1

NUMBER OF EWES TESTED (OR AVAILABLE FOR TESTING) FOR EARLY LAMBING ACCORDING TO YEAR OF BIRTH, YEAR OF LAMBING, AND GENERATION.

INDEX	DATE	YEAR OF LAMBING	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76
	15 - 31	October	0	1	1	0	6	3	0	3
	1 - 15	November	0	4	3	1	30	9	0	22
+	16 - 30	November	0	4	3	1	64	12	3	41
	1 - 15	December	0	4	4	2	74	20	8	47
	16 - 31	December	6	9	19	19	79	34	13	57
	1 - 15	January	12	19	49	54	86	56	34	77
	16 - 31	January	53	76	86	86	94	72	65	91
	1 - 15	February	76	92	87	92	97	84	77	96
−	16 - 18	February	100	100	93	95	100	90	86	100
	1 - 15	March	−	−	98	99	−	97	93	−
	16 - 31	March	−	−	100	100	−	100	100	−
NUMBER			17	73	232	513	440	408	448	387
MEAN DATE			Feb. 1	Jan.21	Jan.17	Jan.15	Dec.4	Dec.25	Jan.14	Dec.17

TABLE 2

ACCUMULATED PERCENTAGE OF LAMBINGS ACCORDING TO DATE OF LAMBING

The selection results obtained so far show that there has been a marked forward extension in the breeding season of the DLS ewes (Table 2). In the 1972/73 lambing season, 79% of the ewes lambed before January 1st. In the 1975/76 season, 57% lambed before January 1st. The 1972/73 season is the best so far. The yearly advance in the breeding season is about six days. Preliminary analysis of the data showed that, in average date of lambing, Generation 2 ewes were superior to Generation 1 ewes by 1.5 days, and Generation 3 ewes to Generation 2 ewes by three days.

Since the DLS sheep showed positive signs of an extended breeding season, a study was carried out to determine the potential of the strain for producing two litters in one year. Groups of ewes of different ages were mated in June to lamb in the autumn. After 14 days of lactation, they were remated to lamb again in the spring. The results of this study are summarized in Table 3, which indicates that about 75% of the ewes lambed again in the spring. The ewes that lambed in the autumn were pregnant again, on the average, 28 days after weaning; and the ewes that lambed in the spring were pregnant again an

Date	Age of ewe in years	No lambing 1st autumn	No lambing in spring	%	Interval wean concep. (days)	No lambing again in autumn	%	Interval wean-concep. (days)	Interval lamb-autumn to autumn
Autumn 72	2	20	16	80	27	14	88	120	452
Spring 73	3	53	41	77	23	35	85	85	435
Autumn 73	4	31	25	81	22	20	80	82	431
Autumn 73 Spring 74 Autumn 74	5	35	21	60	23	18	86	89	440
Autumn 74 Spring 75 Autumn 75	4	42	31	74	43	27	87	41	412
Averages				75	28		85	83	434

TABLE 3

LAMBING PERFORMANCE OF EWES ON A CONTINUOUS LAMBING MANAGEMENT

A DLS ewe from Lennoxville

average of 83 days after weaning. The interval from the first to the third lambings was about 434 days. Assuming that all the lambings were single, DLS ewes under continuous breeding management can produce about 45% more lambs per year than ewes lambing only once every year. This percentage increases, of course, with increased prolificacy.

Observations over the years show that ewes lambing early in the season (October to November) tend to be less prolific (Table 4). To improve the prolificacy of DLS ewes, the females of that strain are being mated to Finnish Landrace rams, a breed known for its prolificacy (average 2.5 lambs per litter) and its extended breeding season. The resulting cross of 1/2 Finn and 1/2 DLS is now being tested for both prolificacy and extended breeding season.

Date of Lambing	Twinning %
15 - 31 October	3.8
1 - 15 November	10.6
16 - 30 November	11.6
1 - 15 December	14.5
16 - 31 December	23.1
1 - 15 January	17.6
16 - 31 January	18.6
1 - 15 February	17.6
16 - 18 February	25.0
1 - 15 March	16.8
16 - 31 March	31.1

TABLE 4
TWINNING PERCENTAGE ACCORDING TO DATE OF LAMBING

The sheep industry in Quebec is interested in both the DLS and the 1/2 Finn-1/2 DLS lines. All the ewes and rams which finish their role in the herd are sold to sheep breeders. After establishing the DLS for year-round breeding, an intensive selection program will start in an attempt to standardize the other characteristics of the DLS strain and establish it as a recognized breed.

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