PASTURE IMPROVEMENT AT INVERMAY

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Invermay Research Station has a total area of 1,300 acres and may be divided, like Gaul, into three parts:

First-class Soil:

About 200 acres flat, fertile, recent alluvium.

Second-ciass Soil:

About 400 acres undulating, yellow-grey earth, shallow, overlying clay derived from phonolite.

Third-class Soil:

About 700 acres, ridgy, some as above, some more recent and more basic volcanic soil, usually with boulders.

About 400 acres of the last-mentioned have been reclaimed from gorse and scrub, mainly by use of the swamp plough wherever it could be taken, leaving the steepest gullies in manuka and the stony outcrops in gorse.

Removal of Brush Cover

The original vegetation of the hill block was probably silver tussock with light bush including manuka in the gullies and flax near the creeks. Burning off with no attempt to raise soil fertility would lead to an extensive spread of manuka, and so make the area, although so near the city, unattractive to prospective farmers. At a later stage gorse invaded the area, and, favoured by repeated burning, intentional or accidental, threatened to take charge.

Because of the necessity to get rid of gorse it has been found more satisfactory to plough as an initial operation rather than to produce a seed bed with giant discs. A considerable'advantage of ploughing is that sticks and roots can be buried deeply, and so a sufficient depth of soil can be obtained for ridging turnips. Admittedly the first ploughing is slow work and stoppages are frequent in places where large manuka trees or boulders are encountered. But, once the ploughing has been completed and the land has received a winter fallow with hard frosts and snow, subsequent cultivation is quite easy.

Where gorse takes charge on land too steep or too stony to plough a difficult problem is presented. As yet a satisfactory technique at a reasonable cost for the replacement of gorse by pasture on such land has not been worked out. Spraying with

2,4,5-T is widely used by farmers as a kind of "mopping up" operation, perhaps for the sake of appearances, but the cost seems too high over broad acres on land of this value.

What is required is a herbicide which will translocate within the plant, 'and particularly one which can be guaranteed to give 100 per cent kill after application by aircraft!

Mole Drainage

Much of the second-class land has a retentive clay subsoil and tends to become waterlogged during a wet winter. It almost seems as if raising of the pH and surface fertility on this soil and the replacement of an agrostis-dominant turf by ryegrass and clover increase the tendency to waterlogging.

A trial to investigate the effects of mole drainage on soil moisture, soil temperature, and pasture production has been in progress over two very wet winters. The drained plots were effectively drained, as proved by soil moisture determinations and demonstrated by the very much improved under-foot conditions when the undrained plots were "squelching" with surface moisture.

Production was a little higher on the drained plots at the first spring cut, but production throughout the 12 months was not significantly increased.

The paddock was not stocked during the winter.

Sub-soiling and the use of chisel times for subsoil contouring are now being tried, but a real basis of comparison with conventional methods has not yet been established.

Pasture furrows on the contour and terracing do not appear to be beneficial, as both types of work hold the surface moisture to the waterlogging stage in wet weather and do not appear of any great value in dry weather..

Improvement by Raising the Nutrient Status

Second-' and third-class soils are what they are because of shallowness, undesirable physical conditions, and lack of plant food. Trials with most of the- recognised nutrient elements have been carried out during the past 8 years.

Lime

Lime is valued for its action in' supplying calcium, in raising the pH, and in favouring bacterial life, micro-fauna, end earthworms. Under field trial conditions it is impossible to differentiate between these effects in the total of improvement.

On aew pasture 1 ton of calcium carbonate (98 per cent) raised production by 59 per cent in the best. season. On old pasture

oversown with clovers 1½ tons raised production by only 19 per cent.

Provided other nutrients are available in adequate amounts the plant does not respond to "luxury" applications of calcium, and it appears unnecessary on this soil to raise the pH above perhaps 6.0. Some of the lime now used on some highly improved properties would be better diverted to the vast area which has not yet received adequate amounts or any at all.

Phosphate

Available phosphate on the unimproved soil is very low (L-2 on Truog scale), and applications of water-soluble or readily available phosphate have invariably given good responses, increasing in the initial application to the 6 cwt level: In one trial the mean superphosphate response over a 5-year period at 3 cwt annually has been 66 per cent, in the presence of 5 cwt of lime annually and an initial dressing of 2½ oz of sodium molybdate.

Thermophos and serpentine superphosphate applied to give the same per acre rate of P_2O_5 have not been significantly different from "straight" superphosphate.

Basic slag has been inferior in pasture yields compared with superphosphate when molybdenum has been included with the latter.

Gafsa (North African) finely ground phosphate proved inferior to superphosphate in the presence of lime, but about equal to superphosphate (although slower in action) on unlimed plots. Finely ground Nauru phosphate proved inferior to all other phosphatic fertilisers.

Molybdenum

Superlatives could be exhausted in describing the effects of this trace element on this soil type-amazing, miraculous, spectacular.

Increases in dry matter production from plots treated with 2 oz per acre once only have been as high as 280 per cent; application appears to be sufficient to last about 4 years.

'The use of moybdenum to save the manpower and expense previously devoted to heavy liming is now well known. It is perhaps less widely realised that the use of this minor element has been the key to improvement over many millions of acres by making soils previously termed "marginal" responsive to phosphate and therefore easily improvable.

Potash

None of the soil types on the Station shows a potash response on pasture at the present stage of development.

Other Nutrients

No pasture responses have been obtained to elemental sulphur or sulphate, to magnesium, or to boron. A trial using vanadium and tungsten is still in the early stages; applied in the autumn of 1958 neither element has yet shown a yield difference.

Applications of copper sulphate on the second-class land have proved of no value in improving the growth rate of lambs.

Improvement by Grazing Management

It is impossible under practical farming conditions to follow counsels of perfection in grazing management. On any trial area it is possible to manage the grazing for the benefit of the sward by bringing in sheep for just as long as they are required. On the farm as a whole one can manage the livestock only as well as the vagaries of the season will permit..

Factors which assist good pasture management are:

1. Subdivision. This is a rather expensive permanent improvement at present costs for fencing and for water supply.
2. Provision of supplementary feed. Planning of the integration of pastures and fodder crops should be a major subject for study. In farming, cultivation costs. have risen more than those of any other major work, and many farms have substantially reduced , the acreage under the plough. That they have at the same time' been able to increase stock numbers is a triumph for the science and practice of grassland exploitation.

Brassica diseases have made these crops less reliable in the south, but they remain a most valuable aid to full utilisation of the grass crop in its somewhat limited growing season.

3.. Planning of seasonal topdressing to increase pasture growth "out-of-season." Examples of this are late summer application of superphosphate and autumn application of nitrogen.

4. The use of special-purpose pastures.

With the exception of short-rotation ryegrass very few winter growing grasses have as yet been used in farm practice in the south, and in fact very little investigational work up to evaluation at the grazing stage has been placed on record.

On the first-class flat land there is no difficulty in growing highly productive pasture, subject only to limitations by winter cold or by drought, which can come in any period from August until June. For example, the rainfall for August 1958 was 0.34 in and for September 0.16 in.

On these pastures research work might usefully be directed to assessment of "quality': from pastures of different herbage com-

position and from pastures of the same composition treated in different ways. Measurement of quality in herbage by growth rate of lambs is subject to many disturbing factors, and we must ultimately look to the analyst for more fundamental data.

DISCUSSION

G. Anderson (comment): The pasture furrows at Invermay were made several years earlier when scanty knowledge was available. It is now realised that diversion furrows are required to divert water into ponds. With pasture furrows soil type is important and it is now considered that the chisel plough and subsoiler has big possibilities on difficult areas. It is considered that terraces had very limited scope.

Q. (C. E. Iversen): You mentioned that a differential liming response occurred on new and old pasture. Could, you supply further details?

A. On newly established pasture a lime response of 59 per cent had been obtained, while on older established pasture, the best response was only about 20 per cent.

Q. (-. Oliver): What rate of potash was sown on the lucerne?

A. 1 cwt muriate annually with the superphosphate.

Q. (T. Burnside): Is molybdenum likely to be harmful if applied annually, and what were the results of the stock grazing trials with molybdenum carried out at the station?

A. On the Invermay soil type the normal rates are unlikely to be harmful as the grazing trials with'up to 8 oz annually for 3 years did not result in any ill effects on the sheep. However, the trials indicate that there is no benefit from applying 1-2 oz molybdenum more than 'once every 3-4 years.

Q. T. G. Sewell): Mr Holmes indicated that two methods of land improvement were followed at the station:
(1) Grassing after turnip cropping.
(2) Direct regrassing.
In the latter case, how much fertiliser is needed ?

A. Good responses with up to 6 cwt of super have been obtained initially, but after fertility has been built up 2-3 cwt appears to be sufficient for maintenance dressings.

Q. (H. R. Henderson): To what extent throughout Otago would the Invermay results be applicable?

A. Probably millions of acres.