A MODERN APPROACH TO PEAT RECLAMATION

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The reclamation of peat land has changed greatly in the last 20 years. In the past very often the enthusiastic pioneer with very little means took on the job of reclaiming peat, and his struggle and experience have given us a very valuable basis for today's peat development.

The right application of fertilisers and the use of suitable grasses and clovers and modern machines for drainage or water control enable the modern farmer to bring in his peat land with much less labour and greater success.

All these factors have been investigated overseas and in New Zealand, and due to the results gained by experiments thousands of sheep and cattle are thriving on previously waste land.

Let us consider why peat is waste land and would not change into fertile soil without the operations just mentioned.

Peat is formed by the accumulation of decaying organic matter, the amount of which decreases after it has been drained, when it changes into loamy-peat. -or- peaty loam. Due to the nature of this material peat can absorb a high amount of moisture-up to 10 times its own weight. But once dried out it takes a very long time to re-wet.

Peat is very light in comparison with mineral soils on a volume weight basis. It stands to reason therefore that the mineral content is very low. For instance dried peat of a 3in. layer covering 1 acre weighs approximately 50,000lb. with an ash content of 2500lb. The ash contains 1.7 per cent of potash and 0.3 per cent of phosphoric anhydride (P_2O_5). In other words the total potash in this layer is 42.5lb. and P_2O_5 7.5lb. per acre.

Water relationship and low mineral content have a bearing on the use of peat for agricultural purposes. Plants may die through the lack of water in summer

and waterlogging in winter. Pasture plants such as ryegrass, cocksfoot, timothy, and white and red clover could not grow in untreated peat because of the insufficient amount of major and minor elements.

pH AND SEED MIXTURES

Over the last 6 years workers at the Rukuhia Soil Research Station have investigated the increase of pasture production by liming and topdressing. Results of various trials have been published elsewhere, but for an understanding of the problem the following has to be said: Peat is extremely acid in its raw state. There are two ways of increasing pH, which means to sweeten the soil:—

1. By burning the surface layer and sowing Yorkshire fog and *Lotus major*. A pasture laid down in this manner will probably revert to scrub, but if this method of sowing down is repeated several times, maybe with the growing of a crop occasionally, a reasonable pH will be gained in a top layer of up to 8in. after about 20 years' farming.

2. The application of ground limestone. Two tons of lime to the acre applied on the surface is a good start. Nearly all New Zealand peats are acid in their whole profile, and an application of 2 tons of lime per acre harrowed in would seldom affect the 3 to 8in. layer.

The majority of the trials laid down by the Rukuhia Soil Research Station and experience gained by farmers have shown that the application of 2 tons of lime per acre, provided adequate potash and phosphate is supplied, resulted in a good clover-dominant sward with very little ryegrass. The maximum production is in the spring, with very little growth during the dry summer and another smaller flush in the autumn. Increasing the lime applications thickens the ryegrass in the pasture and where 8 tons per acre were applied a ryegrass-dominant sward was established. Pot trials with various amounts of lime have shown that peat with a higher pH releases more nitrogen and the nitrogen content of the ryegrass increases with the higher lime applications. Eight tons of lime per acre is certainly a great expense, and very few farmers could afford to do this, although very often overseas there are cases where this amount and 4cwt. of superphosphate, 2cwt. of potash, and lcwt.

of sulphate of ammonia are used in the first year for pasture establishment on virgin country.

The quantity of lime a farmer needs to use on peat is influenced by these factors:—

What kind of pasture does he want to have in the next 3 years after sowing down, and how much money is he prepared to spend on it?

The first step is to have soil samples taken by his local Instructor in Agriculture in order to know the initial pH of the paddock. Soil samples for peat land should be taken in steps of 3in. at least down to 6in., but preferably to 9in.

Let us consider an extreme case first-a very acid peat with a pH of 4. A good pasture can be established with 2 tons of lime per acre disced in approximately 3in. deep and another application of 2cwt. per acre before sowing down. But one should not aim for a ryegrass-white clover sward, because the pH of the top layer would be still slightly under 5, which is too acid for ryegrass. Very good production can be obtained from a fog-white clover seed mixture. With the application of 3cwt. of superphosphate and one' of potash, a firm turf can be established and there is little danger that this sward will revert to fern or manuka.

If 2 tons of lime per acre is applied to an initial pH of 4 and a ryegrass-white clover seed mixture sown, a good proportion of ryegrass grows in the winter, but its production is very low. Where the pH is suitable for ryegrass, bad drainage might still hinder growth, due to the lack of oxygen and nitrogen.

If the initial pH is 5 or slightly above 5 in the 0 to 3in. layer, an attempt should be made to raise the pH to 6, which would guarantee a dominant ryegrass sward. Two to 3 tons of lime per acre disced into this layer and a surface application of phosphate and potash would in most cases achieve this.

DRAINAGE

Adequate drainage is a most important feature in winter production on peat soils. The activity of the micro-organisms which make some of the nitrogen in the peat available to plant' growth ceases under waterlogged conditions, and high liming would be just a waste of money.

Unfortunately peat is very impervious to water and without an internal drainage system no good results can be expected. Several methods can be ap-

plied successfully, such as the provision of tile drains, mole drains, and open 'ditches. The initial cost of the placing of tile drains is very expensive and pays dividends only where intensive vegetable growing is practised.

The drawing of moles is quite cheap and results can be- very effective. The spacing of the moles depends on the decomposition of the peat. Very raw peat is not suitable for mole drawing, because the gap made by the torpedo closes in after a very short time. Partly decomposed peat is very impervious to water an'd a spacing of 10ft. between moles could be recommended.

An attempt has been made to relate the lifetime of the moles to the volume-weight of the peat. Various areas where moles have been running for several years were under close observation. Then moles were drawn in raw and partly decomposed peat to determine the critical point where peat closes in and moles are of no use.

TABLE I

Dry weight of peat in pounds per cubic foot.

Depth of Sampling	Moles running in 18in.-24in. layer	Moles running in 12in.-18in. layer	Moles not running
0in.- 6in.	27.3	13.7	3.3
6in.-12in.	22.9	7.0	4.1
12in.-18in.	7.2	5.4	3.7
18in.-24in.	6.6		

In the first case before the moles were drawn the paddock was extremely wet in the winter; in some hollows the water was standing lft. deep. A great improvement took place afterwards, so that water that collected in the hollows after heavy rains disappeared in a very short time. After 3 years the paddock was ploughed and resown and where the outlets of the moles were kept clear they were still functioning.

In paddock No. 2 drains are approximately 16in. below the surface. Although the water-table is only a few inches lower than in the undrained adjacent paddock, the surface of the peat is much dryer. One part of the paddock was used for cattle grazing, the other for sheep grazing. In the first case the cattle destroyed about half the moles, whereas the weight of the sheep, had no effect on them. For cattle grazing

it would therefore be advisable to draw moles below 20in. from the surface.

It has been shown already that very raw peat is not suitable for mole drainage, as the moles close in very soon after drawing. In some cases, when the water-table goes down in the summer and the peat dries out, small open channels are formed where the knife had cut the peat. Although these channels take some of the surface water away, it would not be worthwhile using a mole plough for this purpose.

OPEN DITCHES

During the last few years very good results have been obtained by using ditch diggers for open drains. The advantages over the dragline is their speed and cheapness. J. D. Wallace Ltd., a contracting firm in Cambridge, is using a Caterpillar tractor on wooden cleats with a small Killefer ditch digger which digs a drain 2ft. deep and 18in. wide at a speed of about 2 miles per hour in peat country without stumps. This type of drain is quite adequate to get rid of the surface water. Drains can be spaced 2 chains apart with very little cost involved. The use of shallow, closely spaced open drains is much more practical than deep ones. The after effect of deep drains can be very detrimental to pasture growth in the summer. Apart from the drying out of the paddock, it becomes dome shaped within a very short time due to subsidence toward the drains.

With the introduction of the mechanical drainplough, the cost of peat reclamation can be reduced to a fraction of that incurred when draglines were used. Raw peat can be drained efficiently and cheaply. The area can be disced after the first winter and laid down in temporary pasture.

It was said that the aim of drainage is to overcome waterlogged conditions. Another very important function is the formation of a crust. It would be quite possible to grow a good pasture on raw peat after the first drains had been put in, but because of the softness of the surface the country could not be used for dairying. With the drainplough, however, the drains can be deepened when required and an even crust is formed. Let us consider the type of peat mentioned in column 3. The volume weight is 3.3lb. per cubic foot. A reasonable crust suitable for a dairy farm is 30lb. per cubic foot, which means that the country has to go down at least 9ft. before this crust is formed.

It seems that the logical approach would be the burning off of the surface layers. Unfortunately in practice more harm than good is done by irregular burning. But should there be a safe method evolved by which peat could be burnt without leaving behind all the hummocks which dry out in the summer and carry very little growth, and hollows which -form water-holes in the winter, it would certainly pay to burn.

Soil moisture conditions were investigated on a typical paddock as described above.

TABLE 2.

Percentage of moisture calculated on a dry weight basis on 22/2/49.

Depth in.	Hollows % Moisture	Hummocks % Moisture
0-2	94.5	58.4
2-4	104.3	58.8
4-6	105.7	73.8

On March 17 after 3.22in. of rain had fallen the moisture contents in the O-2in. layer were as follows:

Hollow: 94 per cent Hummock: 48 per cent

63 per cent of the hummocks were clovery and 33 per cent were bare. These figures show that very little water is absorbed on the hummocks even after heavy rainfall. Where the drying out had not progressed completely the root system of the clovers helped the water to penetrate. The bare hummocks, however, had formed-an-impervious-layer-and--absorbed--very: little water. This long delay in re-wetting continues into the autumn, and the flush of growth which should occur then is greatly retarde'd.

HOW TO OVERCOME DROUGHTS

The policy in the past was to dig deep drains, but this caused overdraining of the peat and so it dried out in the summer. There are three methods of moisture supply in the root zone:

1. Pasture renewal.
2. Sub-irrigation.
3. Spray irrigation.

Pasture Renewal : The beneficial effect of ploughing UP an old pasture is (a) in the breaking up, of the

impermeable crust which in many cases had formed over the years and (b) the formation of a new crust by adding raw peat with a higher water-holding capacity into the surface layer.

Part of a permanent pasture was renewed in the spring of 1950. Samples for moisture determination on January 5, 1951 (that is, in the second summer) had a much higher moisture content than the old pasture.

TABLE 3

Depth of sample in.	Moisture % Old Pasture	Moisture % New Pasture
0-2	41.9	85.3
2-4	40.8	83.5
4-6	59.2	86.8
6-8	109.5	81.5

The water table was 4ft. 2in. below the surface.

Sub-irrigation.-This system is extensively used overseas. The main requirement is a cheap water supply from rivers or lakes.

Trials were conducted at the Rukuhia Soil Research Station where this method was applied on a minor scale. Water was pumped from a bore into open drains and then reticulated through moles 18ft. apart into the paddock.

It was found that to achieve the maximum pasture growth on Rukuhia peat, the height of the water-table should be 6 to 8in. below the surface. As it would be impossible to run a dairy herd under these conditions, this method cannot be applied for that purpose.

Spray-irrigation.-The advantage of spray irrigation is the supply of moisture in the 0 to 3in. layer where it is most needed. The crust remains firm and cattle grazing can continue. As only a small proportion of the farm need be irrigated, a well-balanced pasture supplied with all nutrients should be selected,.

It would be quite feasible in the future to run a high-pressure spray irrigation outfit alongside the main drains and irrigate farms when and where required. This service could be organised by a drainage-irrigation board, who could look after all technical details such as time of application, water supply, and depth. and cleaning of the drains.

CONCLUSION

Adequate and planned drainage is an important factor in peat reclamation. The use of modern equipment makes it possible to drain virgin peat much more cheaply and rapidly than in the past.

The lime and fertiliser requirements can be determined and applied so that pasture growth will not be checked by lack of nutrients.

Summer production can be increased by pasture renewal or spray irrigation.

These are only a few points which make the bringing in of peat land attractive to the modern small farmer.

There is still a great deal of research to be done, but results obtained so far and the co-operation of peat farmers will help to make the development of peat areas profitable not only to the farmer, but to the district and the country as a whole.