PASTURE ESTABLISHMENT PROBLEMS AT TE ANAU

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Introduction

THE Lands and Survey Department began land development in the Te Anau district in 1953 when about 63,000 acres of land including Lynwood Station were acquired. Other blocks were added at a later date, bringing the total area to approximately 148,000 acres.

On the majority of this area, pastures were successfully established using traditional cultivation methods, but on the glacial morainic soils of the Te Anau block, totalling about 30,000 acres, clovers failed to establish and as a result the pastures were very poor and unproductive. These soils are friable brown loams, usually free-draining, but light in texture and liable to suffer from droughts. Much of the area is very broken in terrain and the bouldery nature makes cultivation difficult and expensive. The vegetation in its natural state consists largely of stunted bracken fern, with some fescue tussock, low fertility grasses, and native species.

Details and Results of Investigations

Detailed investigations were commenced by the Department of Agriculture in 1960 and have been continued and expanded until the present time. Prior to 1960, clover inoculation failure was suspected and this aspect was fully investigated on the early trials. Results showed clover inoculation was essential for successful establishment, for example :

	Clover *Plants/sq. ft 11 months after Sowing*	*Green Weight per Plot 14 months after Sowing*
Not inoculated	1.7	69 lb
Inoculated	11.2	326 lb

Where the clovers were not inoculated, they were mainly stunted and yellow and few survived more than a few months. In some of the earlier sowings where the clovers were not inoculated, discing in lime gave superior results. This could be attributed to the lime aiding nodulation as

recent detailed experiments have shown no advantage in discing in lime where inoculated clover seed was sown. Early investigations also indicated that this soil was extremely deficient in phosphate because of its very high fixing capacity, and as a result high initial applications of superphosphate were shown to be necessary for establishment (Table 1).

TABLE 1: DRY MATTER PRODUCTION 15 MONTHS AFTER SOWING

Superphnsphate Treatment (*cwt/acre*)	*Yield* (*lb/acre*)
2	880
4	*1,100*
6	1,890
9	2,530

Because of the high phosphate requirement, drilling young pasture proved nearly twice as effective as broadcasting and this technique is now widely used by Lands and Survey Department. With broadcast sowings, initial applications of at least 6 cwt superphosphate and preferably 9 to 10 cwt are necessary for good establishment. However, with drilling, the initial application can be reduced to 4 to 5 cwt, offsetting the higher costs of drilling.

In various soil fertility investigations, small responses have been obtained to potash, lime, sulphur and molybdenum, but no response has been obtained with magnesium, copper, iron or manganese, despite low herbage nutrient levels. In one trial a very slight response to zinc and boron has been obtained.

In its native state, the soil is extremely low in nitrogen and very large responses to artificial nitrogen fertilizers have been obtained in grasses. Nevertheless, because of the transitory nature of the response and the depressing effect on clover growth, use of nitrogen fertilizers is not recommended. High cost is also a factor. Instead, clover growth should be encouraged by phosphatic topdressing so that the nitrogen status can be raised indirectly.

On the undeveloped country, the nitrogen status is so low that cropping during early development with turnips is not successful. In one trial, turnips grown without artificial nitrogen on newly cultivated ground yielded less than 1 ton wet matter per acre despite high phosphate dressings. The addition of 3 cwt nitrolime increased yields nearly tenfold. Where the bracken fern is cultivated and sown directly

to pasture, the young grass grows to a height of about 1 in. and then shows severe nitrogen deficiency and remains stunted and unproductive for several months. During this early phase, clovers rapidly dominate the sward so that, in the first two years, clovers may comprise 80 to 90% of the sward. In later years, the grass vigour improves and a balanced grass/clover sward is obtained.

Because of the difficult nature of the terrain, the use of oversowing methods has been studied. Results have been spectacular and costs lower than with orthodox techniques. Details of three experiments are outlined below:

(1) A comparison of times of sowing, pelleted and unpelleted white clover seed, and no lime and 10 cwt lime.

(2) Rates of lime and phosphate.

(3) The establishment of grasses and clovers sown at three times of the year and the effect of herbage cover.

In all trials the seed and fertilizers were sown into the fern without burning or soil preparation. Except for sporadic grazing by deer and hares, the trials were not grazed. Results were assessed by counts, vigour ratings, height and composition measurements. Individual plants were pegged and closely observed at regular intervals.

TRIAL 1

White clover was oversown at 3 lb per acre in July, August, September, and November, 1961, with and without 10 cwt per acre limestone. Treatments included unpelleted seed and seed coated with lime and animal charcoal. All seed was inoculated and sown with 6 cwt/acre lime reverted superphosphate. This trial included 81 plots each 24 ft x 9 ft in a factorial design.

Results

Clover establishment was excellent with July, August and September sowings but poor in November when a high mortality was recorded. Results with pelleted clover seed were no better than with unpelleted seed.

Liming-did-not-affect the vigour or survival of early germinating seedlings, but aided the survival of late germinating seed, because it assisted the survival and multiplication of rhizobia in the soil.

Cover provided by fern and stones interacted with time of sowing and was of vital importance with November sowings (Table 2). Cover was less important with winter

sowing. Few clovers sown in the open in late spring nodulated and it is probable that high soil temperatures caused a high mortality of the rhizobia.

TABLE 2: EFFECT OF COVER ON VIGOUR OF WHITE CLOVER
(per cent. healthy plants, February, 1962)

Type of Cover	Month of Sowing (1961) Jul.	Aug.	Sep.	Nov.
None	48	31	19	0
Slight	47	49	32	3
Moderate	67	82	56	14
Dense	100	73	65	33

Two years after sowing, white clover provided nearly 100% ground cover in the July, August and September sowings. This trial showed the advantage of sowing in the late winter and early spring, and indicated the importance of shelter with late spring sowings.

TRIAL 2

This trial was sown in August, 1961, with a pasture mixture containing ryegrass 7 lb/acre, cocksfoot 3 lb, timothy 1 lb, crested dogstail 1 lb, white clover 4 lb, red clover 3 lb, and subterranean clover 2 lb. A 5 x 5 factorial design was chosen and sown in duplicate. Plot size was 24 ft x 9 ft.

Treatments

Ground limestone 0, 5, 10, 20 and 40 cwt/acre.
Lime reverted superphosphate 0, 2, 4, 6, and 9 cwt.
All clover seed was inoculated. A basal treatment of 3 cwt/acre superphosphate was applied in December, 1962.

Results

Establishment was slow and two months after sowing only a few very small seedlings could be found. By early summer, clover growth had improved considerably and treatment differences became apparent. Increasing rates of phosphate stimulated clover growth but not grass growth, while lime stimulated grass growth but not clover growth'.

By October, 1962, 14 months after sowing, clover growth was excellent on the high phosphate treatments and provided almost 100% ground cover,

Although the grasses were small and suffering from nitrogen deficiency, the effect of lime was clearly seen on num-

TABLE 3: CLOVER AND GRASS ESTABLISHMENT
Cover determined by point analysis. Hits per 100 points.

Treatment (cwt/acre)	Clover Cover Apr. 18, '62	Mar. 21, '63	No. of Grasses per sq. yd. Oct. 24, 1962
Reverted Superphosphate			
0	0	11	14
2	5	84	18
4	19	170	29
6	33	207	21
9	45	360	28
Lime			
0	24	182	10
5	14	156	21
10	18	172	17
20	11	138	28
40	14	184	34

bers of plants surviving (Table 3). Grass establishment was also aided by high phosphate at this time.

In the establishment period, clovers made rapid growth, depending on the rate of phosphorus. Because of acute nitrogen deficiency, grasses failed to respond to phosphorus. Lime aided grass vigour and survival, presumably because it accelerated mineralization of soil nitrogen.

Later grass vigour increased with increasing rate of phosphorus, presumably a function of the greater vigour of the clovers and release of nitrogen to the grasses. In the third year, grasses comprised nearly half of the sward in the high phosphate plus lime treatments.

High initial applications of phosphate were the key to successful clover establishment.

TRIAL 3: TIMES OF OVERSOWING

White, red and subterranean clover, perennial ryegrass, cocksfoot, timothy and crested dogstail were sown with 6 cwt/acre reverted superphosphate in July, September and November, 1962, in presence and absence of fern cover.

The trial included 63 plots each 24 ft X6 ft in a split plot factorial layout.

With-the-exception--of-subterranean-clover, early establishment was good at all three times, but seedling survival was superior with the July and September sowings. Clover and grass mortality was very high in the open with the November sowing. Many clovers failed to nodulate, suggesting a high rhizobia mortality. Grass mortality was lowest in July sowings.

In the November and to a lesser extent the September sowings, the presence of cover aided clover and grass survival. Cocksfoot gave the best establishment of the grasses, but timothy and crested dogstail were also quite good. As clover establishment was best from winter and early spring sowings, and grasses also gave good results at these times, there appears no disadvantage in including grasses with clover in oversowing mixtures.

Discussion and Conclusions

Results from oversowing clovers and grasses in the stunted fern at Te Anau have been spectacular and this method offers an economical means for development of this country. Large areas have already been developed by oversowing and topdressing. Key factors in success are:

(1) Inoculation of clovers.
(2) Use of high initial application of phosphate.
(3) Sowing in winter and early spring.
(4) Ensuring some cover is present for seedling establishment.
(5) Inclusion of suitable grass species.

Liming is not necessary on this soil provided that clovers are inoculated. Although pelleting did not give superior results, this method enables the seed to be sown directly with superphosphate and ensures a more even spread when sown from the air.

Results with pelleted seed on large-scale sowings on cultivated ground have not been completely satisfactory. Despite extreme care in manufacturing, a large percentage of the pellets have on occasions proved ineffective, resulting in a thin clover establishment. The alternative of mixing peat culture, lime and seed directly in the drill is now being tried.

Despite the apparent difficulties of land development in this area, excellent high producing pastures can and are being successfully established where the factors enumerated above are followed.

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