Establishing Broadleaves

This note deals with aspects of growing and managing broadleaved woodland on a commercial basis. The information is condensed from *Growing Broadleaves – Silvicultural Guidelines for Ash, Sycamore, Wild Cherry, Beech and Oak in Ireland* by Padraic M. Joyce (published by COFORD) - a comprehensive guide to the characteristics and silviculture of the five broadleaved trees most suited to Irish forestry: ash, sycamore, wild cherry, beech and oak. This note covers recommendations for provenance selection, site preparation, planting stock and establishment procedures for the five species.

Broadleaves are more costly and demanding to establish than conifers, it is important therefore to choose the correct species and to apply appropriate treatment. The following notes indicate which species and provenance are most suitable, and how they should be handled at the establishment phase.

COFORD
Agriculture Building,
Belfield, Dublin 4, Ireland.
Telephone: +353 1 716 7700
Email: info@coford.ie

Characteristic and Provenance

The key characteristics of the species give a lead to appropriate site selection and establishment techniques. Provenance notes will assist in choosing suitable stock. Recommendations are given in Table 2.

Planting

Planting stock and plant handling
Always buy plants from a reputable nursery. Planting stock represent a small part of the overall cost of plantation establishment. However, attention to sourcing high quality planting stock will pay dividends in improved establishment and reduced maintenance costs. Table 1 outlines recommended planting stock types. Good plant handling procedures are necessary to avoid serious losses:

Figure 1: Quality planting stock of ash

- Take care that roots do not dry out.
- Screen against drying wind.
- Put plants promptly in special storage bags.
- Seal bags and open only just before planting.
- Keep bags cool - out of the sun.
- Treat plants in transit carefully.

Planting

- Clear the ground of vegetation, either through the use of herbicides or strip ploughing.
- Notch planting, with a T- or L-shaped slit, is suitable for broadleaves when plant size is small.
- Pit planting may be necessary with large plants to ensure roots are not cramped.
- Distribute roots evenly in the planting hole and firm the soil.
- Do not bend the roots or root collar.
- Avoid cutting of roots.
- Consider a planting machine, where site permits.

Spacing configuration

For a given stocking density, closer spacing within rows and wider distance between rows introduces a greater degree of competition than the equivalent square planting configuration. Thus, for a stocking density of 5,000 plants/ha, 2 x 1 m spacing is preferred to 1.4 x 1.4 m spacing as it induces greater competition between plants and gives better stem form.

Density at stand establishment

The strategy for growing quality broadleaves involves planting at a sufficiently high density to:

- restrict lateral branch (and hence knot) diameter development;
- encourage height rather than lateral growth;
- ensure that there is an adequate number of potential final crop trees.

Table 1: Recommended size and age of planting stock

Planting stock		**Recommended sizes for bare-rooted transplants**					
Species	Preferred plants	Recommended by	Max. age	Root collar diameter		Height	
				Min.	Max.	Min.	Max
			years	mm		cm	
Ash	1+1 and 1+2 year old transplants.	Forest Service	3	7	-	40	75
			4	12	-	60	90
		BSI[1]	-	5	9.5	20	50
Sycamore	1+1 and 1+2 years old transplants.	Forest Service	3	7	-	40	75
		BSI	-	4.5	6.0	30	50
Wild cherry	2+0 year seedlings or 1+1 or 2+1 year old transplants. Reject plants with desiccated or damaged leaders.		-	-	-	50	120
Beech	Use healthy plants with a good root-shoot ratio.	Forest Service	3	5	-	20	40
			4	6	-	40	55
			4	7	-	55	70
			5	9	-	70	85
			-	11	-	85	85+
		BSI	-	I4	7.5	20	50
Oak	1u1 seedlings or 1+1 transplants. Planting should preferably take place after leaf-shed, during mild weather in October/November or in early spring if conditions are not suitable. In Europe two-year-old undercut seedlings are sometimes used on vegetation-free ground. Plants should have a good root/shoot ratio.	Forest Service	3	5	-	20	40
			4	6	-	40	55
			4	7	-	55	70
			5	9	-	70	85
			-	11	-	85	85+
		BSI	-	5	9.5	20	50

[1] *British Standards Institution*

Table 2: Key Characteristics and Provenance Recommendations for the Main Broadleaved Species

Species	Key characteristics	Provenance
Ash	Strong light demander, except when very young. Very site specific. Susceptible to damage by late spring frost. Intolerant of competition from grasses. Very responsive to vegetation control.	Preferred provenance is local grown (likely to outperform imported). If importation is necessary use registered British or Dutch sources.
Sycamore	Tolerant of shade in youth but light demanding later. Prefers cool, humid sites. Tolerant of late spring frost. Intolerant of competition from grasses. Responsive to vegetation control.	Home grown material is suitable. If imports are necessary, use Dutch, British and northern German or French sources.
Wild cherry	Strong light demander, except when young. Site specific. Susceptible to damage by late spring frost. Responsive to vegetation control.	Selected trees from French breeding programmes show better promise than Irish material, and are available as rooted cuttings. If conservation or amenity is the priority then Irish seed collected from the best trees should be used as a first.
Beech	Tolerates shade well, preferring sheltered conditions. Susceptible to damage by late spring frost. Preference for base rich sites, but grows well on acid topsoils. Does not tolerate waterlogging.	Sources from registered seed stands in the UK, Belgium, Denmark and the Netherlands, as well as the northern regions of France and Germany are suitable alternatives to home sources.
Oak	Strong light demander. Accommodating in regard to site. Susceptible to late spring and early autumn frost. Excellent stability in wind.	Material from registered Irish stands should be a first choice. If seed and plants must be imported, the material should come from registered seed stands growing in the UK, Netherlands, Belgium and the northern parts of France and Germany.

Table 3: Site Preparation for Broadleaves

Species	Fencing	Vegetation control[1]	Soil preparation[2]
Ash (Good ash sites are almost always former tillage or pasture).	Rabbit-proof fencing is necessary.	Vegetation control necessary - treat with glyphosate (see footnote 1 below).	Where a plough pan has developed on former tillage, subsoiling will be needed. Former pasture needs no site preparation other than vegetation control.
Sycamore (Bare land planting generally involves land formerly used for agriculture).	Rabbit-proof fencing is necessary; prone to rabbit and hare damage if not protected.	Vegetation control necessary (see footnote 1 below). Sycamore will benefit from vegetation control until the plants are at least 1 m high.	Where plough pan has developed on former tillage, subsoiling will be needed.
Wild cherry (Normally, the young plants will escape damage because of the taller plant material used (greater than 1 m) and the rapid height growth in the second year after planting).	Small groups in a matrix of other species, will require fencing. Stock fencing required for more extensive pure plantations. Where rabbit and hare populations are large, spiral tree guards to protect individual stems may prove more economical than fencing the area.	Vegetation control with herbicide to reduce weed competition may help to ease the planting procedure.	Ground preparation by strip ploughing is an alternative to use of herbicides.
Beech (Planting on open ground subject to frost, without overhead shelter not recommended).	Fencing is essential.	Vegetation control prior to planting is essential, and should be continued until plants no longer threatened by competition from it.	
Oak Pedunculate oak best on heavier lowland soils; sessile oak better on lighter upland soils. Avoid drought- prone soils.	On most sites, regardless of regeneration method, fencing will be necessary.	Competition from grass and weeds is a problem in all young crops. Vegetation control is therefore essential and should be carried out until the plants are no longer threatened by competition.	The growth of crops will be considerably improved by soil preparation. Ground preparation by strip ploughing can be used or as an alternative to, herbicide.

[1] Treat vegetation with glyphosate before planting, this will greatly improve growth performance. Former pasture needs no site preparation other than pre-planting treatment with herbicide - excellent results can be obtained by treating a 1m wide strip with glyphosate. Follow by annual post-planting treatment to keep an area of 1m² around each plant free of weeds for a further 2 to 3 years. Strip ploughing with overlapping ribbons will also control weeds, and may reduce overall planting costs.

2 Complete ploughing as a means of controlling vegetation is not recommended owing to the danger of subsequent invasion by noxious weeds.

Establishment of mixtures at planting time

Mixtures should be planted in groups of a minimum area of 100 m², which will ensure that at least one tree of the mixture species per group will remain in the final crop.

Treatment of Pure Stands

ASH
Avoid low lying areas subject to late frost - use protection of topographic features or mix with other species. Plant in rows 2.0 m apart and 1.5 m in the row (3,300 plants/ha).

SYCAMORE
Best growth is attained in sheltered localities. It grows well in pure plantations and, although it will benefit from mixtures with other broadleaves, it does not require nursing. Plant pure rows 2 m apart and 1.25 m in the rows (4,000 plants/ha).

WILD CHERRY
Current practice recommendations - between 2,000 and 4,200 plants/ha (2 x 2.25 m – 2 x 1.25 m) depending on size and quality of planting stock.

BEECH
Plant 6,600 plants/ha, in lines 2 m apart and 0.75 m in the lines; being close helps curb its tendency to adopt coarse growth. They are more costly to establish than mixtures but, they tend to be easier to manage in the formative stage.

OAK
Pure crops are more expensive to establish but less demanding to manage. On vegetation-free ground 1u1 or 1+1 plants, 25 - 50 cm high are most suitable. Where there is strong competition from vegetation use older plants 50 - 75 cm high (e.g. 2+1 transplants). Pure oak should be planted in rows 2.0 m apart and 0.75 m in the row (6,600 plants/ha).

Treatment of crops mixed with conifers

ASH
Mixtures can provide side shelter, European or hybrid larch being suitable. Larch may dominate in the first decade, especially if the mixture is in rows. Small groups are more easily controlled, with a group size of at least 100m2 (equal to the crown area of one final crop tree). Both ash and larch will benefit from the introduction of an understorey later.

SYCAMORE
The initial rapid growth of sycamore enables it to compete with European larch in the early decades. Then the larch tends to assume dominance and intervention will be necessary to maintain the mixture. Group mixtures are preferable to rows and offer greater flexibility of management later. In sycamore/larch mixtures the sycamore should be planted at 2 x 1.5 m and larch at 2 x 2 m.

BEECH
Two options provide a framework adaptable to most situations:
Late spring frost areas: establish a nurse crop in advance of the beech. First plant with European larch at 2 x 2 m or 2.5 x 2.5 m spacing. When the crop is 10 m high (15 - 20 years), remove every second line, reducing stocking to 1,000 - 1,200 stems/ha. Plant beech in these lines, at a density of 2,000-2,500 stems/ha, by planting at 1 m spacing. The larch acts as a nurse, but requires greater management expertise to ensure it does not dominate.

Free of late frost: side shelter is provided by a mixture of beech with European or hybrid larch. Plant two (or three) lines of beech at 2 x 0.75 m spacing, alternating with one line of larch at 2 x 2 m spacing. The larch provides side shelter. This nursing mixture can be converted to a permanent one. On poorer sites substitute larch with Scots pine.

OAK
Conifers provide shelter, curb side branch development and promote height growth. Establish oak in alternate lines with European larch, 2 m apart. Plant oak 0.75 m spacing in the lines, giving 3,300 oak plants/ha. Spacing for larch should not exceed 2 m in the lines, requiring 1,250 larch/ha. Total plant requirements will be 4,550/ha. The saving in cost is substantial but subsequent management will need to be much more intensive to ensure that the oak does not become suppressed. On poorer sites Scots pine may be substituted for larch. Remove the conifers at thinning, although they may be held if growth or stem form of the oak is not satisfactory.

Japanese larch/oak or Norway spruce/oak mixtures should not be used because of the greater danger of suppression of the oak.

Treatment of crops mixed with broadleaves

ASH
Good ash sites are so rare that ash should be the first option as the main species on such sites. In mixtures other broadleaves can have either a serving and subsidiary role or form a permanent part of the mixture. Serving species assist in natural pruning, provide ground cover and, at the end of the rotation, produce suitable conditions for natural regeneration, if required. The main serving species are beech and hornbeam. Beech, oak and sycamore can form permanent mixture components of ash stands.

SYCAMORE
Grows well with ash, having much in common in terms of site requirements, growth rate and silvicultural treatment. Beech is its natural companion species with which it will compete successfully up to about 50 years, after which it will need intervention to favour the sycamore, otherwise it tends to be overtaken by the beech later on. A beech mixture gives greater management flexibility in that it can be used both as a companion species in the upper storey or as an understorey. Mixtures should preferably be arranged in groups, in rows 2 x 1.25 m for sycamore, and the appropriate spacing for the mixture species. A line mixture is suitable where beech is intended to remain as a serving species in the understorey. Lines will also provide greater protection for the frost tender beech at the establishment stage.

WILD CHERRY
It can be mixed with species such as beech, or hornbeam, which may act as an understorey. It is valuable as a group mixture in stands of oak, ash or sycamore. It can be grown in gaps in beech stands, but the relative competition between beech and cherry needs to be monitored. Mixtures with oaks are less problematic, when mixed in rows or narrow bands. Single trees or small groups of a few wild cherry are recommended at woodland edges. They can be harvested when big enough, without causing damage to the remaining stems.

BEECH
Beech and oak are unsatisfactory as beech outgrows oak at 80 - 100 years and dominates. The unequal rotation lengths also cause problems. Beech and ash may be compatible, but the ash component should not exceed 1/3. On suitable sites ash will outgrow the beech and maintain dominance until harvested.

Sycamore grows well in mixture with beech. Beech tends to outgrow and suppress sycamore during the second half of the rotation. Group mixtures of sycamore, of a minimum area of 100 m^2, are preferable to line mixtures and are more easily managed. Naturally regenerated wild cherry should always be favoured. Rotations for wild cherry are similar to those for ash.

OAK

Suitable are ash, cherry and sycamore, in groups or as single dominant trees, acceptable up to 20% provided they are uniformly distributed throughout the stand. These species often regenerate naturally in oak woodlands. On sites suited to them, oak finds it difficult to compete in height growth in the early years. Harvest ash and cherry at 70 - 80 years of age, when oak is only half way through its rotation. Sycamore can remain for longer and be harvested with the oak.

Serving species are used to aid in the development of the oak. Suitable species are hornbeam, beech and lime. Hornbeam, a natural associate of oak, is much more frost hardy than oak and grows less rapidly. It is adapted to a wide range of soils and is more suited to wetter, heavy clay soils than beech and should be preferred to it on such sites. Create an intimate mixture with oak by planting a hornbeam every fourth tree in lines 2 m apart. Distance between plants in the lines should be 0.75 m, giving a total of 6,600 plants/ha, of which 1,600 will be hornbeam. It forms an effective understorey, keeping the oak free of epicormic branches and the ground free of weeds. The role of oak/lime mixtures is similar to that of oak/hornbeam. Beech forms an ideal middle and understorey for oak if its height growth is kept in check. Beech is so resilient and aggressive that, on suitable sites, it will overtake the oak at 70 - 80 years, when an understorey is most needed. For this reason oak/beech mixtures, at the establishment stage, are not recommended. The general practice is to introduce beech as an understorey at time of first thinning.