

SUSTAINABLE MANAGEMENT OF SCOTS PINE IN THE NORTHERN PERIPHERY



SILVICULTURAL GUIDANCE NOTE 3 - Establishing Scots pine forests

Introduction

This Guidance Note is one of a series produced as part of the **Northern Periphery Programme** (NPP) “**Developing Scots Pine**” project. These Notes seek to add value to the future Scots pine resource by encouraging growers to invest in economically effective and ecologically sustainable forest management leading to the production of high quality timber. The publication “Growing Scots Pine for Quality Timber” (Worrell and Ross, 2004) provides a useful overview of the issues involved.

In this note we give advice on best practice for the establishment of new Scots pine forests and the replanting of existing stands. It has been estimated that over 80% of all Scots pine forests in Scotland are regenerated by planting (Mason, 2000); getting the planting operation right is the first step in establishing stands that will produce high quality timber in the future. Here we consider the key decisions and operations involved in successful establishment: these include stocking density, ground preparation, choice of planting stock, plant handling and planting, fertiliser application and weed control. Information relating to natural regeneration of Scots pine stands can be found in **Guidance Note 4** on that subject.

Stocking density

The initial spacing of trees at planting has a direct impact on the log quality and wood properties of Scots pine (e.g. Agestam et al., 1998). Trees planted at wider initial spacing tend to have increased stem taper, bigger knots, reduced average density, higher grain angle, a greater proportion of juvenile wood¹ and poorer stem straightness, resulting in sawn timber with inferior mechanical properties and dimensional stability compared to that from more densely stocked stands. Wider spacing also means that there are fewer trees to select amongst when thinning.

In Scotland the required stocking density at establishment for productive Scots pine forest in the **Woodland Creation Grant** (under the **Scotland Rural Development Programme**, SRDP) is 3000 stems/ha, which equates to an initial spacing of 1.8m x 1.8m if a square planting pattern is used. Alternatively, on level sites forest managers may wish to plant more closely in the rows and to widen spacing between rows to allow machine access for weeding: spacing of 2.4m x 1.4m, or 2.2m x 1.5m will achieve the required stocking of 3000 stems/ha. Meeting the target stocking density will help to set the foundations for the subsequent production of high quality timber. Where the planted trees are supplemented by natural regeneration of Scots pine or other compatible species (e.g. birch, rowan), the further increased stocking density will be beneficial to future timber quality. However, achieving dense initial stocking is only the first stage in producing high quality timber: selective thinning to concentrate growth on the best quality stems will be required to deliver the most valuable sawlogs, as outlined in **Guidance Note 5**.

Where Scots pine stands are established as **native woodlands**, the required stocking density for the woodland creation grant is 1600 stems/ha. However, Mason et al. (2004) suggest that where a native woodland site has the potential to produce good quality timber there is the option to plant a proportion at much closer spacing to safeguard timber quality and provide future revenue, with clumps of trees at wider spacing established between the denser areas to provide open space and edge habitats.

¹ Juvenile wood can be defined as the zone of wood extending outward from the pith where wood characteristics undergo rapid and progressive changes in successively older growth rings (Larson et al., 2001). It is characterised by low density, thin cell walls, short tracheids with large lumens, high grain angle and high microfibril angle, resulting in low stiffness and strength and poor dimensional stability.

Choice of seed origin and planting stock

Choosing the best planting stock for a particular site is a key factor in the production of high quality timber: material with inherently good stem form and light branching should be sought. The use of genetically superior planting stock can have an impact on survival, growth rate (which can affect establishment success), susceptibility to pests and diseases as well as timber quality – all of which affect profitability.

For Scots pine the best available material comes from seed orchards, which currently offer gains of 8-12% in diameter growth and a small gain in stem straightness, relative to seed from a registered seed stand. Greater gains (14-20% in diameter and 5-19% for stem straightness) are potentially available if there was sufficient demand for the establishment of new seed orchards (Lee, 1999; 2002). If seed orchard material is not available, then planting stock from local registered seed stands should be obtained. Details of available seed origins are provided on the Forestry Commission's **National Register of Approved Basic Material for Great Britain**.

The use of improved and selected planting stock is restricted in or adjacent to any designated area with regard to woodland conservation, and in particular to native pinewood areas. The Forestry Commission Guidance **Seed Sources for Planting Native Trees and Shrubs in Scotland** specifies the current requirements for woodland establishment or restocking on or adjacent to **Caledonian Pinewood Inventory (CPI)** sites, other woodland **Sites of Special Scientific Interest (SSSI)** and **Special Areas of Conservation (SAC)**. Natural regeneration is the preferred method in native pinewoods. Where planting is agreed within a core area, or in any regeneration or buffer zone, indigenous origin material originating from the same native pine seed zone will be required. When planting is outwith any pinewood core area, regeneration zone, or buffer zone, but the objective is still establishment of a native pinewood, the use of selected, qualified or tested material from within the same pinewood zone, or a nearby zone wherever possible, is preferred. For further guidance, see the Forestry Commission's **Practice Guide to the Management of Semi-Natural Pinewoods** (Forestry Commission, 2003) which describes the policies and best practice for management in relation to existing native pine woodlands.

Scots pine plants are available as either bare-root (generally 2 year old transplants or undercuts) or containerised stock that is 12-18 months old. Mason (2000) estimated that about 70% of all Scots pine planting was with bare-root stock. Good communication with the nursery can reap significant benefits for a forest manager in both certainty of supply and cost. Nurseries may not hold substantial stocks of the particular plants required, given the costs of investing in seed and cultivation. Material may be supplied at a better price (up to 30% cheaper) if a supply contract is agreed with the nursery at least two years ahead of planting.

Ground preparation

Appropriate ground preparation is a key factor in the successful and cost-effective establishment of a stand of trees. A suitably prepared planting site will enable faster and easier planting, in easily identifiable locations at the correct stocking density. Improved planting positions will promote better survival, faster growth and lower plant losses. Ground preparation techniques should be considered as soon as possible during the planning phase, and for restocking sites even in advance of felling the

current crop. It is essential to have walked the site in advance and to have dug holes in a number of places to check the soil types present and to identify any features that will require special attention e.g. the presence of an ironpan.

Detailed guidance relating to ground preparation can be found in Forestry Commission Bulletin 119: **Cultivation of Soils for Forestry** (Paterson and Mason, 1999), and Forest Research Technical Development Branch Information Note OD10.01: **Forest Ground Preparation** (Forestry Commission, 2002a). FC Technical Note FCTN008: **Excavator Mound Spacing on Restocking Sites** (Morgan and Ireland, 2004) also provides useful guidance on individual mound specification and getting the correct spatial distribution to achieve the right stocking density. The **Establishment Management Information System** (EMIS) can be used to inform choice of ground preparation approach on the basis of soil type, site slope and species being planted.

It will almost always be necessary to undertake some form of ground preparation in order to achieve a planting site free from competing vegetation, and (on some soils) to remove a top layer of peat and humus to expose the mineral soil in which to plant. Most typical pine sites (freely draining mineral soils) will normally require scarification (Figure 1) or shallow mounding (Figure 2). Sites that have an iron-pan soil, or compaction from past agricultural cultivation, will also require sub-surface ground preparation if the compacted layer has not previously been broken up. Ripping the site, using a plough tine (i.e. without a mouldboard) set to the appropriate depth is the method normally recommended for breaking up any shallow-depth iron pan or compaction. An alternative is Rotary Spot Cultivation, a recently developed method using a vertical, rotating, tined cultivator mounted on a standard excavator, harvester or forwarder head. The technique prepares a clear, weed-free, planting position and cultivates the soil to a depth of 50-70 cm removing any iron pans or compacted layers. This has been shown to make planting easier, promote good early root establishment, and result in more rapid early growth. It also has the advantage of preparing only the exact planting location, and leaving a level (i.e. un-mounded) site, which may be important in locations that are sensitive in terms of amenity and landscape. This method is not yet in widespread use in the UK.

Work should be timed to avoid the wettest periods of the year, to prevent soil damage. A period of at least two months should be allowed between cultivation and planting to allow for settling of the cultivated ground that will occur.



Figure 1: *Disc scarifier*



Figure 2: *Mounding*

If tall, thick or aggressive vegetation is present (as may be encountered on some acidic grassland sites, particularly with bracken), a pre-plant spraying with a suitable herbicide should be considered. Heathland sites (especially those where natural regeneration is to be encouraged) may benefit from controlled burning prior to planting, where suitable skilled labour and equipment is available (e.g. by game management staff). The rate of burn should be controlled: slower burning fires are likely to achieve a more effective vegetation kill and remove a greater depth of moss and organic litter from the surface. Burning should be avoided on acid grassland sites, as it will encourage more vigorous re-growth of competing vegetation, and on any areas of deeper and drier peat as these may catch fire and be difficult to extinguish.

Mammal Control

Damage by mammals, most commonly browsing of the main leader and fraying / stripping of the bark by deer, must be controlled to ensure successful growth and future timber quality of planted Scots pine, which is more palatable to deer than spruce and which remains vulnerable for longer. High browsing pressure will lead to a longer establishment phase, greater variability in stocking, and a higher proportion of forked and poorly formed main stems.

It will often be necessary to erect deer fencing where populations are high or control of numbers by culling is not an available option. Full guidance on fencing can be found in Forestry Commission Technical Guide 2 **Forest Fencing** (Trout and Pepper, 2006). Deer fences present a very significant collision and injury risk to grouse and capercaillie. Appropriate guidance with regard to the location, specification, and any necessary marking should be obtained before erecting fences in areas where these species may be present (see Trout et al. 2001 and Forestry Commission, 2001).

Planting

Detailed guidance relating to the supply and planting of tree seedlings can be found in Morgan (1999). A summary of the key issues is given here.

Timing of planting

After clearfelling, replanting should generally be carried out as soon as possible to minimise weed competition (although this may be less critical on less fertile sites). However, up to at least three years after clearfelling, Scots pine is highly vulnerable to bark damage from Pine weevil (*Hylobius abietis*). This can lead to very significant economic losses. Both planted and naturally regenerated crops are affected, but weevil can be more problematic in planted areas where stocking density is relatively lower, and softer (more palatable) nursery-raised plants are present. If effective monitoring and chemical control of weevils will not be possible, then managers may consider delaying replanting by about five years to allow populations to naturally decline. The **Hylobius Management Support System** can be used to inform decisions regarding all aspects of weevil control, including timing of planting.

Bare-rooted nursery stock must be planted when plants are still naturally dormant, typically from November until March. Container or cell-grown trees can be planted at any time of the year if necessary, but will require monitoring and watering during any periods of drought in the planting year. Note that soil

moisture conditions are more critical than planting date, so you should consider the likelihood of early drought conditions or late frosts (particularly in lighter soils) when programming planting work, and incorporate a degree of flexibility with regard to delivery and planting if at all possible.

Plant Handling

Careful plant handling during transportation and storage is required to ensure a successful planting operation. Poor plant handling damages plants causing losses and slower establishment. Bags of bare root plants should not be dropped, thrown or stacked up and should be protected from high temperatures and frosts below -2 °C. Young trees should be planted as soon as possible after delivery and should not be kept in bags for longer than three weeks.

Planting Techniques

Poor planting techniques can cause significant problems for the future growth and quality of newly planted Scots pine. Careful planting is required to ensure that root systems develop properly thus ensuring healthy tree establishment and future stability. Permanent root architecture distortion and associated growth, stability and stem form problems can result from poor planting. A straightforward summary of good practice for handling trees and the various planting methods available is presented in the Forest Research Technical Development Branch Information Note **Tree Planting** (Forestry Commission 2002b). Figures 4 and 5 below illustrate recommended best practice for manual planting of trees.

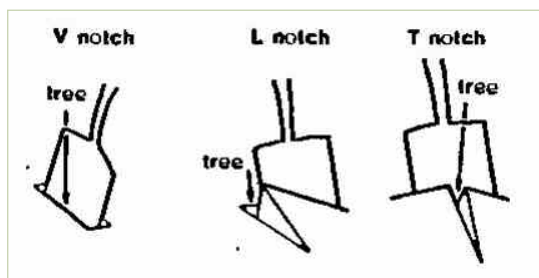


Figure 4: Notch planting methods (Reproduced from Forestry Commission, 2002b)

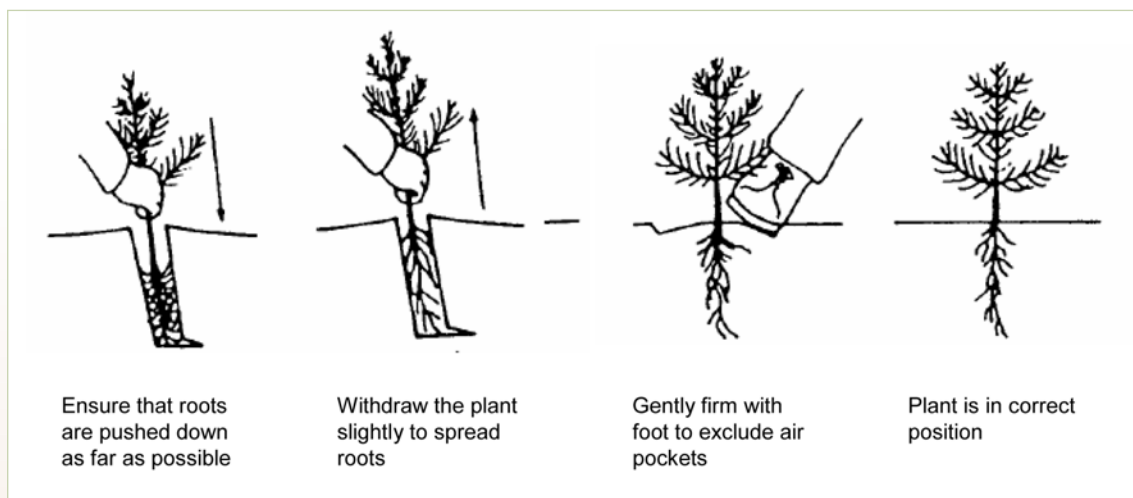


Figure 5: Recommended planting technique (Reproduced from Forestry Commission, 2002b)

Fertiliser application

Full guidance on the use of fertilisers in forest management in Britain can be found in Taylor (1991). Phosphate fertiliser is generally applied by hand when new Scots pine stands are being established, at the rate of c 60 kg of phosphorous per hectare (Mason, 2000). Fertiliser is not usually required when restocking existing stands following clearfell.

Weed Control

Weeds affect establishment success by competing with trees for moisture, nutrients and light. Competitive vegetation can cause physical damage, severe growth suppression and death, particularly when trees are very young. On wetter sites in the uplands, competition from weeds for nutrients or light are likely to be important factors, whereas on typical drier Scots pine sites competition for moisture may be the dominating concern. In all situations adequate weed control is important for establishment success, although the actual weed species present, their relative growth rates and hence the amount and nature of weeding operations that may be necessary will vary considerably depending on location.

Extensive guidance on all aspects of chemical weed control can be found in the Forestry Commission Field Book 8: **The Use of Herbicides in the Forest** (Willoughby and Dewar, 1995; updated in Forestry Commission Technical Paper 28: **Herbicide Update**, Willoughby and Clay, 1999). Reference should also be made to Forestry Commission Practice Guide No. 15 (Willoughby et al. (2004), which sets out a structured procedure for assessing requirements using a core decision chain, aimed at minimising the cost and environmental impact of control measures. Further information can be found through the online **herbicide advisor** system and in the Forestry Commission web pages relating to **pesticides**.

Typical Scots pine sites do not usually suffer from high competition from ground vegetation, as soils are generally of lower fertility and adjacent dwarf shrub vegetation has usually been disturbed by pre-planting cultivation or burning. Where plantations have been established on acid grassland, bracken (*Pteridium aquilinum*) may require control (both pre and post-planting). Established and regenerating bracken can be successfully controlled by applications of Asulox (active ingredient Asulam). The manufacturers, United Phosphorus Ltd, publish a useful on-line **Guide to Bracken Control**. Note that young Scots pine and other tree species may exhibit chlorosis and experience some early growth check if exposed directly to Asulox when actively growing (which they will be during the relatively short season when bracken is susceptible, i.e. late July / early August).

Whilst undertaking chemical control is likely to be the most effective method, use may be restricted, particularly on SSSIs. Bracken can be successfully controlled by repeated cutting or whipping, but note that it may take two or more interventions to do this successfully. You should also be aware that any mechanical ground cultivation can actually lead to denser or more vigorous re-establishment of bracken (as the broken rhizomes regenerate). Any cultivated sites should be monitored for the presence of any invasive species such as Rosebay willowherb (*Chamerion angustifolium*), or non-crop tree species.

Decision Support System

To support the establishment and management of Scots pine forests in the Northern Periphery area of Scotland, Forest Research has developed the “Scots Pine Management Support System”. This programme links existing decision support tools (**Ecological Site Classification (ESC)**, **Establishment Management Information System (EMIS)** and **ForestGales**) with newly developed Scots pine timber quality models to evaluate the impact of site factors and management alternatives on the volume and quality characteristics of Scots pine timber.

The Scots Pine Management Support System is an online tool that users can access either from a link on the project web-page (www.pineinfo.eu) or by following this link:

<https://www.eforestry.gov.uk/forestdss/?app=spdss>. Use of the DSS is free, although users are required to register when they access the programme for the first time (in this way registered users can be informed of any updates to the programme).

Users can choose from two initial options:

1. **Establishing Scots pine forests** - for guidance on planting a new area of Scots pine woodland or restocking an existing, mature forest by replanting or natural regeneration.
2. **Managing Scots pine forests** - for guidance on management of existing Scots pine forests.

Throughout the programme the user is provided with links to relevant sources of additional information, including these silvicultural guidance notes.

Establishing Scots pine forests - summary of key points

- Stocking density is a key determinant of future timber quality: aim to achieve 3000 stems/ha
- Using selectively bred planting stock from seed orchards will provide improved growth and stem form
- Appropriate ground preparation is essential to facilitate planting, improve survival and promote early growth: the site must be carefully assessed to determine requirements
- Careful plant handling and planting are required to ensure optimal early growth and establishment, including good root architecture development which will promote future stability
- Adequate control of browsing mammals, mainly deer, is necessary to minimise losses and avoid damage which will result in forked and crooked stems
- Fertiliser application and weed control should be used as needed according to site conditions

References

- Agestam, E., Eke, P.-M. & Johansson, U. 1998. Timber quality and volume growth in naturally regenerated and planted Scots pine stands in S.W. Sweden. *Studia Forestalia Suecica* 204. 17 pp. ISSN 0039-3150. ISBN 91-576-5555-3.
- Forestry Commission (2002a). Forest Ground Preparation. **Technical Development Branch Information Note ODW 10:01**. Forestry Commission, Dumfries.
- Forestry Commission (2002b). Tree Planting. **Technical Development Branch Information Note ODW 10:02**. Forestry Commission, Dumfries.
- Forestry Commission Scotland (2001). Deer and fencing. **Guidance Note 11**. Forestry Commission, Edinburgh.
- Larson, P. R.; Kretschmann, D. E.; Clark, A. III; Isebrands, J.G. 2001. **Formation and properties of juvenile wood in southern pines: a synopsis**. Gen. Tech. Rep. FPL-GTR-129. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 42 p.
- Lee, S.J., 1999. Genetic gain from Scots pine: potential for new commercial seed orchards. **Forestry Commission Information Note No 27**. Forestry Commission, Edinburgh.
- Lee, S.J. (2002) Selection of parents for the Scots pine breeding population in Britain. **Forestry, Vol 75, No. 3 293-303**.
- Mason, W.L. 2000. Silviculture and stand dynamics in Scots pine forests in Great Britain: Implications for biodiversity. **Invest. Agr.: Sist. Recur. For.: Fuera de Serie n.o 1-2000, 175-197**.
- Mason, W.L., Hampson, A. and Edwards, C. (2004). Managing the Pinewoods of Scotland. Forestry Commission, Edinburgh.
- Morgan, J. L. (1999) Forest Tree Seedlings – best practice in supply treatment and planting. Forestry Commission Bulletin 121. Forestry Commission, Edinburgh.
- Morgan, S. and Ireland, D. (2004). Excavator mound spacing on restocking sites. **Forestry Commission Technical Note FCTN08**. Forestry Commission, Edinburgh.
- Paterson, D. B. and Mason, W. L. (1999). Cultivation of soils for forestry. Forestry Commission Bulletin 119. Forestry Commission, Edinburgh.
- Taylor, C.M.A. (1991). Forest fertilisation in Britain. Forestry Commission Bulletin 95. HMSO, London.
- Trout, R.C. and Pepper, H.W. (2006). **Forest fencing**. Forestry Commission Technical Guide, Forestry Commission, Edinburgh.
- Trout, R.C., Quine, C.P., Dugan, D. and Summers, R. (2001). **Alternative deer fences in core capercaillie and black grouse habitats**. Forestry Commission/RSPB Interim Guidance Note. Forestry Commission, Edinburgh.
- Willoughby, I., Evans, H., Gibbs, J., Pepper, H., Gregory, S. and Dewar, J. 2004. **Reducing pesticide use in forestry**. Forestry Commission Practice Guide No. 15. Forestry Commission, Edinburgh.
- Willoughby, I and Clay, D. 1999. **Herbicide Update**. Forestry Commission Technical Paper 29. Forestry Commission, Edinburgh.
- Willoughby, I. and Dewar, J. (1995). The use of herbicides in the forest. Forestry Commission Field Book 8. HMSO, London.
- Worrell, R. and Ross, I. 2004. Growing Scots pine for high quality timber (2nd Edition). Cairngorms National Park Authority, Grantown-on-Spey, Scotland.

For further information about the “Developing Scots Pine” project, visit: www.pineinfo.eu

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