Afforestation of industrial cutaway peatlands in the Irish midlands: site selection and species performance

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Abstract

In Ireland, industrial cutaway peatlands account for about 80,000 ha, of which 58,000 ha are currently in production, mainly in the midlands. It is estimated that only 16,000 to 20,000 ha of this area is suitable for commercial forestry. The BOGFOR research programme was initiated in 1998 in an attempt to develop new techniques to successfully establish forests on cutaway peatlands. It established that with good planning and the application of site-specific establishment procedures, satisfactory results could be obtained. It recognised however, the heterogeneity of cutaway peatlands and thus, the difficulties associated with site selection necessitate the use of intensive site evaluation procedures in advance of any decision to plant an area. Norway spruce may be the most suitable commercial forest species for planting on cutaways. Survival and growth results from several field trials, however, show that a range of conifer and broadleaved species can be established successfully. While there is still little information on the long-term performance of most species on such sites, the relatively wide range of suitable species affords the forester the opportunity to create interesting landscapes and the potential for providing other options (e.g. a more diverse range of products for market) at a later stage. The variation in site conditions encountered in any given cutaway peatland means that, not one, but several species might flourish within a given area, thus enhancing the sustainability of these new forests.

Keywords

Afforestation, cutaway peatlands, species selection, species performance, tree establishment, tree nutrition, nurse crops

Introduction

Since the late 1940s, Bord na Móna has been responsible for harvesting vast quantities of peat which was used to fuel power stations and heat homes all over Ireland. Most of the Bord na Móna peatlands are located on raised bogs in the midlands, and once these areas are released from peat production, they are called industrial cutaway peatlands. Ireland has a long experience of peatland afforestation, mainly on blanket peatland in the West and on mountain ranges. Industrial cutaway peatlands, however, are very different in character from blanket bogs and present a series of unique, challenging problems. The peat remaining after harvesting has been buried for several thousand years under the enormous weight of the overlying bog. It has been compacted, and its physical properties have been radically altered by this overlay. When the first milled cutaway raised bogs were released for after-use, foresters were presented with unique

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site characteristics for which conventional forestry techniques had limited applicability and success (Jones et al. 1998).

One of the objectives of the BOGFOR Research Programme, which was established in 1998, was to give practitioners tools with which to better understand the complexity of cutaway peatlands and to successfully establish a forest resource on these site types for which little information was available (Renou-Wilson et al. 2008c). The results from over 200 ha of experimental and demonstration plantations show that the successful afforestation of midland cutaway peatlands is possible but requires (a) a sound plan with specific objectives, (b) careful selection of sites with suitable characteristics and (c) the use of specific operational methods tailored to the site conditions and species requirements. Commercial forest crops have been successfully established on certain cutaway site types, each requiring a combination of actions pertaining to site assessment, site preparation, species choice, tree establishment, fertilisation and vegetation management. This paper reviews some significant findings from the BOGFOR Research project pertaining particularly to the identification of sites best suited for afforestation and the performance potential of various species on these sites.

Site selection

Industrial cutaway peatlands

While large peat resources still remain in the Bord na Móna bogs, they are gradually becoming exhausted for fuel production and thereby transformed into industrial cutaway peatlands (hereinafter called 'cutaways'). About 18% (16,000 ha) of Bord na Móna bogs have so far become cutaway (although varying depths of residual peat remain). This area of cutaway is increasing every year but at a variable rate; it is expected that another 60,000 ha of bogs will become cutaways within the next three decades. They represent a valuable resource with potential for new land-uses (Renou et al. 2006). The BOGFOR research programme has been investigating the forestry potential of these cutaways as a future land-use option.

The process of milled peat production and the variation in peat depth in midland bogs means that the cessation of harvesting varies across the bog and that areas become available for after-use in a piecemeal fashion. Consequently, it may take many years to build up a viable management unit for afforestation. During this time, site properties will have acquired their own heterogeneity as a consequence of the different stages of vegetation development, from almost bare peat, in the sites most recently harvested to broadleaved woodland on the sites which had been harvested for some time. This heterogeneity, superimposed on the inherent variability in peat properties, will require management strategies ranging from the conservation of natural or semi-natural stands of broadleaves to site specific establishment techniques for commercial plantations.

Over the next five years or so, it is anticipated that the annual area becoming available for afforestation will be relatively modest, at about 400-500 ha. It will be post-2020 before larger areas become available. In time, the total area with forestry potential has been estimated by Bord na Móna to be between 16,000 and 20,000 ha. This area obviously excludes all cutaways which are currently being pumped to expel excess water or those which will not be drainable when they are taken out of production. However, even suitable cutaway units contain small areas which will not be suitable for forestry. This is to be expected as pockets of deep peat may be too wet for trees to successfully establish and perhaps might better serve as potential biodiversity, amenity, or wetland areas.

Inherent difficulties
Industrial cutaway peatlands are flat, bare, windswept areas and, at first glance, they appear to offer a uniform and relatively easy medium for afforestation. However, site conditions after peat harvesting has ceased are usually far from optimal for tree growth.

In order to understand these inherent difficulties, the formation of these raised bogs should be examined. As the ice retreated, some 11,000 years ago, the landscape of the midlands was characterised by glacial formations (eskers, drumlins) which impeded drainage and as a consequence, shallow lakes were formed. Most of these lakes became overgrown with aquatic plants over a short period. There was insufficient oxygen in the lake water to allow full decomposition, so partly decomposed plant litter accumulated to form peat. Given the right climate, hydrology and physiography, this basal fen peat (identifiable by the presence of macrofossils of the common reed (*Phragmites australis*) and the saw sedge (*Cladium mariscus*)) and the mosses growing on it, acted as water reservoirs, leading to an increasingly high water table. Over many millennia, peat accumulated in a dome shape above the influence of the inflowing mineral water and was supplied only by rain water. A raised bog was thus formed, dominated by *Sphagnum* moss. Initially, ombrotrophic (rain-fed) peat development was confined to swamp and fen areas, but in time it extended beyond the confines of the enclosed basins and onto the surrounding moraine.

Consequently, a cutaway peatland can display different kinds of peat/sub-peat mineral soil combinations depending on the original development of the bog. In a typical cutaway peat profile in the Irish midlands, the layer of ombrotrophic peat (*Sphagnum* or *Calluna* dominant) is either absent or very shallow, and it overlays minerotrophic peat (*Phragmites* peat or woody fen peat). Lake marl, blue clay or unweathered till are often found underlying the *Phragmites* peat, while silty clay and weathered till are found beneath woody fen peat. Because of the way in which the ice retreated, the sub-peat mineral soil present at the bottom of the peat layer undulates. The horizontal removal (through milling) of peat formed over a rolling terrain means that the remaining peat depth can vary greatly over short distances.

The variety of peat profiles across the 200 ha of the BOGFOR experiments confirms this heterogeneity of cutaways and the complexity of the reclamation process for forestry. The sites investigated have a peat thickness varying from 0 to over 2 m. Shallower and more homogeneous peat depths are found where the sub-peat mineral soil is clay, silt or sand. This is because the surface of glacio-fluvial clay, silt and sand deposits is more even and allows peat to be harvested closer to the surface of the sub-peat mineral soil. On the other hand, glacial drift can contain boulders of varying shape and size which can prevent further milling when exposed at the surface. As a result of this variation in thickness, the peat in which the trees are planted has variable properties over short distances, especially nutrient availability.

At another level, the combination of peat type and sub-peat mineral soil can present drainage difficulties. Following the cessation of peat harvesting, waterlogging will occur on most cutaways. To help ameliorate this situation, two aspects need to be considered: (i) the depth to which the level of the water table needs to be reduced, and (ii) the duration of drain maintenance that will be required. *Sphagnum* peat, particularly humified *Sphagnum* and deep *Phragmites* peat are more likely to be difficult to drain than a woody fen, which has a better pore size distribution and a higher non-capillary pore content and therefore a higher conductivity. As local drainage conditions typically vary within a site, depending on the bottom contour of the cutaway, test pit observations may be used to measure the state and movement of the water at different points. Before planning any new drainage system, input from those with the experience and knowledge of the locality should be sought.

Site suitability for commercial afforestation

Cutaway peatlands are highly spatially variable in terms of peat type, peat depth and hydro-physical properties and consequently in their tree productivity. From the BOGFOR trials, woody fen was found to be the most favourable site types for commercial afforestation, followed by *Phragmites* peat with a deep aerated peat layer. Deep *Sphagnum* peat sites (>1 m) were problematic for the growth of all species except the pines. The nutrient status of both Norway and Sitka spruce stands established in the late 1980s on *Sphagnum* peat, deteriorated over time with trees suffering from P deficiency before reaching 10 years of age (Renou-Wilson and Farrell 2007b). Wherever afforestation was successful, the sites displayed an adequate drainage system (i.e. suitable gradient and outlet leading to low water table all year around). Good drainage signifies an aerated medium. It was clear from the investigation of several sites over long periods that tree growth was positively correlated with the depth of aerated peat (Figure 1). Percentage aeration was measured in the field using the technique of rusting of steel rods (Carnell and Anderson 1986) as well as visual observations. Because a cutaway area will often display several combinations of site factors, the forester needs to assess the general quality of a cutaway site in order to test its suitability for afforestation.

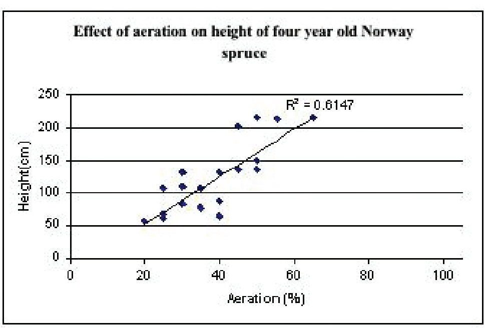

Figure 1: *Effect of percentage of aerated peat (total depth, 1 m) on the height of four year-old Norway spruce on cutaway midland peat.*

Table 1 provides a list of site indicators which can be used to assess the quality of a cutaway peatlands. The more 'good' qualities a site has, the greater is its forestry potential.

Table 1: *Indicators of site quality for the afforestation of cutaway peatland.*

	Quality scale	
Factor	Poor	Good
Drainage system	High water table with waterlogged areas	Low water table and drains cut into mineral soil
Aeration of peat	Orange/brown, anaerobic peat with H^2S smell	Dark brown aerated peat
Peat structure	Massive, dense	Granular
Exposure	Open, windswept land	Presence of wind barrier (e.g. older plantation)
Vegetation	Bare	Grass and shrubs

For site selection purposes, a detailed site survey is required. Soil characteristics (e.g. peat type, peat depth, sub-peat deposits, and permeability), hydrology (e.g. presence of outfall drains), climatic data (e.g. late spring frost frequency tables) and ecological features (e.g. vegetation) should be recorded for each site. Typically, peat depth and peat type should be sampled every 0.25 ha and drainage status should be determined under various weather situations (preferably during the winter). It is important that this database is dynamic, due to the difficulties with the phased timing of the peat fields becoming abandoned within a bog unit. While part of a cutaway may be withdrawn from milled peat production, it may not be available for afforestation for five years or more due to its location within the bog unit. During this time, natural vegetation may start colonising and drain infrastructure may start breaking down, creating waterlogged areas which then become unsuitable for afforestation.

Correct site appraisal is critical to the success of the forest enterprise, as it will provide reliable information which will help in the selection of management options, for example, site preparation and choice of species.

Species performance

While there is still little knowledge of the long-term performance of various species on cutaway peatlands, survival and growth results of a range of species tested in the field (Table 2) indicate that the following species can be generally regarded as suitable: Norway spruce, Sitka spruce (under a nurse crop), Scots pine, Corsican pine, hybrid larch, pedunculate oak, silver and common birch and common alder (see Table 2 for scientific names).

Table 2: *Species tested within the BOGFOR programme.*

Broadleaves	English name	Abbreviation	Latin name		Comments
Alder	Common alder	C. al	*Alnus glutinosa*	Native	Successful
	Italian alder	I. al	*Alnus cordata*		Successful
Ash	Common ash	Ash	*Fraxinus excelsior*	Native	Unsuccessful
Aspen	Aspen	Asp	*Populus tremula*	Native	Unsuccessful
Beech	European beech	Be	*Fagus sylvatica*		Unsuccessful
Birch	Silver birch	S. bir	*Betula pendula*	Native	Successful
	Downy birch	D. bir	*Betula pubescens*	Native	Successful, but not as good as Silver birch
Oak	Pedunculate oak	P. oak	*Quercus robur*	Native	Promising, under nurse crop especially
	Sessile oak	S. oak	*Quercus petraea*	Native	Unsuccessful
Poplar	Poplar	Pop	*Populus Beaupré*		Unsucessful
Maple	Norway maple	Map	*Acer plantanoides*		Unsuccessful
Sycamore	Sycamore	Syc	*Acer pseudoplatanus*		Unsuccessful
Conifers					
Larch	Hybrid larch	HL	*larix x eurolepis*		Successful, on dry sites only
	Japanese larch	HL	*Larix kaempferi*		Promising
Pine	Corsican pine	CP	*Pinus nigra var. maritima*		Successful
	Lodgepole pine	LP	*Pinus contorta*		Successful, but prone to Pine Shoot Moth
	Macedonian pine	PP	*Pinus peuce*		Successful
	Scots pine	SP	*Pinus sylvestris*	Native	Successful
Spruce	Norway spruce	NS	*Picea abies*		Successful
	Sitka spruce	SS	*Picea Sitchensis*		Successful, under nurse crop only
Cedar	Western red cedar	WRC	*Thuja plicata*		Unsuccessful, except in very dry sites
Yew	Irish yew	Y	*Taxus baccata*	Native	Unsuccessful

Field trial results

Since site conditions greatly affect tree growth, species trial results varied greatly across the range of sites investigated within the project. Filling-in was carried out after the first growing season only. Three site types are discussed below.

Site type	*General site description*
1	*Phragmites peat with both deep and shallow areas and good gravity drainage.*
2	*Woody fen peat, with both deep and shallow areas, good drainage and good aeration.*
3	*Sphagnum over Phragmites peat, mostly deep peat, good surface drainage but limited aeration.*

Site type 1 (Blackwater cutaway bog): Phragmites peat with both deep and shallow areas and good gravity drainage

The survival of all the broadleaved species was excellent after the first (>90%) and fourth year (100%) (Figure 2). Silver birch and common alder were the tallest trees after four years and had the greatest growth rate (Figure 2). Silver birch performed better than downy birch at this site. Sessile oak suffered from leader die-back and, like sycamore and ash, growth was disappointing. Aspen was the third fastest growing species after alder and silver birch. All the aspen, birch and alder trees were very healthy.

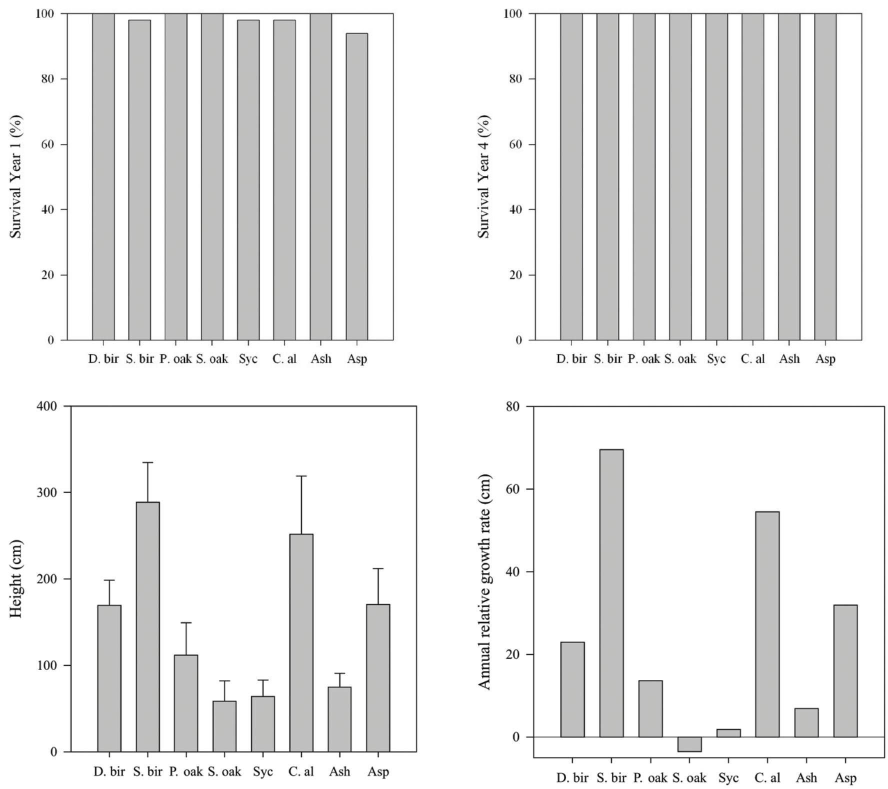

Figure 2: *Survival and height after four growing seasons and annual relative height growth rate of broadleaves at Blackwater cutaway bog (see Table 2 for species abbreviations).*

The survival of all conifer species in this trial was also excellent after one (>80%) and four years (95%) (Figure 3). Hybrid larch and western red cedar were the tallest conifers growing on this site (Figure 3) after four years. Of the pine species, Corsican and Scots pine displayed remarkable growth and were very healthy. Yew survived well, and is still growing, but all trees are in very poor condition.

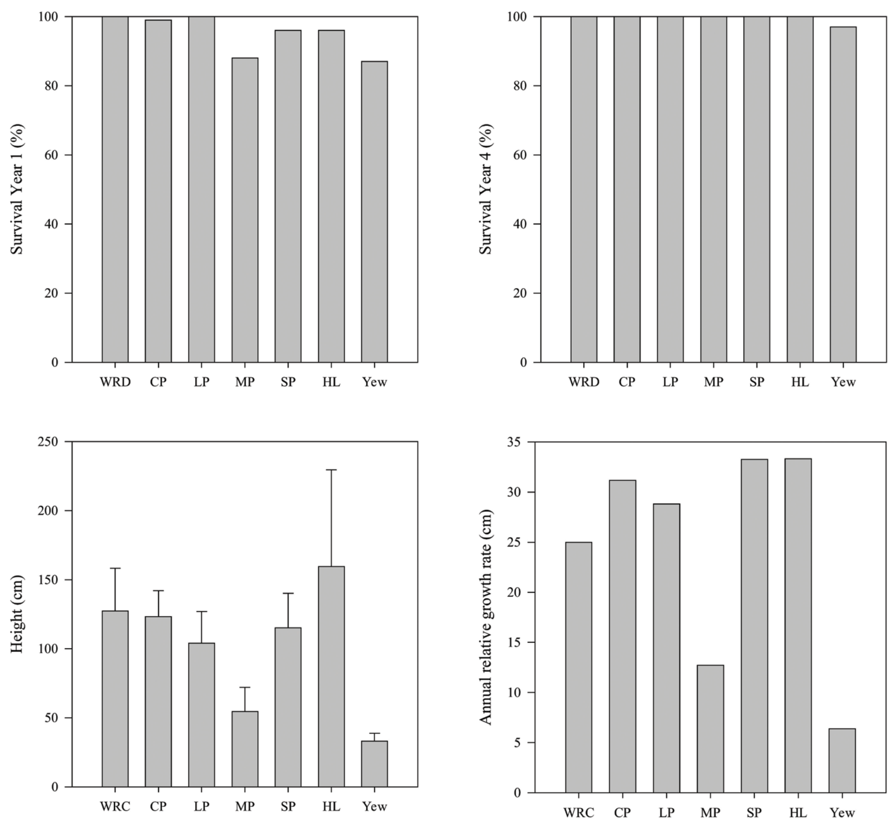

Figure 3: *Survival and height after four growing seasons and annual relative height growth rate of conifers at Blackwater cutaway bog (see Table 2 for species abbreviations).*

<u>Site type 2 (Mount Lucas cutaway bog): woody fen peat, with both deep and shallow areas, good drainage and good aeration</u>

Survival rates of all broadleaved species were good after one year (>90%) but decreased subsequently, especially in beech (Figure 4). Sessile oak, beech and sycamore suffered severely from leader die-back, and although many trees were alive, almost all had lost their leading shoots. Norway maple growth was also mediocre. Poplar and common alder were the tallest broadleaves (Figure 4). Relative to height at planting, common alder had almost double the relative growth rate (RGR) of the Italian alder.

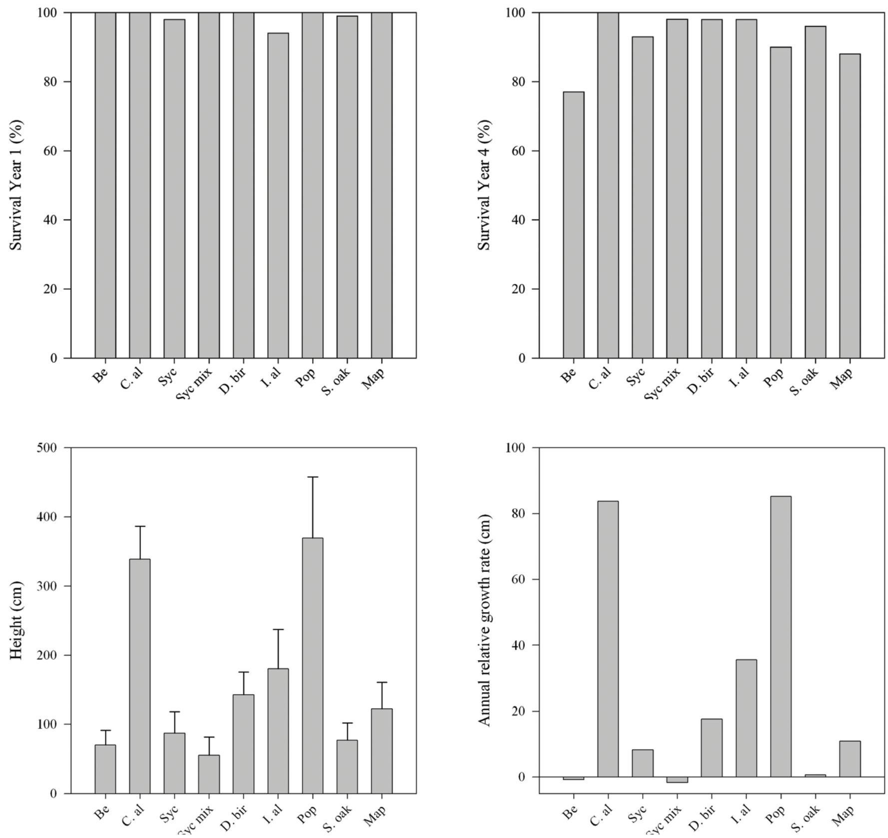

Figure 4: *Survival and height after four growing seasons and annual relative height growth rate of several species of broadleaves in Mount Lucas cutaway bog (see Table 2 for species abbreviations).*

All conifer species survived well at Mount Lucas (>90%), except for hybrid larch which had only 18% survival after one year (Figure 5). Subsequently, one plot was replanted with alder and the second plot filled-in with hybrid larch. The latter had 65% survival after three growing seasons and grew reasonably well. Corsican pine and Scots pine displayed the highest growth rate over the four-year recording period and were very healthy (Figure 5). Western red cedar had also good growth. Yew had good survival but height growth rates were low.

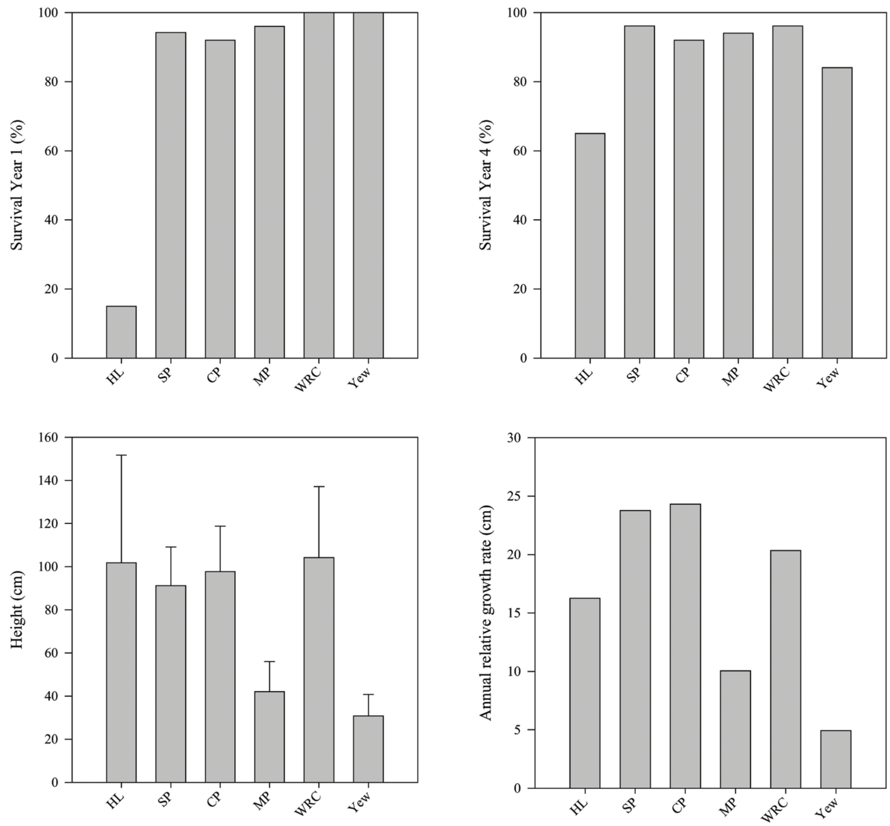

Figure 5: *Survival and height after 4 years and annual relative growth rate of conifers planted at Mount Lucas cutaway bog (see Table 2 for species abbreviations).*

<u>Site type 3 (Tumduff cutaway bog): Sphagnum over Phragmites peat, mostly deep peat, good surface drainage but limited aeration</u>

All species, except Japanese larch, had average survival rates above 75% after year one (Figure 6). Japanese larch performed poorly on this site (less than 20% survival), probably due to wet ground conditions. Sitka spruce height growth was double that of Norway spruce but not as good as most pine species (Figure 6). Corsican pine was the tallest and had the greatest annual RGR. All the four pine species looked healthy after four years growth. Western red cedar was severely damaged by hares as well as being prone to disease. The low height growth is also likely to be the result of winter desiccation damage. Severe leader loss meant that most of these trees were smaller after four growing seasons than after the first year. Many trees, especially the spruce, appeared to be suffering from heather check (Carey 1977).

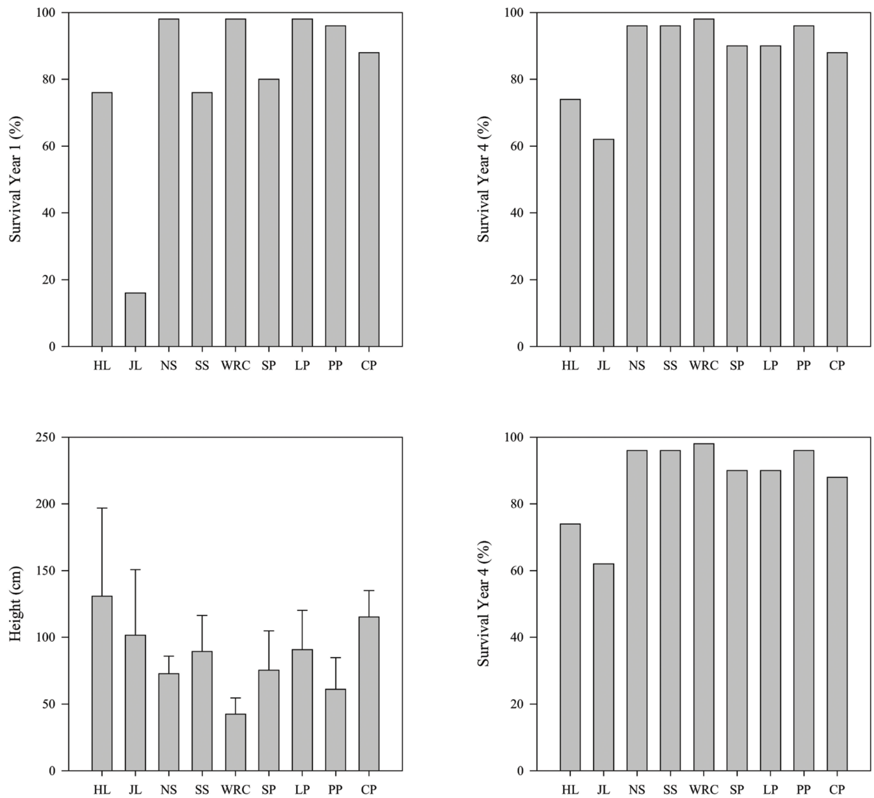

Figure 6: *Survival and height after four growing seasons and annual relative growth rate of several species planted at Tumduff cutaway bog (see Table 2 for species abbreviations).*

Species notes

Norway spruce and Sitka spruce

Data from the BOGFOR field trials suggest that Norway spruce is the species best suited to commercial forest production on the cutaways. The main reason why it should be selected in preference to Sitka spruce is its reduced susceptibility to late spring frost damage. Even within crops of Norway spruce, however, it is very evident that early flushing individuals are more prone to frost damage and are generally not as tall as trees which flush later. Late-flushing provenance material should be used to reduce the risk of frost damage. The best provenances of Norway spruce for use on the midland cutaways are from central Europe – Poland, the Czech Republic and possibly Slovakia which combine late flushing with good growth. Survival rates for Norway spruce were reduced in very exposed sites. Older plots of Norway spruce growing on cutaway peatlands have developed healthy, well-formed canopies and are fairly uniform in size.

In the BOGFOR field trials, the best Sitka spruce growth was recorded under self-sown birch. The key to the success of this system, however, is the timely and effective removal of the 'whipping' birch once its sheltering effect is no longer required. Sitka spruce can thrive on cutaway peatlands, but there is a higher risk of damage from late spring frost than with other species. Therefore, Sitka spruce should not be planted on cutaway peatlands without shelter from a nurse crop. Differences in date of bud flushing among provenances of Sitka spruce are insufficient to provide the potential to reduce damage levels through provenance selection (Thompson et al. 2005).

Pines

In the 1980s and early 1990s, lodgepole pine was the second most commonly planted species on the cutaways. Although considered a low risk choice, because of the low risk of spring frost damage and its low nutrient demand, it rarely produces high-value material. The incidence of pine shoot moth in many Irish midlands sites is an added problem, so the species is now ranked lower on the recommendation list.

Scots pine is a good pioneer species for the cutaway peatlands, especially on the poorest acidic sites. It is very frost-hardy and could be used as a nurse species. Stem form tends to be poor and tree health can deteriorate very quickly on very exposed sites. On suitable sites however, it can produce higher growth rates than spruce and other pine species. The best establishment success is likely to be achieved using small planting stock. Because Scots pine is a strong light-demander, good vegetation control is required to maximise field performance. Scots pine is less susceptible to pine shoot moth than lodgepole pine but will get infested if there are high infestation levels in area. Several older plantations on cutaway peatlands have suffered from unexpected die-off for no obvious reasons, so careful monitoring of established plantations is recommended to confirm the usefulness of this species on cutaways.

As well as having all the advantages of Scots pine, Corsican pine has the added attribute of tolerating exposure quite well. It also tends to produce straighter stems than Scots pine. It is less liable to be attacked by hares and rabbits and also shows resistance to damage from pine shoot moth. In order to ensure satisfactory survival, it is recommended to use containerised stock planted during late spring/early summer. Corsican pine has a role on cutaway peatlands but long-term monitoring is required to verify its performance potential beyond the juvenile phase.

Macedonian pine survived very well on cutaway peatlands but displayed slow growth compared to Scots and Corsican pine. Vegetation control may be required for up to four years after planting. It has two major advantages: firstly it is a good pioneer species with a well-developed deep root system. This means that it can, in effect, improve raw deep peat soils. Secondly, Macedonian pine appears to be attacked by fewer insects than other pines. Growth rate usually increases after 6-10 years, making this species particularly promising for cutaways.

Larch

Both hybrid and Japanese larch displayed the lowest survival rates of all the planted species, but there was much variation among and within sites. As the dwarf-shoot buds flush very early in season, hot-planting (i.e. planting the seedlings immediately after being lifted from the nursery beds) should be completed by early March. However, planting directly in cold wet conditions has resulted in high plant mortality. Larch has also suffered from late spring frost damage. The use of containerised larch offers the opportunity to delay planting until the risk of frost is reduced. Containerised seedlings are likely to grow more quickly, so they may emerge above the frost layer sooner.

On well-drained woody fen peat, both larch species grew very fast but, as expected, hybrid larch was the more productive. This rapid early growth makes it very useful as a nurse species. While its use may be limited, its growth is sufficiently promising to justify further planting on appropriate sites. Generally, waterlogged areas and frost hollows are unsuitable for larch. It should also be avoided on shallow peat soils.

Western red cedar

Great variations in growth were encountered with this species across different sites. Western red cedar seemed to suffer adversely from wind exposure (discolouration and reduced needle size) as well as browsing damage which render it unsuitable for planting on most cutaway peatland sites. On more sheltered sites, best development is probably to be expected on shallower peat sites.

Oak

Of the two native oak species, sessile oak is less suitable for cutaway peatlands. Pedunculate oak has shown potential on some areas, particularly those which are relatively fertile and sheltered from exposure (Renou-Wilson et al. 2008b). Exposure is a big problem on the cutaway peatlands, and when severe, oak can suffer from critical leader die-back. In our field trials, however, oak grew back quite well once other species had established around it. It is thus preferable to grow oak in mixture with a fast-growing species, but considerations should be given to the mixture species and spacing. Oak is not suitable in frost hollows, on poorly drained peat, very infertile peat and very shallow peat where the sub-peat mineral soil is essentially unweathered. In addition to the above factors, a hare-proof fence is essential if the species is to grow well on cutaway peatlands.

Birch

Birch species had high survival rates and established quickly on cutaway peatlands (Renou et al. 2007). Of the two native species B. *pendula* is the superior species, displaying both quick growth and reasonable form. In all cases, browsing and vegetation competition will need to be controlled, especially if small seedlings are planted. Birch is a pioneer, and as such, is a key species in ecosystem development which can broaden options for future uses of the cutaways, such as for biomass production.

Alder

Of all species planted on cutaway peatlands, common alder has been the most productive. Unlike all other species, it also demonstrated a relatively uniform growth over different site types. Alder grew well on acidic peat but also on the more shallow woody fens. It did not suffer from exposure and because of its fast early growth, very little vegetation control was required. As with all broadleaves, it requires adequate protection against hares. Alder is probably the best species with which to quickly establish forest cover or shelter on cutaway peatlands. It has soil-improving attributes due to its vigorous fibrous root system and its capacity to fix atmospheric nitrogen. This makes alder a particularly useful nurse species for growing in mixture with more commercial species such as spruce (Schaible 1992). Because of its coppicing ability, alder can also play a role in biomass production.

Other species tested on cutaways

Aspen and ash showed relatively good (but slow) growth rates and neither can be excluded as potentially suitable for planting on cutaways. Both sycamore and beech are unsuited to cutaway peatlands where they suffered high levels of mortality, apparently due to late spring frosts and exposure damage. In particular, they performed poorly on very acidic *Sphagnum* peat. Beech is also very susceptible to browsing by hares. Although not considered a commercial species, yew survived on all sites but its growth rate was very low. It may, however, have a role to play as part of a native woodland scheme or for biodiversity.

Notes on tree establishment

Early results from field trials showed that direct seeding of birch or alder was not successful; shelter and fertilisation seem to be critical to improve emergence and survival. Planting seedlings from cold storage in April/May is likely to be successful on such sites. Later planting would delay fertilisation which has been found to be environmentally detrimental in terms of nutrient leaching (Renou-Wilson et al. 2008a).

It has been ascertained that the application of phosphatic fertiliser is critical for the survival of new plantations on cutaway peatlands. Research to determine the optimum fertiliser levels for various peatland types have been the subject of a number of studies (Carey et al. 1985, Renou and Farrell 2004, Renou-Wilson and Farrell 2007a, Kaunisto and Aro 1996) but are beyond the scope of this paper. Some other BOGFOR research work carried out on Norway spruce stock on a cutaway site showed that good quality small bare-root or containerised seedlings had greater growth rates than large bare-root stock (Renou-Wilson et al. 2008a).

Protection of broadleaves from hares is critical, so fences must be well maintained throughout the first three years following planting.

Norway spruce, Sitka spruce and oak performed best when planted under nurse crops of birch, alder or hybrid larch but attention must be given to subsequent management (e.g., timely vegetation control and pruning of a whipping nurse crop). Any nurse crop (natural or planted) should reach a sufficient height (5 m tall) and density before underplanting.

Conclusion

The results of the BOGFOR project showed that a wide range of conifer and broadleaved species were suitable for planting on cutaway peatlands. This means that the forester has the opportunity to create a range of forest types, most of which are likely to be ecologically sustainable and varied landscapes with the potential to provide other options at a later date. The variation in site conditions encountered in any given cutaway peatland means that, not one, but several species might flourish within a given area.

It is important that the monitoring of the BOGFOR trials and demonstration areas should be continued to verify the promising early findings. A phased approach to the afforestation of cutaways peatlands is needed, with due consideration to wider land-use issues.

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