Afforestation of Peat-lands in Northern Ireland. *

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A target of 150,000 acres of forest by the end of the present century has been set by the Government of Northern Ireland, and up to the present, the progress of afforestation towards this target is most encouraging, there being 43,000 acres under forest, about 30,000 acres of government owned land awaiting planting and the annual planting programme has now been geared to 3,000 acres. In addition to the government programme, approximately 600 acres are planted each year by other public bodies, farmers and private landowners.

It is an important government policy that afforestation should proceed in harmony with agriculture and not in competition with it, so that much of the afforestation is confined to marginal and sub-marginal agricultural land. The peat covered moorlands, which often lie derelict, or at the best carry a very small sheep population, form a high proportion of the sub-marginal agricultural land and it is here that much of the future afforestation may be carried out. In the past only a relatively small proportion of the planting has taken place on those areas of deep peat, mainly because of the difficulties and expense of providing adequate drainage, but the areas that were planted have produced very promising stands of timber, so that with the advent of mechanical draining in recent years, large-scale afforestation of peat covered land has been stimulated.

This paper summarizes the present policies and techniques of afforestation of peat covered areas in Northern Ireland, mentions the lines along which research is proceeding and briefly assesses the future management problems which may be anticipated in the developing forests.

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Classification of Peatlands.

It is estimated that approximately 600,000 acres,—(one-fifth of the total land area) of Northern Ireland is covered with a discontinuous peat layer of varying depth. Of this total over 500,000 acres may be classed as blanket bog and the remaining 100,000 acres is predominantly basin bog.

A good deal of the basin bog occurs at low altitudes, and where this has proved economically drainable it has been reclaimed for agricultural purposes or has been cut-over for fuel. It, therefore, does not often become available for afforestation purposes. When drainable basin bog has been planted with trees, vigorous growth has normally occurred, probably due to the accumulation of nutrients in this type of peat and to the more favourable climatic conditions associated with the low altitudes.

The blanket bog of the hill land must therefore remain the main planting medium for the forester. At first sight this blanket bog appears remarkably uniform both in depth and in the type of vegetation it supports. Closer analysis, however, reveals a complex variation in the peat type associated with moisture content, nutrient status, degree of decomposition, etc. An understanding of this variation is vital to the success of afforestation on the blanket bog for it is well known that within this range lie peat conditions which will support excellent tree growth and others upon which afforestation is doomed to failure from the start. While a study of the local tpography and climatic influences provides valuable indications of the suitability of a moorland site for tree planting, a knowledge of the peat fertility is essential if afforestation is to be anything more than an expensive gamble.

The accepted method of assessing the fertility of peatlands for afforestation purposes is to use the existing vegetation cover as a classification factor, on the assumption that peats of a particular fertility will support similar plant communities. This is the current practice in Northern Ireland, plant communities dominated by *Molinia, Eriophorum, Trichophorum, Calluna* or *Sphagnum* being accepted as indicators of sites of differing forest potential.

When dealing with considerable areas of peatlands which are approaching the limits for economic afforestation, as in Northern Ireland, it is becoming increasingly obvious that these accepted plant community classifications have important limitations. Accordingly an intensive programme of investigation into the possibilities of providing more reliable indicators of peat fertility is being undertaken largely by botany and soil experts from Queen's University.

Drainage.

The first consideration when undertaking afforestation of peatlands is to provide adequate drainage. The water table of most peat covered

areas is at, or very close to, the surface and it is essential for the establishment and ultimate development of a tree crop that the tree roots should remain in a well-aerated medium above the water table. The task of lowering the water table in normal peat is both difficult and expensive and until recent years this was a serious obstacle to economic afforestation. Recent development of large drainage ploughs and machines capable of pulling these over soft peat has now made intensive mechanical drainage an economical proposition, so that this barrier to afforestation of peatlands has been virtually removed.

The Northern Ireland Forestry Division has a fleet of tractors and ploughs of various kinds designed to drain and provide planting turves in an efficient and inexepnsive manner on most types of peatland to be encountered in this country.

Drainage techniques have been developed to meet a variety of topographic conditions. The moorland blanket bog areas in Northern Ireland are characterised by gentle slopes and a regular surface broken only by occasional flushes or streams and on such areas the standard practice is to provide a deep cut-off drain along the top edge of the proposed planting area and then to cross the slope with wide-spaced, main run-off drains into which are ploughed the planting or turfing drains at 5 or 10 feet intervals. The cut-off and run-off drains are normally at least 3 feet deep and are usually the maximum depth plough drains deepened by hand. Normally, the main drains are put in during the same year in which planting will take place, but on very wet peat areas a system of "pre-draining" is carried out up to 5 years ahead of planting in order to promote surface consolidation of the peat.

Other Pre-planting Treatments.

Some of the peat moors which are being afforested have lain practically derelict for many years and on the drier slopes there is sometimes a vegetation of high woody heather. This interferes with the turf-ploughing of the area to such an extent that the general policy is to remove it by burning one or two years ahead of planting. Other peat vegetation is not normally burnt prior to ploughing.

It is standard practice to fence all planting areas against stock and harmful vermin. A wire and netting fence is normally employed.

Many of the moorland areas now being afforested are quite remote from existing roads, so that a new road system has often to be built into and through the planting sites in order to get men, machines and materials into the area. Such roads form part of a more complex network which will eventually be used to remove the forest produce. Many of these roads pass across areas of deep peat and special techniques of construction and bridging have been developed to ensure that they will carry the heavy loads of the future.

Layout of Plantations.

To facilitate future management of the plantations the stands are divided up into units or compartments of approximately 25 acres. The compartments are separated by unplanted strips (rides) about 35 feet wide which will form future extraction routes and roadways. Through the compartments are left unplanted strips (racks) 15 feet wide, which will allow the passage of future extraction machinery. These racks are laid out so that the maximum distance of drag of a pole during extraction to a rack will never exceed 100 yards.

The laying-out of these roads, rides and racks is one of the first operations undertaken on a proposed planting site. It is considered very important that the peat surface of these future extraction routes should not be disturbed by the intensive drain and turfing ploughing which is employed on the actual area to be planted. The future risks of windblow also make it important that the racks should be left unplanted now to avoid having to cut the extraction routes through the stands during thinning operations—a frequent cause of the start of windblow.

Wherever possible the layout of the main drains corresponds with the roads, racks and ride system, as this can appreciably reduce the number of bridges or culverts, and maintenance and inspection of the drains throughout the life of the forest is facilitated.

Planting.

The turfing ploughs provide ribbons of peat about 9 inches thick and five feet apart across the planting area. The young trees are planted on these at 5 foot intervals using a semi-circular spade. With this tool a peat plug 4 inches in diameter and 9 inches long is removed from the peat ribbon and the young tree is inserted into the resulting hole so that the tips of the roots reach the bottom of the hole and hence the layer of vegetation which was formerly growing on the ribbon of turf before inverting. The peat from the broken-up plug is then used to pack the tree roots. When planting on ribbons from main drains, which may be up to two feet thick, a piece of the ribbon is removed to leave a 'step' 9 inches thick through which the tree is planted.

On the less fertile peat it is the standard practice to give each plant a dressing of 2 oz. of Basic Slag. This is deposited in the hole left after the removal of the plug and before the tree is inserted. Several experimental trials have indicated that high grade Basic Slag is more beneficial than other forms of phosphate when applied in this way at the time of planting.

The actual organisation of the planting is as follows: A number of men start on the removing of peat plugs with semi-circular spades, these are followed by men who drop a handful (2 oz.) of slag into each hole. Behind them other men (or usually boys) drop a plant into each hole

which has had slag and these are followed immediately by men who do the actual planting. A well organised squad plant at the rate of 800 trees per man per day.

Planting of the high moorlands is normally undertaken as late as practical in the season—usually the end of March—since exposure of the newly-planted trees to winter conditions before the roots are established leads to many failures. Well rooted 2 + 1 year plants are preferred.

Choice of Species.

Certain of the lowland peats which have a high nutrient status and a relatively high pH will support a wide variety of tree species, but on the acid, infertile blanket bog areas the choice of species is very limited.

In flush areas on the peat moors, Norway spruce is sometimes planted if the peat is not very deep but Sitka spruce and contorta pine are undoubtedly the most successful species on a wide range of peat types.

For many years it was the practice in Northern Ireland to plant contorta pine either pure or in mixture with Sitka spruce on the peats considered to be of very low fertility, but recent studies of the older stands containing contorta pine suggest that it is not a species for planting on deep peat at all. While it undoubtedly gets off to a good start in mixture with Sitka spruce it appears very doubtful whether it has any beneficial effect as a nurse whereas it frequently delays the closing of the tree canopy and consequent suppression of the ground vegetation. A pure crop of contorta pine appears to start off well on deep peat but after a first thinning the shade cast by pine never appears to be sufficiently intense to prevent the invasion of Sphagnum moss which may well lead to the stagnation of the pine stand. Consequently the current choice of species policy on the areas of blanket bog is to plant pure Sitka spruce wherever there is a possibility of any tree growing and to concentrate on helping them through the period of check which often follows a few years after planting. Contorta pine is planted only on the shallow, dry, infertile peat areas characterised by a plant community dominated by *Calluna* and lichens.

Heather Competition.

The considerable drying out of the surface peat layer which results from the intensive drainage associated with mechanical turfing prior to planting, causes remarkable changes in the surface vegetation. On the less fertile blanket bog areas a vigorous re-growth of *Calluna* within three years of planting is characteristic. Apparently associated with this *Calluna* development is a yellowing and slowing down of the growth rate of the young Sitka spruce planted on this peat—which for the first two years after planting normally grow extremely well. This checking

of the spruce is a very serious matter and if no treatment is provided the trees often cease growing and eventually die. It has been discovered, however, that there are a number of ways of overcoming this "check" and stimulating the trees into renewed growth. Top dressing the checked spruce with a phosphatic fertiliser often has the effect of turning the trees green again and starting growth the following season. This phosphate stimulus is often only temporary, however, and the trees may go into check again after a year or two. A more permanent improvement has been brought about in many checked areas in Northern Ireland by spreading peat—dug during drain deepening operations—around the base of the checked trees. The exact reasons why this spreading of peat around the base of the plant causes re-vitalization is obscure—it may be merely that it causes temporary suppression of the *Calluna* or it may provide a supply of nutrient which has become limiting in quantity. However there is no doubt that this treatment is highly effective in its stimulation of the trees to such a size that their own developing lower branches cause sufficient shade to kill off the *Calluna* after which stage the stand growth continues unchecked. The disadvantage of this treatment is its expense—the cost of providing sufficient peat and spreading it around each plant may approach £10 per acre. Accordingly, experiments are being carried out to try to discover an economic means of overcoming this *Calluna* check in young spruce plantations. Three main approaches are being tried experimentally. They are :—

(i) The addition of fertiliser to the plants after "check" has occurred, to stimulate them to a size when they can suppress the *Calluna* by shade.

(ii) The addition of fertiliser at the time of planting to provide sufficient vigour to permit the tree to reach the heather-suppressing size before the *Calluna* can cause it to check.

(iii) Treatment of the site before planting in such a way as to reduce the vigorous return of *Calluna* after planting.

Results to date are limited but they suggest that top dressing with organic fertilisers containing slowly available nitrogen will bring spruce out of check and will stimulate rapid growth.

Development of Plantations.

Only a few of the plantations on deep peat in Northern Ireland have reached exploitable size and, since no detailed records of the original sites were kept, the application of development information from these old plantations to the ultimate growth of those being established at present is very limited. However certain parallels may be expected and these will influence management policies to some degree. For instance, the susceptibility to windblow of trees growing on deep peat has often been revealed in the past and this knowledge should stimulate foresters

to avoid underthinning and to provide wind-firm edges to all plantations. The fact that the developing stands cause considerable shrinkage of the peat is obvious from a study of the older plantations and this demands that frequent attention to drains will be a future management policy since some of the drains provided at planting time will lose their effectiveness as the peat shrinks beneath the developing trees. The invasion of stands by *Sphagnum* moss after thinning has been observed on areas of deep peat and it is probable that special thinning regimes may be necessary to avoid this invasion and the apparent stagnation which follows it.

These and many more problems will beset the forester faced with the task of growing and harvesting timber on these difficult peat lands, but new and often encouraging information is coming to light constantly as the older peatland plantations develop and new techniques and treatments yield results.

Conclusions.

It may appear from this paper that the Northern Ireland Forestry Division is rushing ahead with the wholesale afforestation of vast areas of infertile peat lands which have long been accepted as unplantable. This impression would, however, be erroneous, for up to the present, large-scale planting is confined to sites which past experience has indicated beyond reasonable doubts will produce a crop of timber. The planting of the doubtful peat areas is being undertaken on an experimental scale only, but all aspects of this are being tackled with enthusiasm under the stimulus of the knowledge that each advance opens up for afforestation considerable expanses of land at present lying barren in a country which is so short of raw materials.