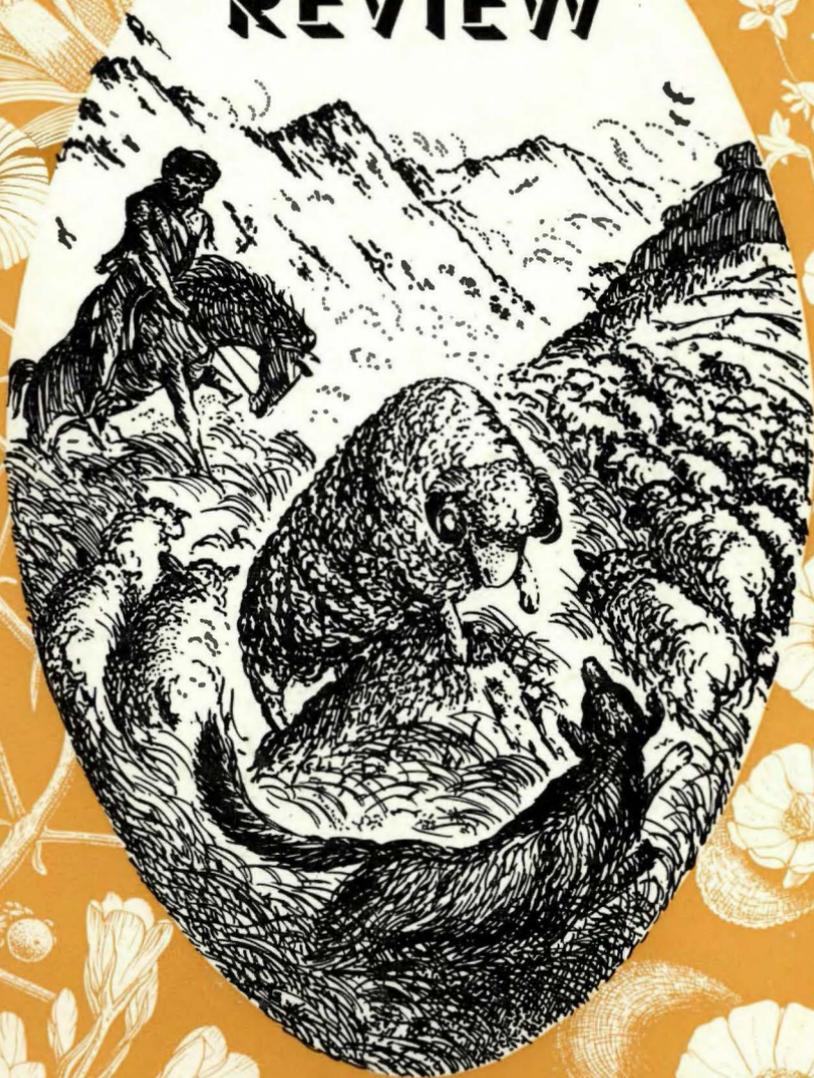


TUSSOCK GRASSLANDS AND MOUNTAIN LANDS INSTITUTE REVIEW



TUSSOCK GRASSLANDS AND MOUNTAIN LANDS INSTITUTE

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TUSSOCK GRASSLANDS AND MOUNTAIN LANDS INSTITUTE REVIEW

No. 4

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FERTILISERS FOR TUSSOCK GRASSLAND

For several years Farm Advisory Officers of the Department of Agriculture have in conjunction with Scientific Officers, carried out some hundreds of plot trials on tussock country in an endeavour to discover fertiliser responses. Clovers have been used as indicator plants and the trials have been located on the major soil types and at various altitudes. Considering that the results of this work should be given wide publicity the Institute asked the Department of Agriculture for brief statements of the advice given on fertiliser usage at the present time. The Institute is grateful to the officers concerned for their co-operation in supplying the statements.

The numbers refer to the farm advisory districts as shown on the map; the names indicate the advisory officers who supplied the statements.

4. J. P. Beggs, Blenheim

a. High Country (e.g. Upper Awatere)

Sow July-August using 1 cwt sulphur-super (400) per acre annually. Seed should include white clover 1 lb and alsike 1 lb. Add cocksfoot 4 lb if much bare ground, otherwise at later date. Montgomery red clover 2 lb could also be included. Add ryegrass at later date.

b. North of Wairau River

Sow in March with white clover 2 lb and sub clover 3 lb. Initial super 3 cwt, and follow-up 2 cwt annually. Add ryegrass 10 lb and cocksfoot 3 lb in third or fourth year when fertility built up. Use molybdenum initially and every second year thereafter: sulphur-super useful in some localities.

c. Hill Country of Medium Altitude and Rainfall (e.g. Wairau and Waihopai Valleys, Lower Awatere).

Sow 2 lb white clover and 3 lb sub clover in March with 2 cwt sulphur-super (225). Apply 1 cwt sulphur-super (400) annually. Add ryegrass 10 lb and cocksfoot 3 lb in third or fourth year when fertility built up by clover. Molybdenum required in some parts only.

FARM ADVISORY OFFICERS' DISTRICTS

NELSON

- 1 Motueka
- 2 Westport
- 3 Nelson
- 4 Blenheim

CHRISTCHURCH

- 5 Greymouth
- 6 Rangiora
- 7 Christchurch
- 8 Akaroa
- 9 Ashburton
- 10 Fairlie
- 11 Timaru
- 12 Waimate

DUNEDIN

- 13 Oamaru
- 14 Alexandra
- 15 Alexandra
- 16 Ranfurly
- 17 Palmerston
- 18 Dunedin
- 19 Balclutha

INVERCARGILL

- 20 Invercargill
- 21 Gore
- 22 Lumsden



DEPARTMENTAL DISTRICTS.

General Points:

- a. Inoculate clover seed.
- b. Molybdenum required in some parts not covered by above summary.
- c. Lime very beneficial in few localities.
- d. It is not considered wise, particularly under the more difficult conditions, to apply heavy rates of seed initially. It is often better to spread the risk over two or more seed applications.

6. P. Thaine, Rangiora

Most of the hill country in this district is sulphur-responsive and its application is essential for clover establishment. However, before maximum utilisation can be obtained from sulphur, the phosphate status must be corrected. Sulphur-super serves this purpose and this is available to the farmer in two strengths—200 lb and 400 lb mix.

For maximum establishment it is recommended that a mixture of red and white clover at the rate of 3 lb of each per acre be sown during June and July with $1\frac{1}{2}$ - $1\frac{1}{2}$ cwt of the 400 lb mix.

Maintenance treatments are required to keep a dense cover of clovers and to improve the natural grasses of the sward. Trial work to date has shown that this can be achieved by applying a further 1 cwt per acre of the 400 lb mix within two to three years.

Inoculation of clovers is not necessary on North Canterbury hill country as no difficulties have been experienced in getting clovers established.

7. R. G. Jolly, Christchurch

Some of the best results have been obtained from winter sowings—June and July. August has been quite satisfactory, especially where rainfall has been adequate. Establishment has been best from the use of high rates of fertiliser. It is preferable to do a small area well, than try to spread materials over a large area at low application rates. Sulphur-super is recommended for general use. Although there are some soil types where sulphur alone appears to be sufficient, these are of limited area. Trials have shown that, in establishment, phosphate is just as important as sulphur. Molybdenum, too, should be applied although responses have been variable. In many trials, good results have been obtained without the inoculation of the clovers, but seed should be inoculated and preferably lime-pelleted. Pelleting is essential when sowing inoculated seed with superphosphate. Pelleting and inoculation are cheap and well worth doing.

It has been shown that where practicable, the drilling of the seed and fertiliser into the turf has given better results than from surface seeding. Establishment is more certain, quicker and more even, and introduced grasses do better.

To control grass grub and porina, established pastures should be treated with D.D.T.

Recommendations:

- a. Seeding: 2 lb white clover, 2 lb Montgomery clover, 1 lb alsike, 3-4 lb cocksfoot.
- b. Apply 2 cwt of molybdc sulphur-super (400 lb).
- c. Inoculate and pellet clovers.
- d. Topdress in second year after sowing with 1 cwt D.D.T. sulphur-super.
- e. Drill on suitable areas.
- f. Spell in the first season for flowering and seeding.

9. C. P. Whatman, Ashburton

In general, the run country is deficient in clover growth. Topdressing and oversowing aim to correct this by the use, primarily, of sulphur. Initial topdressing from the air should be $1\frac{1}{2}$ cwt per acre of a 400 lb per ton mix of sulphur-super. If little or no clover is present the cheapest and most effective over-sowing will be with 2-3 lb per acre of white clover with a fairly high (e.g. 10-20 per cent) suckling clover content. The greater expense of other clovers (red clover and alsike) makes them a doubtful proposition on all but the better country. The results obtained from the inclusion of grasses do not usually warrant their inclusion. The optimum time for topdressing and oversowing is late winter and early spring. Two and a half ounces per acre of molybdenum should be included in the fertiliser mixture only on browntop-invaded areas.

Topdressing should, in the initial stages at least, be confined to the easier slopes and the better soils, with the object of keeping stock off the more difficult country on which active erosion is occurring or is likely to occur. Burning prior to topdressing and over-sowing is warranted only where cover is excessive. Following the initial topdressing, subsequent treatment should be with the same sulphur-super mixture, biennially, at the rate of 1 cwt per acre.

10. D. G. Reynolds, Fairlie

In the lower-rainfall areas of the Mackenzie country (those under 25 inches) the usual problem met with is insufficient cover. Such areas must be spelled for a year to allow the sward to develop a complete ground cover three inches tall. If the ground is very open it may be necessary

to accept a poorer standard of over-sowing to hasten ground cover. Superphosphate containing 400 lb sulphur per ton is used at 1 cwt per acre.

In the higher-rainfall areas the problem can be one of too much cover and here, burning followed by over-sowing in the succeeding year gives best results. Superphosphate used should contain 2 oz of molybdenum per cwt and 400 lb sulphur per ton and be applied at $1\frac{1}{2}$ cwt per acre.

Seed used initially in all cases is a mixture of 2 lb each of Montgomery red, white and alsike clover per acre. The best time to apply is in July; later sowings are not so satisfactory.

Maintenance topdressing depends on production required but in any case must not be less than $1\frac{1}{2}$ cwt of 400 sulphur-super every third year.

Spelling until December or January in the first year is an advantage to clover establishment. Inoculation and pelleting are not necessary. Grass introduction can be attempted after a period of clover dominance.

11. C. C. McLeod, Timaru

Topdressing trials on open tussock have very consistently given maximum topdressing responses, in the initial dressings, to 50 lb sulphur per acre. Little additional response has been obtained with phosphate application. The use of $1\frac{1}{2}$ cwt 400 lb sulphur-superphosphate per acre is recommended.

Re-topdressing requirements are not yet clear. It has been noted, however, that an initial high rate of sulphur, for example 50 lb, followed by a similar high rate four to five years later can cause yellowing (due possibly to manganese toxicity) and a reduction in clover density. It appears that a high initial rate of sulphur is best followed by a lower rate and conversely.

In tussock swards which contain much browntop, sulphur, phosphate and molybdenum are required for satisfactory clover establishment and 2 cwt molybdenised super per acre every two to three years is recommended.

Times of over-sowing and species trials have shown that excellent takes of clover can be obtained regardless of time of over-sowing. The most satisfactory species have been Montgomery red, alsike and white clovers, and cocksfoot.

Summary of Recommendations:

- a. Open Tussock: $1\frac{1}{2}$ cwt 400 lb sulphur-super, 1 lb w/c, 1 lb Mont. red, 1 lb alsike and 2-3 lb cocksfoot per acre followed by 1 cwt of the mixture, and at least cocksfoot, in four to five years.

- b. Browntop/tussock: 2 cwt Mo-super every two to three years. A repeat over-sowing of 1 lb w/c, 1 lb Mont. red and 2-3 lb cocksfoot may be necessary.

12. J. L. Symons, Waimate

For initial topdressing and oversowing the application in August or September of 2 cwt of superphosphate together with 2 lb each of white and red clover and 1 to 2 lb of cocksfoot is recommended. On the colder and sourer soils of the Hunter Hills, the addition of molybdenum at 3 oz per acre and inoculation of the clovers is also necessary.

Burning prior to over-sowing is only required where there is a dense cover of snowgrass, browntop or fescue which could tend to smother the introduced clovers or grasses.

For maintenance topdressings, which should normally be applied every three years, the use of $1\frac{1}{4}$ to $1\frac{1}{2}$ cwt of super-sulphur (400 lb) mixture is recommended. This is best applied in the autumn and if possible should include D.D.T. to give some measure of protection from grass grubs or porina. Clovers and grasses should also be included if a poor initial establishment has been obtained.

13. J. C. Richards, Oamaru

On the lower foothill country of the Kakanui Ranges inland as far as Kurow, phosphate, sulphur and molybdenum have proved responsive fertilisers and 1 cwt per acre of molybdenised sulphur-superphosphate could be recommended for topdressing. The introduction of white clover at the rate of 2 lb per acre has proved very successful.

On this Kakanui run country, rainfall is more adequate than in the drier and more extreme climatic districts of Otematata and Omarama. Here sulphur has been found to be of more initial importance than phosphate, with the result that the higher sulphur content of 400 lb sulphur-super is recommended when any programme of oversowing and topdressing is commenced. Included in the 1 cwt fertiliser mix per acre should be 2-3 lb of mixed clovers, white, red and alsike. This latter clover appears to do very well in these regions.

14, 15. T. E. Ludecke, Alexandra

In tussock country where the rainfall is greater than 20-25 inches, spectacular improvement can be brought about by over-sowing and topdressing. Research work has shown that all the soils in Central Otago derived from mica-schist rocks are sulphur deficient; sulphur is the major element limiting legume growth. The soils, however, vary in their

phosphate requirement. As the rainfall increases above 25 inches the phosphate response increases. It has been found that the Department of Agriculture's quick test for phosphate gives a very good idea of the phosphate status of these soils. As a result of research findings advisory officers are now able to tell farmers what type and quantity of sulphur-super they need to apply.

16. W. A. Lunn, Ranfurly

Assuming that rabbits have been controlled, the most important points in improving tussock country, are suitable sub-division in proportion to the size of the property, and the availability of stock water.

It appears that we can make greater use of pasture for winter feed, even on tussock country, and this will be more easily done as fertility is improved.

Heavy grazing, especially by cattle, in autumn will allow application of nitrogen through stock residues to encourage fresh growth on certain blocks, to relieve as far as possible, the demands on forage crops.

On low-rainfall tussock-country areas such as the dry brown-grey soils of Central Otago, improvement in the initial stages at least, will be by sub-division only, with suitable management to allow regeneration of native grasses and tussock.

On medium- to heavy-rainfall country, fertility can be improved by the use of fertilisers in conjunction with sub-division, but close attention must be paid to the application of the correct elements, such as the combination of phosphate, sulphur and molybdenum on some yellow-brown snowgrass soils.

17. S. M. J. Stockdill, Palmerston

Over much of the rolling and steeper tussock country of East Otago, where white and suckling clovers are already present, correction of phosphorus, sulphur and molybdenum deficiencies brings about remarkable improvements in vegetative cover and productivity. In coastal areas molybdenised superphosphate supplies molybdenum, phosphorus and sufficient sulphur but further inland, from about Dunback through the Pigroot and towards Macrae's Flat, Nenthorn and Moonlight, sulphur deficiency is more acute and molybdenised sulphur-super (400 lb sulphur per ton) is recommended.

Although the response to heavier rates would be greater and longer-lasting, that from 1 cwt per acre is worthwhile provided repeat applications are made at intervals of two to three years. The lighter rate is more practicable under the present degree of subdivision.

Surface sowing of white clover of certified strain will provide high-producing clover capable of giving maximum response to fertiliser but finance should not be wasted on "cheap" seed of unknown origin. Montgomery red clover establishes well, is productive under relatively low fertility and has the advantage of remaining green throughout the winter. Cocksfoot, dogstail, ryegrass and timothy have established well in open swards. However, unless clovers are sparse, available finance may be better employed on additional fertiliser than on seeding.

The lower-fertility, flatter uplands, where clovers are non-existent, present special establishment problems with the need for inoculation and lime pelleting of legume seeds and in some areas the application of up to 10 cwt per acre of lime.

18. R. K. Darwin, Dunedin

While much of the tussock country on the Taieri Plateau will ultimately be developed by ploughing, there is at present a great potential for oversowing and topdressing this type of country. By oversowing during the later winter with Montgomery red clover at 2 lb per acre and "permanent pasture" white clover at 2-3 lb per acre and topdressing with 2 cwt molybdc superphosphate, good vigorous clover growth should result.

On the drier soils molybdenum, phosphorus and sulphur are deficient. When over-sowing with inoculated clover seeds at the 4-5 lb rate per acre, applications of sulphur-super at 1½ cwt per acre are necessary with periodic dressings of molybdc superphosphate at 2 cwt per acre.

On the more acid soils which have higher rainfall and altitude, for vigorous clover growth applications of 5-10 cwt lime per acre with 2 cwt molybdc superphosphate per acre are necessary, with inoculated red and white clovers at 5 lb per acre oversown in the late winter.

In any over-sowing and topdressing programme, provision of adequate fencing for better utilisation of the improved tussock blocks is very important.

19. R. C. Stephen, Balclutha

Hard tussock (*Festuca novae zealandiae*) and silver tussock (*Poa caespitosa*) associations occur on moderately acid soils which are deficient in molybdenum, phosphorus and sulphur. Vigorous white clover can be established in hard tussock and silver tussock associations on these soils by oversowing and topdressing in the early spring with inoculated "permanent pasture" white clover seed 3-4 lb per acre and molybdc reverted superphosphate 3 cwt per

acre. In subsequent years vigorous clover growth can be maintained by regular applications of sulphur-super (sulphur 200 lb per ton) at $1\frac{1}{2}$ cwt per acre and periodic applications of molybdc superphosphate 2-3 cwt per acre.

Red tussock (*Chionochloa rubra*) and snowgrass tussock (*Chionochloa spp.*) associations which occur in the higher rainfall areas and/or at higher elevations, are established on strongly-acid soils which are molybdenum and phosphorus deficient. These soils may lack also other plant nutrients such as potassium but do not appear to be markedly sulphur deficient. White clover can be established in red tussock and snowgrass tussock associations by over-sowing and topdressing in the early spring with inoculated "permanent pasture" white clover seed 4-6 lb per acre, lime 5-10 cwt per acre and molybdc reverted superphosphate 3 cwt per acre. Vigorous clover growth can be maintained in subsequent years by regular applications of superphosphate 2 cwt per acre and periodic applications of molybdc superphosphate 2-3 cwt per acre.

21. T. G. Sewell, Gore

Where silver tussock (*Poa caespitosa*) and some resident clover are present, apply 1 cwt of 400 lb sulphur-super plus 2 lb of inoculated white clover in the late winter or early spring. Repeat topdressing at three-yearly intervals. This treatment should be given mainly on the Wehenga soils.

Where fescue tussock, and open fescue tussock and red tussock grassland occur, apply 2 cwt of molybdenised super plus 2 lb of inoculated white clover in the late winter or early spring. Repeat every third year. This applies on the more favourable Waipori and Pukekoma yellow-brown earths and the Crookston intermediate yellow-grey/yellow-brown earths.

Where heavy red tussock is present it is advisable to burn to reduce the top growth before over-sowing and topdressing, otherwise poor establishment of clover will result. It is not warranted to topdress country over 2,500 ft except on very favourable northerly-facing country.

22. M. J. Fitzharris, Lumsden

On Northern Southland tussock country, there is little difference in the results from over-sowing when it is attempted in late July-August or early September. However if later than this, there is a high mortality in the seedling plants. In initial over-sowing and topdressing it is most essential to sow clovers. No more than 3 lb (say 2 lb white and 1 lb Montgomery red) is necessary. Clovers

must be inoculated, but not necessarily pelleted. Cocksfoot can be included in the seed mixture in some localities, depending on the vegetative cover present.

On the dominant fescue and silver tussock areas (Kingston, Garston, Athol, Lowther, foothills on the west side of the Takatimu Mountains, North Range, west end of Hokonui Hills) sulphur responses are quite marked. Here 1 cwt sulphur-super (400 lb added sulphur) per acre, gives quick, outstanding responses. Maintenance dressings are necessary every second year, and again best results are obtained with 1 cwt sulphur-super.

On the dominant fescue and red tussock areas (east side of Takatimus, foothills bordering the Five Rivers plain, Taringatura Mountains, rolling country around Te Anau, rolling country to the east of Lumsden) 2-4 cwt molybdenised super is necessary initially. The quantity to use depends on the aspect of the country. Maintenance dressings are necessary every second year with 1-2 cwt superphosphate.

Members of the Committee of Management inspect a wind-charger on Mt. Nicholas Station, Lake Wakatipu.



INSTITUTE NOTES

RESEARCH GRANTS

In addition to the research grants listed in Review No. 2 financial assistance has been given to the following to carry out work connected with the aims and objects of the Institute:

Professor I. E. Coop, Lincoln College, for work on the relationship between liveweight and productivity of high-country ewes.

Miss J. Burrell, University of Otago, to make ecological studies on manuka and kanuka in the tussock grasslands of Otago.

Mr B. P. J. Molloy, Lincoln College, to assist with his studies of sweet brier.

Mr W. J. Harris, University of Canterbury, for a study of sheep sorrel and its place in the tussock grasslands and mountain lands.

Mr S. J. Carryer, University of Canterbury, for a study of alluvial fans in the Rakaia Valley.

Lincoln College, for the continuation of work on soils, creeping lucerne and tussock insects.

ELECTRIC FENCING

Runholders will receive with this issue of the Review a complimentary copy of a booklet on electric fencing in high country. It was written by Mr L. Weston, Farm Machinery Officer of the Department of Agriculture, Dunedin. Copies are obtainable from the Institute, price 2/-, post free.

PLANT BREEDING FOR HIGH COUNTRY

The Institute called a seminar to discuss the question of the breeding of pasture plants specially suited to the more difficult environments. As a result the Grasslands Division of the Department of Scientific and Industrial Research will make seed of new varieties available for testing in tussock grasslands. Mr John Scott of Godley Peaks has made land available for some of this work and the necessary cultivation will be done by Mr J. W. Simpson of Mount Hay.

SOD SEEDING

The Institute called a meeting to discuss proposals for the improvement of machinery suitable for sod-seeding in the more difficult country in tussock grasslands. Pending the results of further trials with existing machinery this autumn, the Institute is acting as a centre for the collection of information. Later it will sponsor a symposium on the whole problem of sod-seeding or over-drilling, including chemical control of existing vegetation.

STOCK GRAZING CHARTS AS A GUIDE TO RUN MANAGEMENT

J. Wallace Ramsay, Farm Planning Officer,
Otago Catchment Board.

In order to introduce soil conservation measures necessitating changes in management on sheep stations of the tussock regions of the South Island, it is essential that stock movements and stock concentration be known for all areas of the run at any time of the year. The following method is one which I have found successful in illustrating grazing patterns on sheep stations, and it may be of help to runholders who wish to vary their grazing programme.

The chart is set out like a calendar with the months of the year along the top and names of the grazing blocks down the side. I have found it convenient to commence the chart with the autumn muster when all the stock are transferred from summer to winter country. The blocks can be grouped into summer and winter blocks, and the farm is usually treated as one grazing unit. (See Fig. 1.) Above the names of the months one can insert the main operations of the sheep station such as mustering, tupping, eye-clipping, dusting, shearing and weaning. An arrow from the particular operation pin-points it on the chart. The various mobs of sheep have their grazing blocks and numbers in the mob. A different colour is used to denote the principal age and sex groups of the sheep, e.g., purple for wethers, blue for ewes, yellow for hoggets, red for two-tooths. If hoggets and two-tooths are run as separate mobs of ewes and wethers, then different colours must be used to denote each sex. (Note: In this article cross-hatching is used to replace colour.)

The next important feature of the chart is to mark in with two heavy black lines the native seeding periods for tussocks and palatable native grasses. In the Roxburgh East area, the Department of Agriculture trials have found this period to be from 1 November to 1 March. On the drier tussock country of the Dunstan Mountains, such a seeding period can be a month to six weeks earlier at the foot of the mountain and later and shorter by a similar period at the top of the mountain.

With all this information illustrated on a chart, the run-holder or planning officer can see at a glance which blocks are being grazed during the seeding period and with how many sheep. Knowing the period of grazing and the number of stock, he can estimate the number of sheep-grazing-months per block and hence estimate the carrying

capacity of the block. Comparison of blocks with similar vegetation indicates which blocks are over-grazed or under-grazed. The different classes of stock are all converted to ewe equivalents, e.g. one lamb (up to weaning) equals one-half ewe equivalent, one hogget equals two-thirds of a ewe equivalent, and one wether equals one ewe equivalent. One breeding cow equals five ewe equivalents.

Let us look at an example.

Shine block (Fig. 1)	6360 acres
Grazing 1800 ewes + 1370 lambs for two months and and then grazing 1800 ewes for a further two months.	
Sheep Equivalents.	
1800 ewes	= 1800 ewe equivs.
1370 lambs	= 1370 x 0.5 = 685 ewe equivs.
Sheep Months	= 1800 x 4 + 685 x 2
	= 7200 + 1370
	= 8570
	Sheep months
Carrying Capacity	= $\frac{\quad}{\quad}$
	acres
	8570 sheep months
	= $\frac{\quad}{\quad}$ = 1.35 sheep
	6360 acres months per
	acre
	8570 1
or =	$\frac{\quad}{\quad} \times \frac{\quad}{\quad} = 0.11$ sheep/acre/year
	6360 12
	or = approx. 1 sheep to 9 acres per year.

For comparison see Fig. 1, Carrying Capacity of Blocks.

(Note: One sheep to one acre per year is the same as twelve sheep-grazing-months per acre per year.)

Having calculated the carrying capacities for the various blocks, the planning officer returns to the Land Capability Map of the property and looks for the areas of Class V and Class VI land, which will yield alternative grazing following aerial topdressing and over-sowing, and/or which will withstand harder grazing than Class VII land. He plans his programme and estimates the fencing, seed and fertiliser required. One by one he relieves the grazing pressure on the blocks which require spelling during the native reseeding period. Subdivision of the native reseeding blocks will allow further spelling such as alternating the grazing years. Native reseeding is necessary on areas which have either been badly depleted or which do not respond to aerial topdressing and oversowing techniques.

As a further precaution, trials to indicate initial seeding and fertiliser and future maintenance requirements should be planned to cover the areas to be improved.

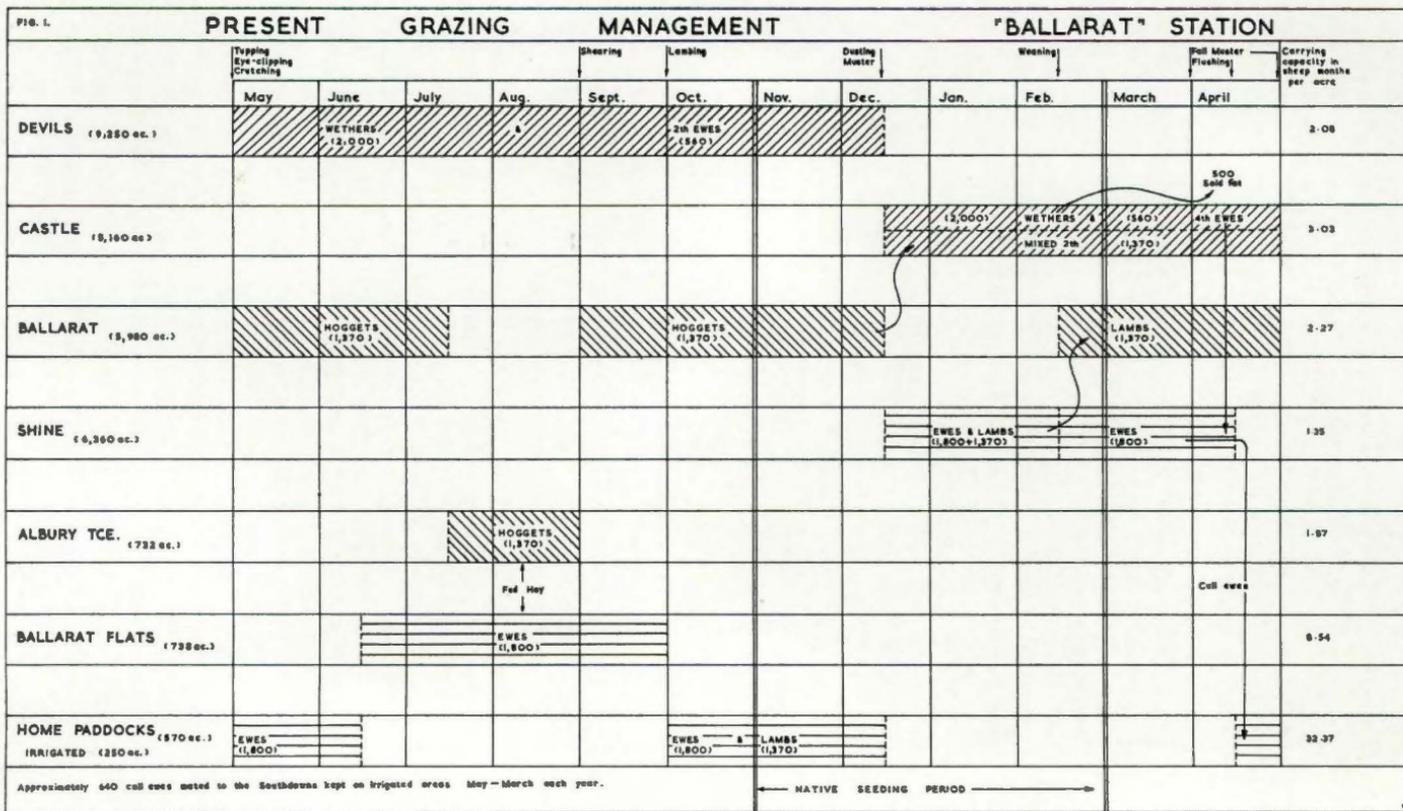
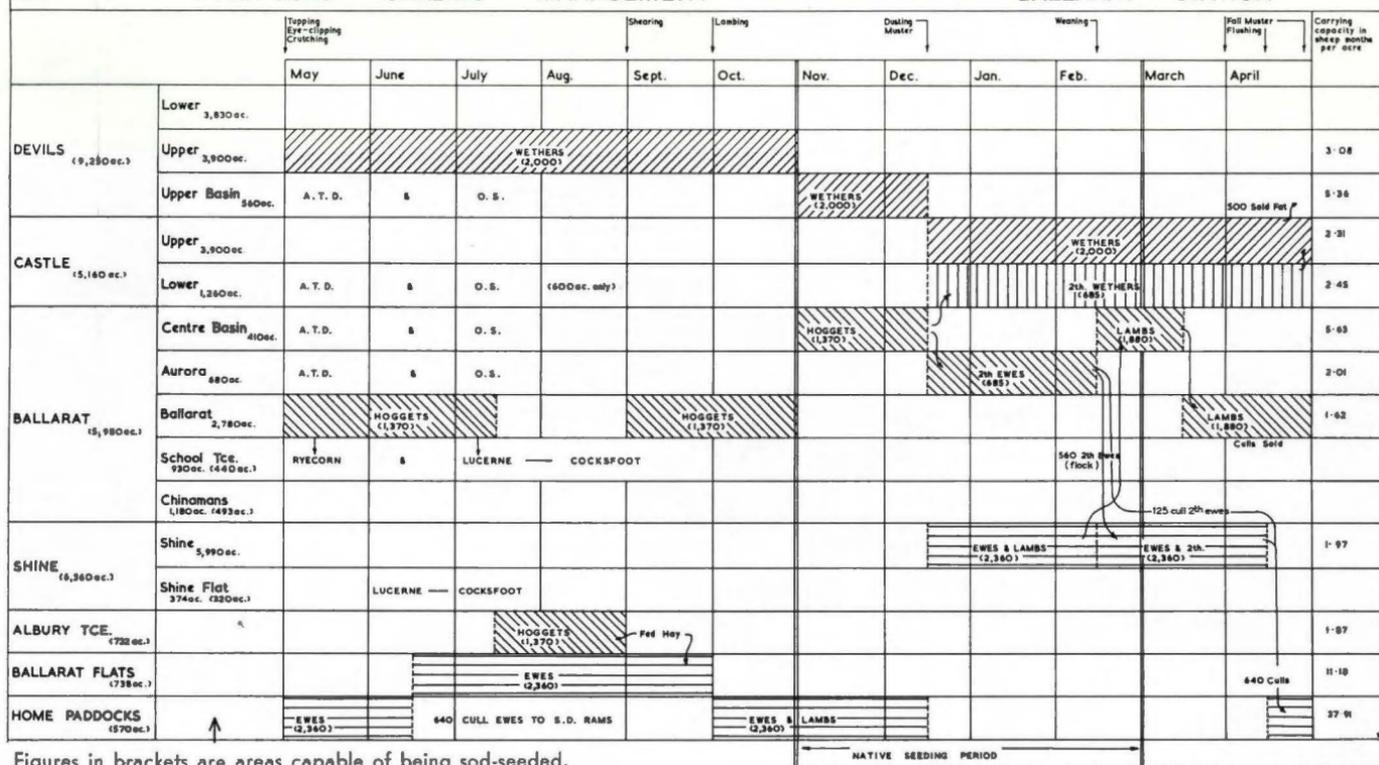


FIG 2

PROPOSED GRAZING MANAGEMENT

'BALLARAT' STATION



Figures in brackets are areas capable of being sod-seeded.

In the second chart (see Fig. 2) is the proposed grazing management for the sheep station after the conservation run plan has been operating for five years.

On aerially topdressed and oversown blocks, grazing time can be calculated by the following method. If you consider the improvement means that the block will now carry one sheep to the acre all year, then the number of sheep-grazing-months at this carrying capacity is the acreage multiplied by 12. If the improvement is equal to two sheep per acre, then the figure is acreage multiplied by 12 multiplied by 2.

e.g. Centre Basin (Fig. 2) 410 acres. Estimated improvement—
1 sheep/acre
Number of sheep grazing months = $410 \times 12 = 4920$

If you have a mob of 1370 hoggets which are equivalent to 913 ewes (since one hogget is two-thirds of a ewe equivalent) you should be able to graze them on this block for $\frac{4920}{913} = 5\frac{1}{2}$ months. Therefore it should not be difficult to carry 1370 hoggets for $1\frac{1}{2}$ months followed by 1880 weaned lambs for one month on this 410 acre block. Rank growth can be controlled by cattle.

The larger improved blocks will need to be sub-divided for maximum utilisation of feed, and the native tussock blocks can be relieved of stock at any stage to enable surplus feed to be consumed on the improved areas.

Comparison of carrying capacities in Fig. 1 and Fig. 2 will indicate the change in grazing pressure on the various blocks brought about by subdivision and topdressing. Emphasis has been placed on feeding the young stock well and building up their constitution to enable them to be mated as two-tooth Merino ewes.

The above method is the one used in Otago to give us some estimate of both the alternative feed available and the manner in which we should consider the movement of sheep on the blocks. With further experience this rough guide will probably prove that we have under-estimated the carrying capacity of the improved tussock blocks. If this should be so, then the problem of relieving grazing pressure on the depleted native tussock blocks of Class VII land will be solved. Although this technique has been evolved on the tussock grasslands of Otago, there is no reason why it cannot be of some use to runholders and their advisers elsewhere. Correct land use of Class VI and Class VII land depends upon good grazing management. Therefore, knowledge of stock movement and stock concentration is vital to the success of any run improvement programme.

BURDOCK

Following on the article on burdock in the Review, No. 3, September, 1962, the Department of Agriculture, at the request of the Institute, arranged for a rapid reconnaissance survey to be made into the incidence of burdock on tussock grasslands. The Institute is grateful to the officers of the Farm Advisory Division for producing their reports at such short notice.



The following extracts from the reports are published because they show that burdock is widespread; also that there is a lack of appreciation by farmers of the importance of this weed. (One report summarised the attitude of farmers in one district by saying: "Generally more wind than spray is directed at control.")

Southland

Burdock, which is found usually on roadsides around stock yards, does not appear to be increasing to any extent.

Balclutha

Burdock has been observed in the Beaumont, Lawrence and Waitahuna districts where it appears to be slowly increasing. It has shown up along tracks which have been gravelled for the first time, suggesting that the seed has been in the river gravel.

Dunedin

Burdock occurs as scattered infestations on the Otago Peninsula and the Maungatua Range, mainly on roadsides

and around stock yards but occasionally in pastures where it has been controlled by spraying.

Palmerston

Infestations occur in widely scattered parts of the district, in the Pigroot, at Garden Bush inland from Waikouaiti and in the Kilmog area between Waikouaiti and Waitati. It is probably present over much of the district including the lower reaches of the Shag and Waikouaiti river beds. Odd plants have occurred at the Palmerston saleyards. It does not occur on high-producing pastures but could be a serious problem on run country as it can be carried long distances on sheep.

Southern Central Otago

Small areas of burdock are present in the district. An area on the Galloway-Ida Valley Road has increased slightly in the past 15 years. Farmers appear to be regarding occurrence of the weed more seriously now.

Northern Central Otago

The chief infestation is in the Motatapu and Matukituki valleys, mainly on country covered with bracken fern. It is increasing in the area already infested and is no doubt spreading to other similar areas around Lake Wanaka and possibly around Lakes Hawea and Wakatipu. Farmers affected are alarmed at damage being done to wool and around yards they have had satisfactory results by using MCPA or 2, 4-D. The problem becomes particularly serious in the extensive areas of bracken fern.

Ranfurly

Burdock in the Maniototo County is confined to waste land or ungrazed areas in the bed of the Manuherikia River in the St. Bathans-Becks district and in the bed of the Kyeburn River. There are odd plants on the site of old gold workings in the Naseby district.

Oamaru

Burdock occurs, mainly on roadsides, in the Kakanui, Maheno, Maraweka and Dansey Pass areas. There are isolated plants throughout North Otago and the weed could be increasing.

Northern Half of South Island

Officers throughout Canterbury, Marlborough, Nelson and Westland report that burdock occurs rarely, and as a localised weed of waste places, roadsides, stock yards and, very occasionally, pastures. In no area is it common except perhaps on the fringes of the high-country tussock grassland of the Mackenzie Country where it is widespread. Elsewhere there is not at present any indication that it is likely to become a serious menace.

INFORMATION FROM FARMERS

Mr Arthur Scaife, Glendhu, Wanaka, writes:

"There is no question but that this plant is spreading too rapidly, in this district at least. I consider that I have been reasonably vigilant in my effort to keep the weed off this place but at the moment I seem to be losing the battle. All accessible plants have been dug out but now, chiefly through outside cattle, infestation is increasing on country where control either by hand or spray is no simple matter. It would be safe to say that practically every run in this area will have some degree of infestation at the present time. As the farmer has been severely criticised in the past for not attending to the eradication of noxious weeds in the early stages of infestation, I think it sound business that we seek assistance in finding ways and means of control before the task becomes too big."

Mr J. C. Aspinall of Mt. Aspiring has also drawn attention to the harmful effects of burdock on high-country stations, both from damage to wool and from the fact that seed adheres also to cattle and may depress their sale value.

ATTITUDE OF THE INSTITUTE

The Committee of Management of the Institute believes that burdock is already a serious problem in certain areas and could develop into a menace over a large extent of tussock grassland. It would urge runholders and County Councils to make every effort to control this weed and to aim at extermination.

CONTROL OF BURDOCK

Mr L. J. Matthews, Principal Scientific Officer, Department of Agriculture, has kindly supplied the following statement.

Burdock is susceptible to hormone weedkillers up to flower-head formation, but most satisfactory control is obtained in the seedling stage. For seedlings, use $\frac{1}{2}$ lb and for older plants, 1 lb acid equivalent of the salts and amines of MCPA and 2,4-D. Treatment should be made when soil moisture levels are high and the plants growing strongly. If this is not possible, the rates of chemical should be increased, and for older plants it may be necessary to use the emulsifiable esters of 2,4-D to obtain good control.

OUR COVER

The cover of Review No. 3 showed the first burn designed to open up the country. In this issue our artist gives his impressions of the initial stocking with Merinos the following spring.





REHABILITATION ON MOLESWORTH

On the previous two pages we reproduce two photographs taken by Mr D. R. Wilkie on the St. Helens block of Molesworth, near the junction of the Acheron and Clarence rivers. The one on the left shows the condition of a northern slope at about 2,500 feet in 1953 at the time control of the rabbit was achieved. The white patches are cushions of scabweed (*Raoulia lutescens*); the remainder of the face is almost bare and severely sheet-eroded and rilled. In the spring of 1955 cocksfoot and clover were sown from the air about two-thirds of the way up the face. The second photograph was taken in 1959, only four years later. Planned grazing was by cattle only and then in the winter months. (In fact a varying number of sheep, stragglers from a neighbouring run, grazed the area at various times of the year.) The cover of cocksfoot and clover is well established, the scabweed has practically disappeared and soil erosion is no longer in evidence.

The photographs on the opposite page give a closer view of the rehabilitation process on the face mentioned above. The upper one shows establishment of cocksfoot in a scabweed cushion in the last stages of decay in 1959. In the spring of 1961 about one hundredweight of superphosphate was sown from the air on the lower part of the slope. The lower photograph shows the result in February, 1962.

Altogether some 33,000 acres have been sown from the air on Molesworth. The resulting growth together with natural regeneration and careful management, have produced increasing numbers of sale cattle of high quality. In addition the development of vegetative cover has had striking effects on soil loss, run-off and stream flow. In every catchment the same pattern is developing. Where previously were broad patches of shingle, now there are stabilised beds covered with vegetation, with the streams flowing in degraded channels similar to those occurring in virgin country.



SPANIARD OR SPEARGRASS

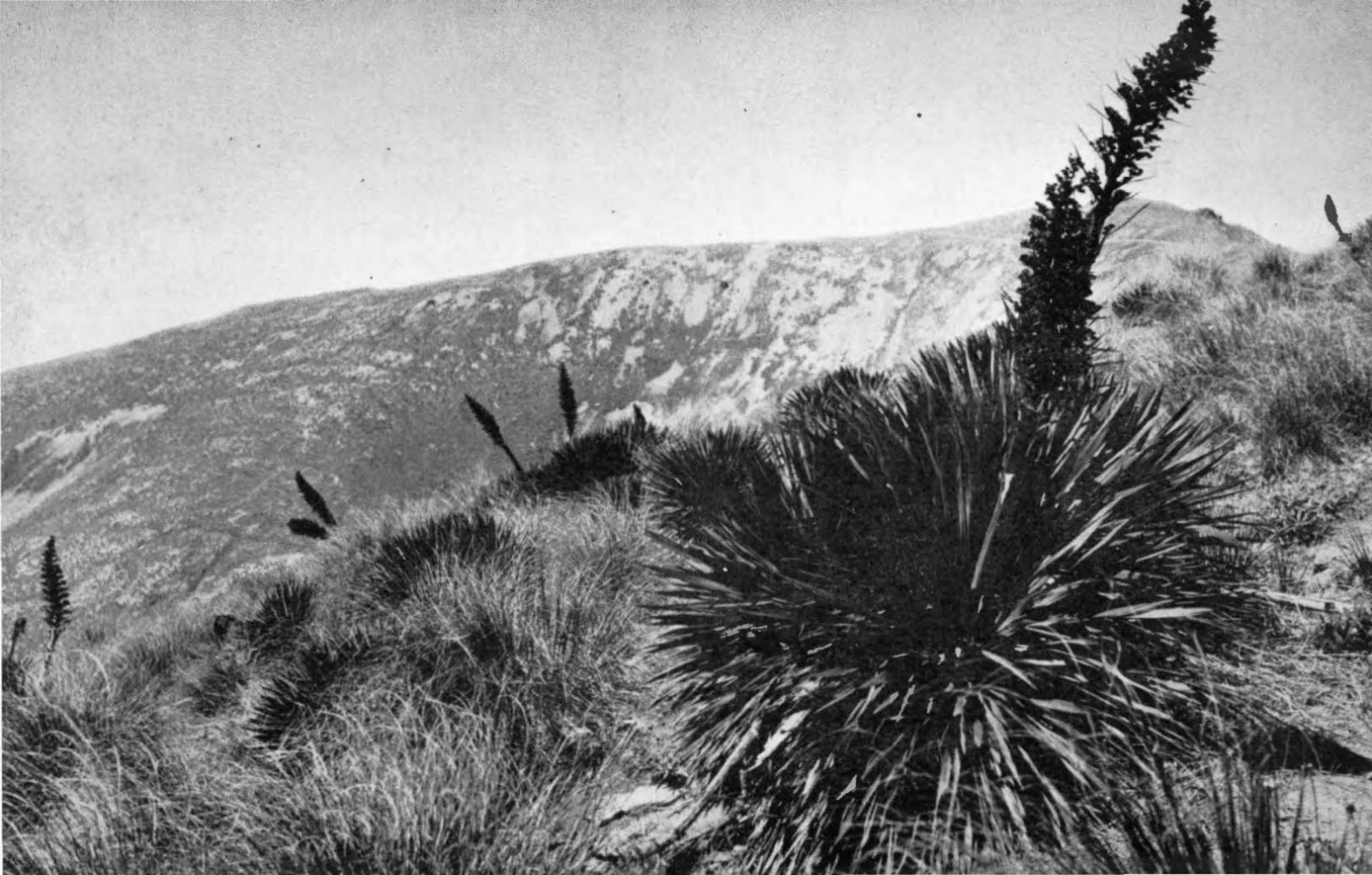
Reduction in burning and control of the rabbit have brought many changes to the tussock grasslands but none has been more striking than the recent increase in the number of large spaniards. This increase has been particularly noticeable in enclosure plots where hares and domestic stock are excluded but it has also been common in some areas which are lightly grazed.

Altogether there are 39 species of *Aciphylla* (the botanical name of the spaniards) found in New Zealand; there is also one in Australia. They vary from insignificant herbs forming tufts, cushions or rosettes to giant tussock-like plants with leaves five feet long and flower stalks up to ten feet high. Those in the larger group go under the name of spaniard or speargrass and it was this group which was known to the Maoris as taramea.

All the spaniards have sword-like or bayonet-like leaves, extremely stiff, strong and sharp-pointed. They are so rigid that they remain almost motionless in the strongest gale. The flower stalks are quite in keeping with the leaves. The upper parts produce masses of small flowers, much like those of the garden relations parsley, carrot and parsnip, and in among them are numbers of vicious, spiny leaves.

When the early botanists came to New Zealand they asked themselves why should spaniards be so spiny when there were no grazing animals from which they would require protection. Alfred Russell Wallace thought they "may have gained their spines to preserve them from being trodden by moas," but it is now generally agreed that the spines have no connection with animals. In most places where the larger spaniards grow, they have to contend with frequent winds of great evaporating power, with the hot sun of summer and the severe cold of winter, and with periods of drought. Reduction of leaf surface to the spiny form means less evaporating surface so that the plant does not give off water so readily by transpiration. The hard and rigid nature of the leaf will also help protect it against sun and wind.

Usually male and female flowers occur on different plants; those on which the flower stalks wither and decay soon after flowering are the males. In the seedling, the leaves are soft and in fact resemble those of garden carrots. At this stage they are very palatable to stock and hares and rabbits, and where these are present in numbers, the plant disappears because it is unprotected at the most helpless stage. If food is short, as was the case in the days of heavy rabbit infestation, rabbits would eat the larger



species down to low cushions. They would also burrow under the lower leaves and eat the basal stems which are highly nutritious.

The Maori valued taramea, as he called it, because of the sweet-smelling gum found at the bases of the leaves. Sometimes this gum was chewed but more often it was used to make a scented locket hung from the neck. The tohunga used the gum to impart a pleasing smell to his ceremonial mats. He built up a tapu round the plant and ordained that only young girls might gather the leaves, and then only at dawn. They held the leaves over a fire and caught the gum in dishes as it exuded. The gum was then mixed with oil of miro, the resin of kohuhu or matipo and with the flowers of the small, prickly, grassland heath, patotara. The mixture was strained through the plumes of toe-toe and the resultant product kept in a carved box with the mats of the tohunga.

(The illustration shows female spaniards in seed in January on Mid-Dome, Southland.)

INOCULATION AND PELLETING OF SEEDS OF LEGUMES SUCH AS LUCERNES AND CLOVERS

There is considerable evidence that where inoculated seed is being sown under the rather unfavourable conditions of seed bed or soil frequently experienced in tussock grasslands, pelleted inoculated seed should be used. Some runholders have expressed concern at the indifferent quality of certain commercial lines of pelleted seed so we are printing the following article by Dr Michael Proctor, of the Plant Chemistry Division, D.S.I.R., in which he gives advice as to a method which can readily be carried out on the farm and which has given very satisfactory results. By this method one runholder with one assistant recently lime-pelleted 3,000 pounds of inoculated lucerne seed in one day. The sowing period for the 300 acres sown extended over 18 days but, since by this method the inoculant lasts at least three months, with one batch of seed he was able to complete the job. If not pelleting their own seed, farmers would be wise to enquire if the commercial line proposed to be purchased is prepared by a similar method. In all cases farmers should use only a certified inoculant. Such certified cultures are available from seed and produce firms and from Biological Laboratories, C.P.O. Box 2749, Auckland.

DETAILS OF THE METHOD

1. Prepare two pints of a five per cent water solution of Cellofas A or Methyl Cellulose (2 ozs of Cellofas or Methyl Cellulose in 2 pints of water) and leave to thicken overnight in the cool room or refrigerator. Stir occasionally.
2. Thoroughly mix and wet with half a pint of fresh or powdered skim milk twice the amount of peat culture recommended by the maker for treating:
 - (a) 15 lb of small seed (such as white or suckling clover or lotus).
 - (b) 30 lb of medium seed (such as subterranean clover, or lucerne).
 - (c) 60 lb of large seed (such as vetch, peas or lupins).
3. Thorough mix 1. and 2. and use to inoculate
 - (a) 15 lb of small seed.
 - (b) 30 lb of medium seed.
 - (c) 60 lb of large seed.
4. Add immediately about 15 lb of finely ground calcium carbonate (micronised lime or other covering material—see below) and stir rapidly until the pelleted seeds are evenly coated and well separated.

Advantages

Seed, inoculated and pelleted by this technique, may be sown in contact with toxic fertiliser such as superphosphate without injury to the bacteria.

Sufficient seed may be inoculated and pelleted at one time to last for several days' seeding. Also, the bacteria are afforded some protection from desiccation when sowing in dry soil is unavoidable.

In soils where the acidity is marginal for nodulation, pelleting by this technique can make the difference between success and failure.

Materials

For satisfactory results it is necessary to use a fresh culture of the right strain of bacteria and suitable grades of glue and covering material.

When ordering commercial cultures specify the type and amount of seed to be inoculated; and on receipt, check the label to ensure that the correct strain has been forwarded, and that the culture is still fresh as indicated by the expiry date. Commercial peat cultures are available from leading stock firms, some seedsmen, and Biological Laboratories, C.P.O. Box 2749, Auckland. When using a packet of peat culture, always use the whole packet at once. An opened packet deteriorates quickly.

Although the use of peat cultures is probably easier, agar cultures of suitable bacteria may be preferred by some farmers. Suppliers of agar cultures are as listed for peat cultures.

Finely ground limestone (calcium carbonate) is the only type of lime suitable for pelleting. Builders' lime, hydrated lime, and air-slaked lime are injurious.

Other suitable pelleting materials appear to be a 1 : 1 mixture of dolomite and blown Nauru phosphate or 1 : 1 mixture of dolomite and fine-ground Gafsa phosphate. In 4, above, use 15 lb of these materials in place of the fine-ground lime.

Cellofas A (the adhesive agent used for pelleting), is available from Imperial Chemical Industries Ltd., Wellington, and through stock firms including Dalgety and New Zealand Loan Ltd. Methyl cellulose is usually available from chemists' shops.

The solution of Cellofas or methyl cellulose should be free of lumps, and if necessary, filtered through cheese cloth or mutton cloth to remove lumps before mixing with the milk and peat inoculum.

Other types of glue cannot be recommended.

Care should be taken that during dressing the seed has not been treated with chemicals (fungicides) which could injure the inoculating bacteria.

Hints on Processing the Pellets

A clean cement mixer is very satisfactory for pelleting large quantities of seed. It should be noted that the first batch which is pelleted may be somewhat inferior to the remainder due to the residue of lime and Cellofas which adheres to the walls of the mixer.

After inoculating the seed with the milk/Cellofas/bacterial culture suspension, add immediately the total quantity of lime required to pellet that amount of seed. Inferior pellets result when lime is added bit by bit.

After preparation, allow the pellets to firm and set for about 24 hours before planting, by spreading out thinly on a clean floor or sheet in the shed.

Adjustment of Sowing Rate for Pelleted Seed

Note that:

- (a) For small seed—3 lb of plain seed/acre is equivalent approximately to 6 lb of pelleted seed.
- (b) For medium seed—6 lb of plain seed/acre is equivalent approximately to 9 lb of pelleted seed.
- (c) For large seed—40 lb of plain seed/acre is equivalent approximately to 50 lb of pelleted seed.

Sowing Methods for Pelleted Seed

It is recommended that pelleted medium or large seed be sown through the ordinary grain box of the drill so that it drops into the soil with the fertiliser at a precise depth. Special reducing cogs may be obtained for most drills to reduce the sowing rate.

Pelleted seed may also be sown through the fertiliser box, but this method is recommended only for small areas. If this method is used, add the requisite amount of seed to the fertiliser in the box and mix thoroughly.

It is difficult to achieve a uniform rate of seeding when pelleted seed is sown through a small seedbox attachment, for as the box empties, the sowing rate is reduced. If this method is used, keep the small seed box as full as possible.

Reports

Reports on results obtained with this pelleting method, especially under dry sowing conditions, or, of any difficulties encountered, are of interest. Correspondence should be addressed to Department of Scientific and Industrial Research, Plant Chemistry Division, Palmerston North or Department of Scientific and Industrial Research, Plant Diseases Division, Auckland.

Further Information

This report has been compiled by Michael Proctor, Department of Scientific and Industrial Research, Plant Chemistry Division, Palmerston North, from his research and from research papers published by: HASTINGS in "The New Zealand Farmer," 21 September 1959; HASTINGS and DRAKE in "The New Zealand Journal of Agriculture," December 1960; HASTINGS and DRAKE in "The New Zealand Journal of Agriculture," April 1962; and by CASS-SMITH and GOSS, Bulletin No. 2518, Department of Agriculture, Western Australia. Those interested should refer to these original papers for further details.