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The Mineral Content of Lamb Pastures

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Introduction

This note summarises data on the mineral content of pastures used for lambs in Southland, Otago and South Canterbury in the period between weaning and May the following year. Data were collected during surveys of lamb thrift in 1974-6, an investigation into ill-thrift on a commercial property in 1976 and a subsequent trial on that property in 1977.

Interpretation of Plant Chemical Analyses

Table 1 summarises published estimates of the concentrations of essential elements required by a 30 kg lamb. Care must be taken when using these estimates to assess the adequacy of a feed. This is because:

1. Intake of an element depends on its concentration in the feed and on the amount of feed eaten.
2. Animals obtain nutrients from sources other than the feed analysed, such as soil or water.
3. The sample analysed may not be typical of the total feed available.
4. Animals may have reserves of mineral nutrients which are adequate for temporary limitations in supply.
5. Animals may select mineral rich components from the hetrogenous sample analysed.
6. The standards in Table 1 are frequently based on inadequate information.

Hogget Ill-thrift Survey

Ministry of Agriculture officers surveyed ewe lamb performance on 36 properties in 1974-5 and on 42 properties in 1975-6.

Fifty ewe lambs on each property were ear-tagged and weighed at weaning. They were re-weighed at approximately monthly intervals for five or six months. Samples of herbage were taken from all paddocks grazed by the lambs and visual estimates of the adequacy of the amount of feed available were made. Herbage samples were analysed for nitrogen, essential minerals (other than Se and I) and organic matter digestibility.

Lamb growth rates

Table 2 summarises the ranges and average values of weaning weights, final weights and liveweight gains for each region in the project, together with values for the whole project.

Of the 78 separate lamb growth rate curves drawn, six characteristic shapes or types can be recognised. These are illustrated in Figure 1. Also in Figure 1 are the number of groups in each category in the two survey years. The increase in category D in 1975-6 was probably due to drought conditions and the consequent decrease in feed supply in autumn. By contrast, there appeared to be more genuine cases of ill-thrift in the 1974-5 season; growth curves like those in category E indicate one or more periods of poor growth with adequate growth rates before and after.

Herbage composition

Each sample analysed was assessed by the standards in Table 1. Apparently deficient samples were then compared with the current and subsequent growth rate of lambs eating them and with other samples from the same farm to estimate the proportion of deficient samples from that farm. Estimates of feed adequacy referred to in the following sections are based on visual assessments by Farm Advisory Officers.

(a) *Nigrogen.* Of the 17 farms submitting samples containing less than 1.7 percent N, 13 were also short of feed or had very low digestibility. Lamb growth was poor on two of the remaining farms but could not be related exclusively to feed nitrogen since concentrations of other elements (P, Na, S, Cu) were also less than the estimated requirements.

(b) *Phosphorus and calcium:phosphorus ratios.* The concentration of phosphorus was less than 0.25 percent in at least one sample from seven farms in 1974-5 and 25 farms in 1975-6. However, inadequate feed or low digestibility eliminated all but 11 of these 32 farms. Low herbage phosphorus coincided with poor lamb growth on seven farms. Twenty-eight samples from 13 farms contained Ca:P ratios greater than seven. Wide Ca:P ratios coincided with poor lamb growth on seven farms; samples from six of the seven also contained less than 0.25 percent P.

(c) *Sodium.* Samples containing less than 0.1 percent sodium were obtained from 12 farms in 1974-5 and 20 farms in 1975-6. Sodium values were most commonly less than the critical value in North and Central Otago and the Riversdale/Te Anau area of Southland. Eliminating farms with inadequate or indigestible feed and those known to be providing salt blocks left 19 farms. On only two of these did low feed sodium coincide with poor lamb growth; in both cases only a single low sodium sample was submitted.

(d) *Sulphur.* There was less than 0.2 percent sulphur in samples from six farms in 1974-5 and seven farms in 1975-6. Only one of these farms submitted more than one sulphur deficient sample and on no occasions did feeding low sulphur pasture coincide with poor lamb growth.

(e) *Copper.* Samples from 1974-5 were contaminated with copper during preparation for analysis. In the 1975-6 season samples from 21 farms contained less than 4 ppm copper; of these, eight produced a single copper deficient sample and four farms produced two copper deficient samples. Farms near Popotunoa and Lawrence (Te Houka and Okuku soils) in South Otago and Hedgehope (Makerewa soil) and Winton (Otonamo peat and Makarewa and Otapiri soils) in Southland produced the highest proportion of copper deficient samples.

On one farm low copper values for a period of two to three months coincided with a decline in lamb growth rate, suggesting a depletion of copper reserves after weaning. On another farm the copper deficient sample which coincided with poor lamb growth was also deficient in nitrogen, phosphorus and sodium.

(f) *Cobalt.* Cobalt was not determined in samples from the 1974-5 survey year. In 1975-6 samples from nine farms contained less than 0.1 ppm Co. No farm submitted more than two cobalt deficient samples. Low herbage cobalt did not coincide with poor lamb performance on any farm where there was adequate digestible feed.

(g) *Zinc and calcium:zinc radios.* The zinc concentration was 20 ppm or less in samples from nine farms in 1974-5 and 28 farms in 1975-6. After omitting farms on which either the quantity or digestibility of feed was inadequate, there were no occasions in 1974-5 when low herbage zinc coincided with poor lamb growth. In 1975-6 low herbage zinc coincided with poor lamb growth on seven farms while on eight farms lambs grew well in spite of some samples containing 20 ppm zinc or less. The calcium:zinc ratio in low zinc samples fed to slow growing sheep averaged 811, compared with 547 in samples fed to more rapidly growing sheep. The high calcium:zinc ratios tended to coincide with high calcium:phosphorus ratios and was generally a reflection of the high calcium concentration in lucerne.

Discussion of Ill-thrift Survey

Few positive conclusions can be drawn from the data summarised. Chemical analysis indicated that considerable numbers of herbage samples contained less of several essential elements than are required by healthy, growing lambs. However, it was rarely possible to relate these apparent deficiencies to poor lamb growth.

Cause and effect cannot be implied when apparently deficient feed coincided with poor lamb growth; mineral deficiencies can only be positively identified in dosing trials.

Ill-thrift in South Canterbury

Hogget ill-thrift was reported on a farm in the Morven area of South Canterbury in January, 1976. Lambs grazing rank pasture lost weight and 20 out of 500 died. Fifty percent of the lambs had scabby ears and an ocular discharge. Pasture had grown faster than it could be consumed and contained dead litter. Lambs on closely grazed pasture were unaffected.

Pasture samples were taken from six paddocks in January and March for chemical analysis. Phosphorus (0.10 to 0.29%) and zinc (12 to 19 ppm) were less than estimated requirements in most samples while sulphur (0.09 to 0.29%), nitrogen (1.00 to 3.37%), and copper (3 to 5 ppm) were low in half the samples. Cobalt (0.136 to 0.21 ppm) appeared adequate in all samples.

Pathological examination of affected lambs (Clark *et al* 1978) indicated liver damage of a type associated with fungal toxins. This possibility was examined in a trial in the 1976-7 season.

Morven Fungicide Trial

One of the paddocks on which lambs suffered in the 1975-6 season was divided into six plots, each of 11.3 ha. Three plots were sprayed with Benlate fungicide at 300 g a.i./ha Each paddock was set stocked with 46 lambs. After six weeks the lambs were moved to a neighbouring, similarly treated set of plots. Lambs were weighed initially and at three-weekly intervals for 12 weeks. Details of blood, wool and *post-mortem* examinations are described elsewhere (McKnight *et al*, this Symposium). Pasture samples were taken from caged areas on each plot at three-weekly intervals for estimating dry matter production, consumption and nutrient content. Fungal spores in pasture litter were sampled at irregular intervals with a greasy-slide technique and counts made of *Pithomyces chartarum*, the fungus responsible for facial eczema.

Results

(a) *Lamb growth.* The fungicide treatment had no effect on lamb growth. No ill-thrift was apparent. Lambs averaged 24.60 kg at the beginning of the trial, grew at 90, 163, 233 and 91 g/day for the four three-weekly periods of the trial and averaged 36.75 kg at the end of it.

(b) *Herbage growth and composition.* The fungicide treatment had no effect on herbage dry-matter yields, consumption or composition. Herbage grew faster than it was eaten in the first half of the trial and slower in the second half. Estimated dry-matter composition declined from 2050 ± 523 g/sheep/day in the first three weeks to 1835 ± 280 g/sheep/day in the final three weeks, indicating that feed was always adequate.

Chemical analysis showed adequate concentrations of nutrients in most samples. Exceptions were slightly low sulphur (0.16%) and phosphorus (0.21%) in samples taken during the final period in the first paddock. The pasture had become rank and stemmy by this period.

(c) *Fungal spores.* The distinctive spores of *Pithomyces chartarum* were found on all occasions when samples were collected. The fungicide treatment had no effect on the numbers of spores trapped, which declined from over 1,100 per m^3 of air on December 30th 1976 to less than 30 per m^3 on March 9th 1977. Data summarised in Table 3 shows that while spore counts were variable mean counts were at critical values (700 per m^3) during the first part of the trial.

Discussion

The fungicide treatment had no effect on any factor measured in this trial. The supply and mineral content of the feed was adequate and all lambs thrived. The most significant finding was the large number of *Pithomyces chartarum* spores trapped at the end of December. Rapid pasture growth and low stocking intensity (4 lambs/ha) probably protected lambs from infection as *Pithomyces* spores are found mainly on dead plant litter at the base of the sward, whereas lambs could obtain more than enough feed from new growth at the top of the sward.

General Conclusions

The occurrence of lamb ill-thrift is variable and erratic and the responsible factors are complex. Plant analysis alone can eliminate possible primary deficiencies but cannot positively identify them. The coincidence of apparent deficiencies with poor growth does not imply cause and effect.

Acknowledgements

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Table 1 Nutrient requirements of a 30 kg lamb

Nutrient	Range	Reference	Values used in this paper
Nitrogen	1 9%	1	1 9%
Phosphorus	16 — 37%	2, 8	25%
Potassium	3 — 5%	2, 6, 7	—
Calcium	23 — 50%	2, 8	—
Magnesium	04 — 08%	2, 8	—
Sulphur	08 — 64%	2, 3	20%
Sodium	04 — 10%	2, 5, 8	10%
Iron	30 — 70 ppm	1, 2, 6	—
Manganese	20 — 40 ppm	1, 2, 5	—
Copper	3 — 6 ppm	1, 2, 5, 6	4 ppm
Zinc	18 — 50 ppm	1, 2, 4, 5	20 ppm
Cobalt	08 — 10 ppm	1, 2, 5	10 ppm
Iodine	10 — 1 2 ppm	1, 2, 5, 6, 8	—
Selenium	03 — 10 ppm	2, 5, 8	—

References
(1) ARC (1965)
(2) NRC (1975)
(3) Albert *et al* (1956)
(4) Mills *et al* (1967) Ott *et al* (1964)
(5) Egan (1975)
(6) Blood and Henderson (1968)
(7) Telle *et al* (1964)
(8) Butler and Jones (1973)

Table 2. Mean values for weaning weights, final weights and liveweight gains for regions in the Ill-thrift Survey

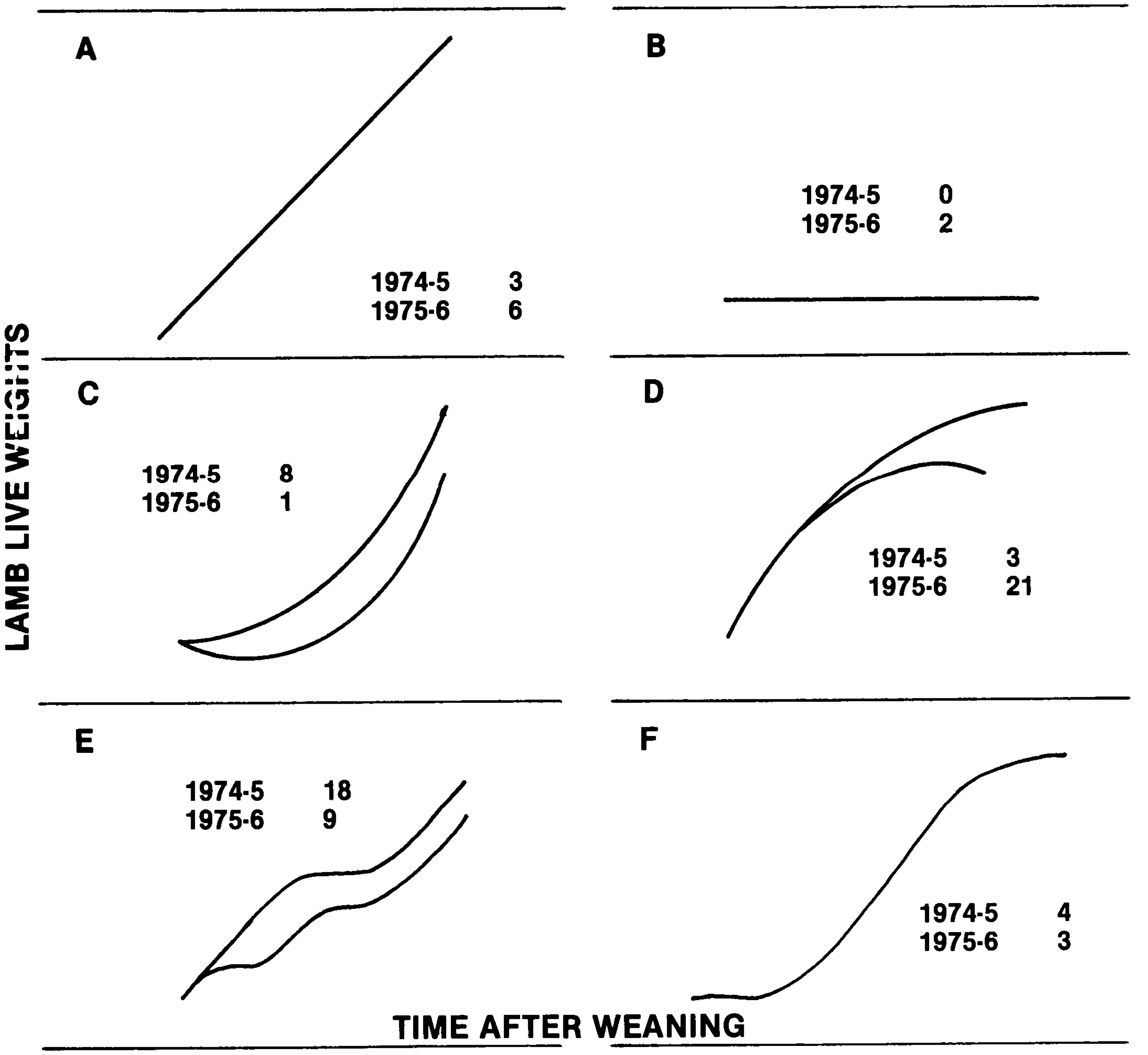
		No. of farms	Weaning weight (kg)		Final weight (kg)		Liveweight gain (g/day)	
			Range	Mean	Range	Mean	Range	Mean
North Otago	1974-5	6	24 7 — 27 3	25 8	33 7 — 39 7	36 7	56 — 96	76
	1975-6	7	19 5 — 31 8	24 2	35 6 — 38 0	36 5	39 — 135	95
Central Otago	1974-5	4	19 8 — 25 0	22 3	22 4 — 36 6	29 0	31 — 93	59
	1975-6	4	22 0 — 30 5	24 4	24 9 — 37 2	30 1	32 — 77	52
South Otago	1974-5	8	19 4 — 26 5	23 7	30 5 — 36 3	32 9	46 — 100	68
	1975-6	6	22 6 — 30 7	26 6	27 2 — 39 0	33 2	22 — 71	43
Gore Te Anau	1974-5	6	19 7 — 23 3	21 3	28,6 — 35 0	31 1	51 — 110	70
	1975-6	12	21 2 — 33 1	25 2	25 6 — 38 5	33 4	6 — 90	55
Invercargill	1974-5	7	22 1 — 27 1	24 3	28 6 — 40 6	35 3	47 — 111	83
	1975-6	8	23 6 — 29 7	26 1	29 6 — 47 6	38 5	44 — 141	92
Hindon	1974-5	5	22 0 — 31 5	27 2	37 6 — 42 4	40 3	85 — 107	97
	1975-6	5	24 9 — 32 0	27 7	25 9 — 38 4	31 5	1 — 67	40
All areas	1974-5	36	19 4 — 31 5	24 1	22 4 — 42 4	34 3	31 — 111	76
	1975-6	42	19 5 — 33 1	25 6	24 9 — 47 6	34 3	1 — 141	65

Table 3. *Numbers of* **Pithomyces chartarum** *spores in trial pastures at Glenavy*

No. of Date of samples	No. of samples	Number of spores per m, air*	Standard deviation
30 12.1976	11	1 155	414
12. 1 1977	11	700	239
25 1 1977	10	123	63
28 1.1977	12	152	64
2 2 1977	9	52	17
7. 2 1977	10	57	36
4. 3 1977	12	49	29
9 3 1977	12	26	19

* Critical value 700 (Parle, pers comm.)

Figure 1. *Characteristic shapes of lamb growth curves.*



Figures indicate the number of farms in each category the two survey years.