Technical Note TN592

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# Plants & Planting Methods

## SUMMARY


- **Select the appropriate plant type for your planting programme and method of planting. Cell grown trees can extend your planting season but are more expensive to purchase.**
- **Plant size is not as important as quality. Be realistic: larger plants may look attractive and create instant impact but size is not a reliable indication of speed of establishment.**
- **Always match species to site conditions and use plants with a suitable origin or provenance, failure to do so could result in widespread losses.**
- **Mixtures can speed establishment and improve the conservation and amenity value of a woodland, but careful selection and management is critical for success.**
- **It can be advantageous to prune certain species before planting. In particular shrubs and willow species benefit as this treatment encourages a dense growth habit.**
- **Always handle plants with care and never allow their roots to dry out. Trees should never be slit-planted; use an L, T, or V-shaped notch. Machine planting is quick, but is only suitable for certain sites. It is not always cost effective on smaller or less densely planted areas.**
- **Tailor plant spacing to your objectives, using denser spacing for timber production and to achieve rapid establishment and lighter spacing for amenity planting and to achieve more natural edges.**


## Introduction

The selection of quality plants and their method of planting will be vital for successful establishment. Trees grow in the same location for hundreds or in some case thousands of years and during this time they are exposed to many dangers. The most critical period, however, is usually during the first five years of growth.

# Plant Types

There are three main types of plants:

- **Bare Rooted Plants**

Bare rooted plants are, as the name implies, sold with no soil around their roots. Being generally cheaper than cell grown plants, they are often the more popular choice. Most common woodland species can be bought as bare rooted stock. They can only be handled and planted when the tree is dormant, usually from late November to early April.

The disadvantage of using bare root stock is that some root damage during handling and planting is unavoidable. This can cause stress or checking (poor or very slow growth) after the tree is planted. Some species, such as birch, Douglas fir and Corsican pine, have very delicate roots and may suffer relatively high losses when planted as bare rooted stock.

The main problems encountered with bare rooted stock arise from roots being allowed to dry out, even for very short periods of time, or damage from rough handling. Bare rooted plants should always be delivered in co-extruded polythene bags; these are black on the inside and white outside. These help reflect the heat of the sun and insulate against frost. They also make handling easy and convenient, and, most importantly, help prevent roots from drying out. Plants may keep in the bags for several weeks, but it is always best to carry out the planting as soon as possible. Bags should be kept closed at the neck except when removing plants and, as far as possible, must be protected from sunshine and frost. Bags must always be handled gently. Forestry Commission research has shown that rough handling, throwing and dropping bags causes root damage. This can result in much higher losses and poorer growth.

- **Cell grown plants**

Root trainers or cell grown plants are grown in small cells of peat or other organic medium and are supplied as a rootballed plug. Some species, such as holly, are only sold in cells or containers. Cell grown plants must be kept well watered prior to planting, especially in the spring.

Due to their method of propagation, cellular plants are more expensive than bare rooted plants. However, because the root system is protected to an extent by the peat plug, the planting season can be extended from September to May. There is also reduced risk of checking in certain species, notably Corsican pine and birch and losses after planting are often lower than with bare rooted plants in these cases. This can reduce costs incurred for replacing failed trees and subsequent weeding and may compensate for the higher initial cost of the plants.

- **Cuttings**

Plants produced vegetatively by cutting a section from a young branch or stem, are known as cuttings. New root and shoot growth develop from buds on the stem. A cutting can be planted directly onto site (short rotation coppice plantings employ this method) or can be allowed to grow on in a nursery bed for a year to form rooted cuttings. Willow and poplar trees are almost always sold as either cuttings or rooted cuttings, and although nurseries are now growing more of these plants from seed, cuttings are still proving popular.

Cuttings are cheap to produce and can be quickly and easily planted by hand or machine, making them cost effective, especially when high planting densities are required. As a cut plant is in effect a clone, it is important to use a variety of parent plants to reduce the risk of disease. In practice, it is recommended that a variety of clones and species are used for anything other than small scale planting.

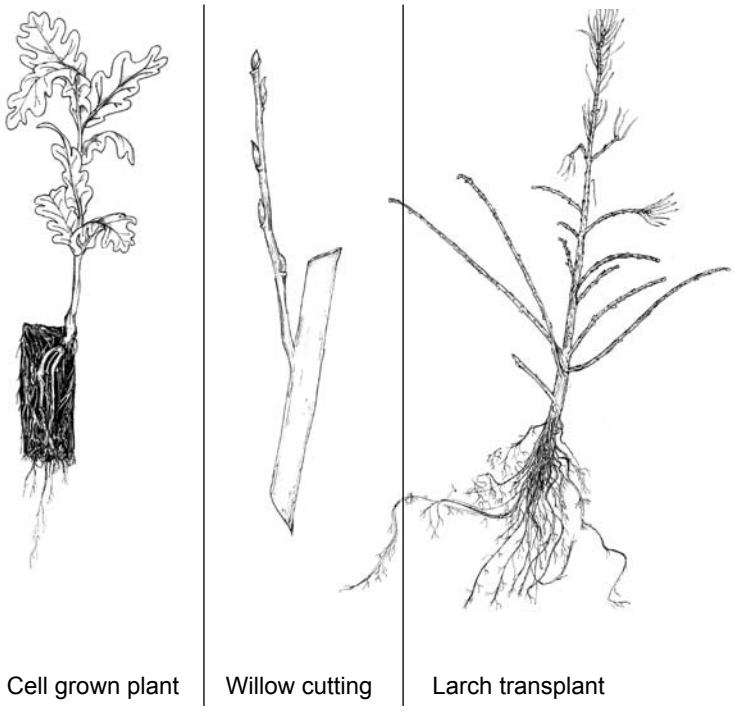


Figure 1

## Plant size

For most woodland schemes, plants will normally be between 20 and 60 cm tall. Cell grown plants tend to be at the lower end of this range. Size is not an indicator of plant quality. The ratio of root to shoot is important and a plant should have a good, well-developed system of fibrous roots to balance their shoot growth. If a tree has poor roots and a lot of shoots and branches, it is very likely to die back when planted.

There is no one ideal size, as the most appropriate plant to use will vary with the site and to some extent also with the species.

When planting broadleaves in shelters in situations where the environment is very favourable to tree growth, a 30cm tall plant is adequate. However, if planting on an open hillside, a larger plant will have greater reserves to deal with adverse conditions and a size of 40-60cm is often more appropriate. Towards the west of the country, on wet exposed sites with poorer soils or on sites close to the sea, plants of 20 - 40 cm should be used, as in such conditions plants with less shoot growth tend to be less susceptible to check and die-back.

There is seldom any justification for using bare-root stock larger than 60cm in height. Invariably, the root to shoot ratio suffers, plants go into check and die-back is likely to occur. Larger plants are also more expensive to buy and to plant. The only circumstance in which larger plants might be considered would be for planting of fertile and sheltered lowland sites, provided the trees will not need to be planted in shelters for protection against wildlife. Here 60-90cm or even 90-120cm plants can establish well and require less weeding because of their larger size.

Conifers are seldom planted in tubes and on an open site, a plant of 20-40cm is generally used. For Scots pine which has denser foliage that tends to catch the wind, a smaller plant of about 15-30cm is often more appropriate. On a site that is likely to be weedy, or perhaps somewhere that is more sheltered, 40-60cm plants can establish well and due to their larger initial size, may require less weeding. In general, however, use of larger plants on dry or exposed sites should be avoided,

## Species choice

Matching the correct species to the site conditions is essential if trees are to establish and grow well. Ecological site classification is presently the best method of assessing whether a particular species is ecologically suited to given site. Species choice will also depend upon the purpose of the scheme. If timber production is the primary purpose, the range of species is likely to be fairly limited.

Suitable species of tree should be identified at the design stage as within a planting site there may be considerable variation in micro-climate, soil types and wetness so species or mixtures of species will need to be allocated to specific areas within the site. For example, Norway spruce should be planted rather than Sitka spruce in frost hollows; pines will tolerate drier and poorer soils than spruces, and different types of oak may be required, depending upon whether soils are light or heavy.

## Provenance and origin

Once suitable species have been chosen, and all other factors taken into consideration, the provenance or origin of a tree is probably the most important factor in determining successful establishment and subsequent growth. This is important, because when trees grow over a wide geographic area,= local populations can arise which are suited to local climatic conditions and day lengths. The provenance of a tree refers to the local climatic area where its parent tree was grown and from which its seed was obtained. If the parent tree has thrived, then there is a degree of assurance that the offspring will do equally well in a similar situation. The origin of a tree is the local climatic area in which previous multiple generations of the tree occurred in their native state and from which seed for the tree or for its parents originated. Origin is thus potentially more important than provenance when selecting trees.

Some species of trees become more closely adapted to localities and show more variation than others, therefore, the importance of provenance and origin varies from species to species. Birch for example should not be moved more than 200 km from its provenance source, whereas oak from the Netherlands can be grown successfully in most parts of Britain. Availability of trees in the nursery from a given provenance or origin may further complicate the issue and affect your choice. As a rule, if you are unable to obtain trees of the origin you are seeking, then the provenance will do. If neither are available, then the use of trees of a differing origin or provenance is acceptable, provided they come from

a compatible climatic area. Remember your grant contract may imply or specify a particular provenance, always check before you buy..
Do not allow yourself to be confused by nationality, as this has nothing to do with provenance or origin. The relevant broad climatic areas or zones have been mapped and numbered for reference and information is always available from advisers, nurseries, the Forestry Commission and published sources.

## Mixtures

It is still common practice, especially when growing timber, to plant areas with a single species for ease of management. There are, however, many advantages to using mixtures when planting.

Tree mixtures are used to improve the conservation and amenity value of woodland, speed the rate of woodland establishment, provide early utilisable timber and to nurse some more demanding tree species. Broadleaf mixtures are commonly planted in native woodlands, land reclamation schemes and amenity plantings. Mixed conifer plantings are used when establishing productive trees on nutrient poor soils, or to improve landscaping of forests and woodlands. Conifer/ broadleaf mixes are normally planted with timber in mind, although their use in amenity woodlands is popular.

Care must be taken when selecting mixtures, as tree growth rates must be compatible. In some cases, non-compatible species are deliberately planted with the intention of one outgrowing the other. Mixtures also require greater attention in their management than single species plantings, especially in the timing and selection of trees for thinning. This is especially critical than in conifer broadleaf mixes, where a faster growing conifer can quickly swamp a potentially more valuable but slower growing broadleaf. The rule of thumb here is that the yield class of the conifer (effectively its expected rate of growth for a given site in m3/ha/year) should never be more than double that of the broadleaf. For example an oak of expected yield class 6 (YC6) can be mixed with Norway spruce of an expected YC12 but not YC16.

There are four common types of mixture:

- **Intimate**

Here different tree species are planted in close proximity to one another. A system commonly used in nursed crops is to plant alternating species along a row. This, while diverse at the individual tree level, can appear monotonous at distance and is better suited to timber crops where only two or three species are used. Intimate mixes for timber production require careful species selection, high levels of supervision at planting and during subsequence maintenance and management to ensure success.

- **Group mixtures**

In a group mixture, trees are planted in single species groups of often between10 to 25 trees. Competition between faster and slower growing species is therefore less critical and in this respect the planting is more robust. Such mixtures are quickly planted but care must be taken to ensure that individual tree groups are suited to their planting location. For example, a group of silver birch should not be allowed to extend onto flushed wet ground which does not suit this species. On very variable sites, planters need to be experienced to achieve good results. Group mixtures are often appropriate for multi-species and multi-purpose woodlands, as they allow considerable flexibility in management to be maintained.

- **Random mixtures**

In random mixes, trees are planted in both single species groups and in mixed species groups. This type of planting is generally used for native woodlands as it provides the most naturalistic woodland. It does, however, requires a high degree of ecological understanding and experience from the planter and maintenance can be difficult as randomly planted trees are not easily found in thick vegetation; the use of tree shelters can solve this problem.

- Line mixtures

Possibly the easiest of mixtures to plant and manage, line mixtures consist of single species rows, traditionally of three and three in conifer and broadleaf mixes. This mix is almost entirely used for commercial timber production, but is now rare, as it is considered  inappropriate in terms of the striped landscape impact.

Mixed tree planting, spruce & larch

**Table 1: Common mixtures for timber production**

| | **Nurse trees** | | | | | |
|---|---|---|---|---|---|---|
| **Final Crop trees** | *Norway spruce* | *European larch* | *Scots pine* | *Lodgepole pine* | *Japanese Larch* | *Western Red cedar* |
| *Ash* | ✓ | ✓ | | | | |
| *Beech* | ✓ | ✓ | ✓ | | | ✓ |
| *Oak* | ✓ | ✓ | ✓ | | | |
| *Sitka spruce* | | | ✓ | ✓ | ✓ | |

## Pruning

Some plants, especially willows, roses, hawthorn, blackthorn and some other shrub species, characteristically grow very fast in the nursery. Even if your order specifies willows at 45-60cm tall, they may be taller (perhaps up to 2 metres) when they arrive. If plants arrive outsized, or unbalanced in terms of root and shoot growth, send them back!

Pruning of some species at planting is essential. Willows should be cut back to 60cm for planting. Thorns, roses and other shrubs such as elder should be cut back to 45 cm, or even 30 cm if being used in a hedge. This will do the plant absolutely no harm at all, and, in fact, is positively beneficial. Pruning reduces die-back of the shoots after planting and will stimulate thick bushy growth from the base, developing the dense multi-stemmed form desirable in a shrub. Conifer species, however, should never be pruned and plants required to grow into single-stemmed trees should only be pruned after planting once appropriate advice has been taken.

## Planting method

Planting work should be planned in advance. To avoid stressing plants or drying plant roots, each day, only take out to site those trees that will be needed. Leave the main stockpile of plants in their bags in a shed or undercover where they are protected from the weather. At all times keep plants in bags to prevent roots from drying out, and handle them as little as possible.

Planting machines are now commonly used on larger schemes where ground conditions are suitable. Some machines are attached to the three point linkage of a tractor and these can be hired from machinery rings or a specialist contractor. Planting machines allow the work to be completed quickly. However they are only cost effective on where trees are planted at higher densities. They are not suitable for use on steep or unimproved ground, or where variable spacing or more complex mixtures of trees may be required for landscaping reasons.

On most schemes, especially those undertaken on a DIY basis, or with farm labour, the planting will be carried out by hand. To prevent poor root development, trees are best planted in a T or an L notch, with the ground level with the top of the root collar, straight and firmed in; as illustrated in Figure 2. Special forestry spades are available, but a normal garden spade is almost as effective. For large rooted plants, pits may be needed.

Planting is much easier when the plants are carried in a planting bag worn over one shoulder. This allows roots to remain protected until actual planting and avoids the damage that may be caused by dragging a bag along the ground. If planting into a grass sward, the turf over a circle of about 30cm in diameter should be scraped away. This is known as screefing and also provides a degree of weed control, aiding subsequent maintenance. Hand screefing should be followed up soon using a chemical herbicide.

Sometimes the planting pattern is complex. In this case do avoid the temptation to lead out plants and drop them on the ground in the required planting position, returning only later to plant them. It is far better to spend a little time measuring out the planting site and marking the boundaries where different species or mixtures are to be planted with canes or pegs.

On wetter areas, where water can lie on the surface, or high water tables affect the trees for considerable periods, it is essential to cut a raised turf of at least 30cm square, and then notch plant into this. The raised planting position helps drain the soil locally and aerates the root system, as well as providing localised weed control. It is important, however, that the roots make contact with soil and that no airspaces are left. For this reason, it may be better to cut long or rank vegetation prior to turfing. Turfs can be cut by hand, or, on larger sites, can be created by machine in a process known as mounding. On mounded sites additional drainage may also be required.

The planting position on mounds should be as central as possible. Machine mounds tend to be much larger than hand cut turves and require a period of settlement before planting, sometimes of several months.

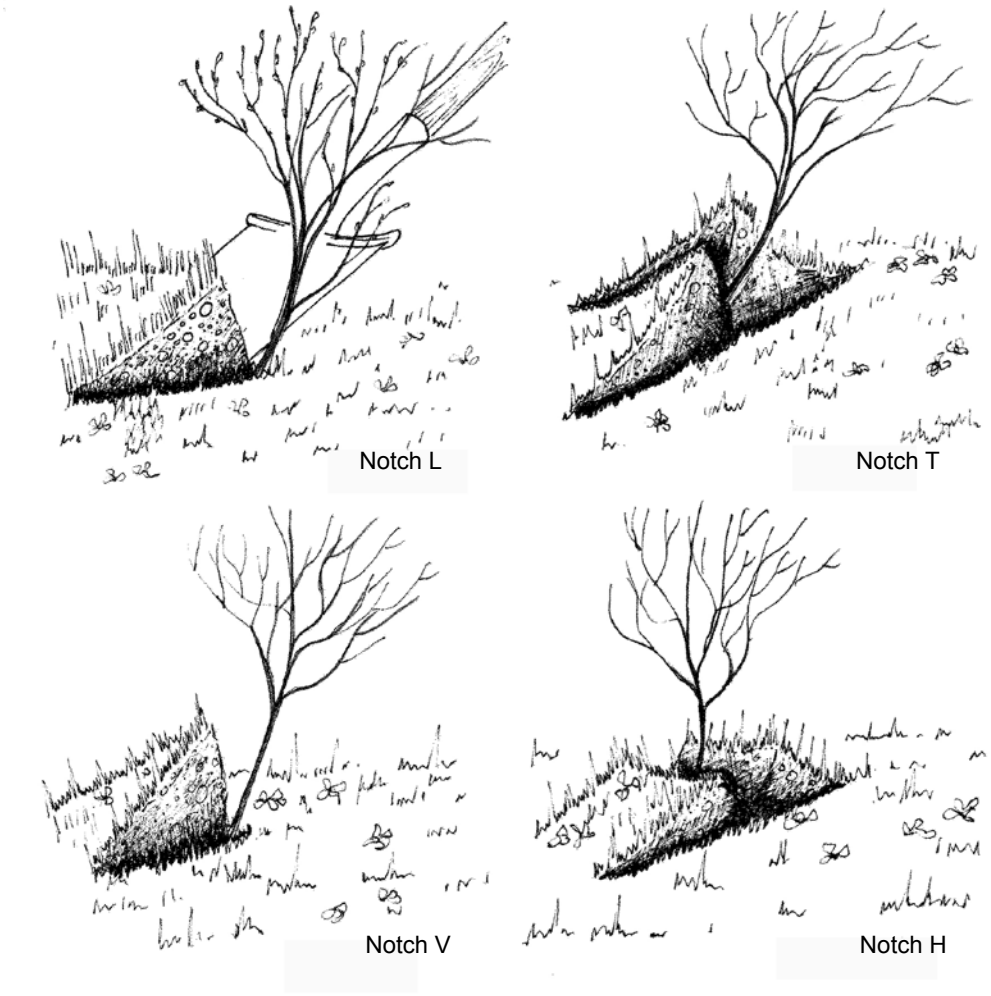


Figure 2: Planting notches L, T, V and H

Machine planted trees

## Spacing

Plant spacing is very important and is always specified in the grant contract. Plant spacing is a function of the species and scheme objectives. For instance, many trees will do well at wider spacing, but trees such as oak or beech when grown for timber need much tighter spacing at planting to help achieve straighter, unforked stems. Initial close spacing can speed up establishment and thus reduce weeding costs, but as more trees are required, expenditure at planting is greater. As there will always be some losses after planting, it is often sensible to plant at a slightly higher density than specified in the contract, to reduce subsequent costs associated with replacing failed plants (known as beating- up) planting areas.

Spacing is ultimately a compromise, based on a range of considerations but, as a general rule, the closer the spacing the more options you have at a later date, when thinning. Table 2 provides a table of recommended spacing.

**Table 2: Recommended spacing**

| Species | Amenity & conservation | | Timber production | |
|---|---|---|---|---|
| Pines, Larches & firs | 2.1 x 2.1m | 2,000/ha | 2.0 x 2.0m | 2,500/ha |
| Spruces | 2.0 x 2.0m | 2,500/ha | 1.8 x 1.8m | 3,100/ha |
| Ash & Sycamore | 1.6 x 1.6m | 1,600/ha | 2.0 x 2.0m | 2,500/ha |
| Beech | 1.6 x 1.6m | 1,600/ha | 1.8 x 1.8m | 3,100/ha |
| Cherry | 3.0 x 3.0m | 1,100/ha | 3.0 x 3.0m | 1,100/ha |
| Oak | 2.0 x 2.0m | 2,500/ha | 1.8 x 1.8m | 3,100/ha |
| Poplar | N/A | N/A | 8.0 x 8.0m | 156/ha |
| Native woodland | Random | 1600/ha | N/A | N/A |

Note; if you are in receipt of a grant the plant spacing will be specified in your contract, do not allow your woodland to drop below the stocking density stated in the contract, as there may be a financial penalty..

A simple method to check that the desired planting density has or is being achieved, is to lay out sample plots with an area of 0.01 hectares. This is done by putting a peg or stake in the ground at random positions. Tie a tape to this and sweep out a circle with a radius of 5.6 metres and count all the trees within the plot. Multiply this by 100 to obtain the number of trees per hectare; see Figure 3.

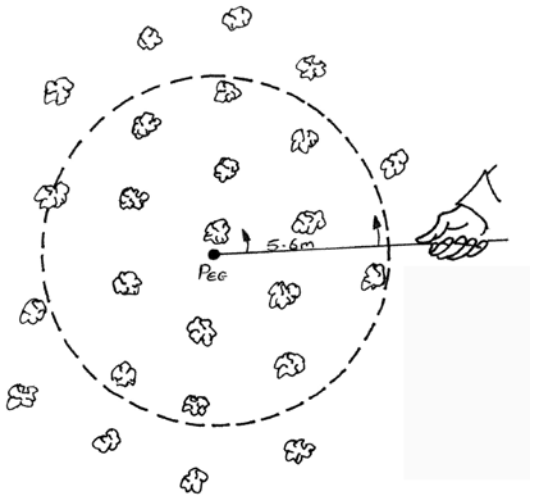


Figure 3

## Further Information

Further information can be found from the following publications and sources:

**Publications**


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**Web Sites**

- *www.forestry.gov.uk/scotland*

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