

BROADLEAVES IN BRITAIN

Choosing suitable planting stock

When considering quality in planting stock the nurseryman, forester and arboriculturalist has two distinct ideas in mind. The first is genetic or inherent quality and the second is the ability of the plant to survive and grow after planting.

Inherent quality is expressed for the forester by rapid rate of growth, straightness of stem, persistence of the leading shoot, resistance to frost and drought, freedom from disease or insect attack, and good characteristics of the timber.

The arboriculturalist who is creating amenity will look for stature, form of crown, size and colour of leaves, colour and form of flowers and fruits, and features of the bark.

Those responsible for planting in housing estates, along motorways and trunk roads, or on restored industrial sites look for resistance to wind or fumes and tolerance of difficult soil conditions.

All these are inherited characters which can be ensured by careful selection of the sources of seeds or cuttings; they can also be improved by selection and breeding.

The second aspect of quality in plants derives from the way they are grown in the nursery; these characters are phenotypic or induced and together ensure that the plants will have a high capacity to survive and grow after planting on the chosen site. The nurseryman seeks to produce plants which are healthy and are well furnished with buds and branches and have stems which are thick at the base and sturdy in relation to their height. He raises plants from seed, or propagates them vegetatively under carefully defined conditions of soil, temperature, moisture, nutrition and day length.

 A feature of modern nurseries is the control that can be exercised over these and other factors.

Polythene tunnels and cloches, supplementary lighting, mist irrigation, additional carbon dioxide and applications of nutrients are all available for use. Of course, the nurseryman cannot prescribe for a severe frost or drought after planting, or strong competition from weeds, or neglect of the plant but he can prescribe for good survival if normal care is taken before and after planting.

The precise specifications for the two aspects of quality mentioned above appear in British Standard 3936 Part 1 and Part 4.

A suitable size of planting stock is important for good survival, as also is season of planting. On forest sites mechanically prepared by ploughing so that weed growth is suppressed, small plants are preferable. On all other sites it is the height and strength of the weeds that determines sizes of plants; they must be sufficiently tall to have buds and branches above the weeds. The aftercare of most broadleaved species must include control of weeds by mechanical, chemical or hand methods.

Selecting suitable species

In the pages which follow we describe the silvicultural, arboricultural and timber characters of more than 30 broadleaved species native or long-cultivated in Britain. They can be classified into four main groups:

Those that grow quickly when young but soon culminate in height and diameter increment. They produce useful timber on short rotations but can also be grown on rotations of medium length (say 40 years). The poplars and tree willows produce light timber and reach their best development in southern England on moist, fertile soils. The alders and birches produce medium to heavy timbers and can be grown throughout Britain.

Those that are fast growing when young and can be grown on rotations of medium length ranging from 45 to 60 years. Sweet chestnut and Red oak produce ring porous timbers of medium to heavy density; the Small leaved and Large leaved limes, Norway maple and London plane are diffuse porous woods of medium density. All five species grow best in the south of Britain.

Ash, various species of elm, Wild cherry or gean and sycamore are grown throughout Britain and the last named is especially well suited to northern Britain. All produce useful timbers, the elms and ash being ring porous and heavy to medium in density, while Wild cherry and sycamore are diffuse porous and medium in weight. The Scuthern beeches *Nothofagus obliqua* and *N. procera* appear to belong to this group and show promise in the western and central parts of Britain. They produce diffuse porous timbers of medium density.

Those that are normally grown on long rotations of 80 to 120 years and have in the past been planted throughout Britain. Beech, Pedunculate oak and Sessile oak reach their best development on lowland sites in the southern half of Britain but good stands are also found on fertile sheltered sites throughout Wales, northern England and lowland Scotland. The timbers are classed as heavy; beech is diffuse porous and the oaks are ring porous. Walnut can also be placed in this group of long rotation species but it requires fertile soils in the south of England.

There is also a fourth group of species which play important roles in the silviculture of the main species and contribute to amenity and conservation. Horse chestnut, holly, hornbeam, Field maple and *Robinia* produce medium to heavy woods often with specialised uses. Hazel, hawthorn and dogwood, the Osier and Basket willows and Goat willow are rarely allowed to reach timber size and the *Sorbus* species -rowan, whitebeam and Wild service - have silvicultural, conservation and amenity values.

Black alder *Alnus glutinosa*

Many cultivars are available, including leaf variants. See also *A. incana*, *A. cordata* and *A. rubra*.

Sources of seed and plants

Grows naturally and has been planted throughout Britain, from sea level to 500 metres. The finest trees and stands are found in the Peak District of England. Good natural or seminatural stands of Black alder occur throughout Britain on wet ground overlying both acid rocks and limestones. Trees with strong buttresses and depressions in the stem below large branches should not be used as seed trees.

Silviculture

A light-demanding, pioneer tree usually found in pure stands, Black alder will grow in mixture with ash and birches and is a valuable nurse for oak and spruce on heavy clays.

Soil types

Remarkably tolerant of difficult soil conditions such as land that is marshy or liable to flooding, heavy clays and compacted soils ranging from acid to alkaline. The root nodules containing *Frartkia spp.* enable it to fix nitrogen.

Establishing and tending

Alder can produce adventitious roots and all common sizes of nursery stock establish well. It seeds regularly and coppices strongly.

Rate of growth and yield

Young trees grow quickly to 15 metres with whorls of short, upward-slanting branches to produce a conical crown. In woodlands the stem is straight and cylindrical. Black alder grows strongly for 25 to 30 years and the crowns then reach their full development. It commonly attains a height of 18 metres and stem diameter of 30 cms but on fertile alluvial sites it will attain 27 metres height with stem diameter 120 cms. When grown for biomass Black alder can yield 8 to 10 dry tonnes per hectare per year on rotations of 15 to 20 years.

Protection and resistance

There are reports of dieback on heathland soils but the cause is unknown. Black alder is completely hardy to late spring and early autumn frosts. It is windfirm and can be used in coastal shelter belts because it withstands salt spray. It can be planted in industrial areas and because it is tolerant of alkaline conditions can be planted on pulverised fuel ash. Black alder is seldom damaged by grey squirrels.

Timber properties

A ring-porous wood with coarse texture, pale when first cut but soon darkening to red and then dries to light, reddishbrown. The sapwood is not distinguishable from the heartwood. Generally straight grained, the timber is of medium density (530 kg/ml seasoned). It kiln-dries well and fairly rapidly and is good for turning, moderate for wood bending and satisfactory for staining and polishing. The heartwood is perishable but permeable to preservatives. Very durable under water.

Amenity value

Has been planted with good effect alongside motorways and on reclaimed land in industrial areas where its nitrogen fixing ability is valuable.

Conservation

Acts as host for 90 insect species. It can be used to fix riverbanks and check erosion.

Timber value

A relatively light and soft wood, easy to work. Very suitable for general turnery, sawn wood and veneer; makes good charcoal but as a firewood is rather quickly consumed.

Economic appraisal

An adaptable, hardy and fast-growing tree suitable for upland sites where its windfirmness and tolerance of wet soils makes it useful in mixture with conifers and as a timber tree in pure stands along water courses. It should also be used more widely as a nurse for spruce and oak on clay soils in the lowlands.

Ash *Fraxinus excelsior*

Many cultivars are available including leaf variants and pendulous forms.

Sources of seed and plants

Grows throughout Britain but is less common in the extreme north of Scotland. The finest trees and stands are found in the Welsh borders, southern and western England. Individual trees bear largely male, female or hermaphrodite flowers and those with male flowers often have the best stem form. Seed trees must have straight stems and small branches.

Silviculture

A light demanding, pioneer species best grown in mixture with sycamore, beech, the oaks, the limes and Wych elm.

Soil types

Prefers moist, fertile soils with pH above 5.5 (a good indicator is wild garlic); will tolerate clays, but not dry slopes with thin soils.

Rate of growth and yield

Young trees grow quickly with upward-slanting branches to give a rounded crown. In woodlands the stem is straight and cylindrical. Grows rapidly up to 40 years, then increment falls off. Diameter increments of 4 to 16 rings per 25 mm are suitable for most purposes. Trees older than 100 years often are unthrifty in Britain. Commonly attains heights of 25 to 30 metres and diameters of 60 to 150 cms with clear boles of 10 to 15 metres.

Protection and resistance

Ash is frequently cankered, the causes being frost, fungi or bacteria; such trees should be removed in thinnings. The ash bud moth, *Prays curtisellus*, causes forking of the leading shoot of trees up to 5 metres tall. Late spring frosts can also damage the leading shoots. Ash is often free from damage by grey squirrels but is not immune. It is damaged by rabbits and hares and is severely browsed by deer. Withstands exposure to salt-bearing winds and is resistant to atmospheric pollution. It is sensitive to pulverised fuel ash.

Establishing and tending

All common sizes of planting stock establish well but ash cannot compete with matted grass. It fruits freely and coppices well from young stumps.

Timber properties

A ring porous timber with coarse texture, white to light brown in colour. Dark brown or black heart is not associated with loss of strength or disease but is disliked by timber users. The sapwood is not well defined and the heartwood is perishable and moderately resistant to preservatives. Generally straight grained. The weight averages 690 kg/m³ seasoned and clear timber is outstandingly tough, excellent for wood bending and good for staining and polishing. Kiln dries fairly rapidly but tends to distort.

Amenity value

A beautiful and dignified tree, much planted in rural and urban areas.

Conservation

The keys are eaten by birds and small mammals.

Timber value

Selected timber is used for sports goods, tool handles, furniture, interior panelling, road vehicles, agricultural implements and boat building. Branchwood makes excellent firewood.

Economic appraisal

A very valuable lowland tree which also succeeds in the uplands on fertile brown earths. Should be grown in mixture with beech, gean, oak, sycamore and larch on rotations of 45 to 50 years. Must be regularly thinned to encourage large free crowns and rapid diameter increment. The timber can be sold in all sizes from small roundwood to sawlogs.

Beech *Fagus sylvatica*

There are many cultivars, including leaf shape and colour variants, pendulous and fastigate forms.

Sources of seed and plants

Very widely planted throughout Britain, beech reaches its best development in England south of the Cleveland Hills. It also grows well in north-east England and eastern Scotland. Beech must be collected from stands recorded in the National Register of Seed Sources under EEC rules.

Silviculture

A strong shade bearer, it is often grown in mixture with ash, birch, gean, the oaks, sycamore, Wych elm, Scots pine and larch.

Soil types

Grows best on light, well-drained soils over chalk or limestone but also succeeds on deep acid brown earths and deep sandy soils. Does not tolerate cold, wet or poorly drained soils or infertile, dry sands.

Establishing and tending

All common sizes of planting stock establish well. Beech does not coppice in Britain. Can be grown with a nurse of birch, Norway maple, Scots pine or larch, especially on chalk downland.

Rate of growth and yield

Young trees grow slowly at first, but after 20 to 30 years beech begins to overtake many other native broadleaves. Plants of good provenance have straight persistent stems and in well-tended woodlands the stems are straight and cylindrical. A long-lived tree, remaining healthy for up to 200 years, beech maintains its growth increment for 100 to 120 years. It commonly attains heights of 30 metres with stem diameters of 120 cms and clear boles of 10 to 15 metres.

Protection and resistance

Cryptococcus fagi, the felted beech coccus, can appear at all ages. Among diseases, *Nectria ditissima* is the most important. Late spring frosts damage leaves and flowers and can kill young trees. Beech trees of all ages are sensitive to drought. It is very susceptible to damage by grey squirrels which can ruin pole-stage plantations, but red deer, hares, rabbits and mice also peel the bark. Beech is resistant to exposure, is a valuable shelter tree and makes an excellent hedge.

Timber properties

A diffuse porous timber with fine, even texture, whitish to very pale brown in colour, darkening on exposure to slightly reddish brown. The sapwood is not distinguishable from the heartwood. Usually straight grained. One of the strongest timbers grown in Britain (average 720 kg/m³ at 12I MC) beech kiln-dries fairly well but tends to split, distort and shrink. Clear timber is exceptionally good for bending, good for turning, and satisfactory for staining and polishing. The heartwood is perishable but permeable to preservatives.

Amenity value

The young foliage in May is particularly beautiful, the autumn colour can be dramatic and mature beech woods are ideal for public access and recreation.

Conservation

Beech mast is relished as food by pigeons, pheasants, deer, squirrels and mice.

Timber value

The largest consumer is the furniture industry for cabinet work, chairs, school desks. Also for joinery, turnery, flooring and plywood. Beech wood flour is saleable and beech is good for firewood and charcoal.

Economic appraisal

Beech should not be confined to lowland sites and grows well on fertile upland sites. It remains the most commonly planted broadleaf tree and the most used timber. When grown in association with ash, gean and oak valuable woodlands result. When a stem diameter of 45 cms is taken as being marketable for most purposes beech can be grown on rotations of 80 to 100 years.

Downy birch *Betula pubescens*

In Scotland sub-species *pubescens* occurs in the south and lowlands, while sub-species *odorata* is found in the Highlands. See also *B. pendula*.

Sources of seed and plants

Widespread in Britain from sea level to 800 metres, but is most common in the wetter, western side of the country; also plentiful in south-east England. Downy birch grows pure or in mixture with Black alder, Grey willow, Pedunculate and Sessile oak, rowan and Scots pine.

Progeny testing shows that careful selection of parent trees can result in improved stem form and habit of growth, thus raising the value of Downy birch.

Silviculture

A light-demanding, pioneer species but tolerates more shade than Silver birch. It soon appears naturally on felled woodland sites.

Soil types

Prefers well-drained, sandy-loams but tolerates poorly-drained and acid soils with peat in the uplands and is found on the edges of fens, bogs and lakes.

Establishing and tending

Requires care in transplanting and containerised plants should be used on difficult, reclaimed sites. Downy birch fruits freely and coppices strongly.

Rate of growth and yield

Young trees grow quickly up to 20 years and provided the stem is persistent a slender crown is formed, but it does not grow as fast as Silver birch. The branches are more erect and secondary branches do not become pendulous. On poor, wet sites the apical dominance of the leading shoot is soon lost. Downy birch commonly attains heights of 15 metres in 30 years with stem diameters of 16 cms, and 18 to 20 metres in 50 years.

Protection and resistance

The rust fungus *Melampsorium betulinum* is troublesome in the nursery and *Polyporus betulinus* is associated with the deterioration of old birches. Downy birch is hardy to late spring and early autumn frost. It is not often damaged by rabbits and grey squirrels. Used in shelterbelts because it is wind firm and withstands exposure. Downy birch is also moderately resistant to atmospheric pollution and so can be planted in towns and industrial areas to reclaim derelict land.

Timber properties

The timber of Downy birch is similar in all respects to that of Silver birch

Amenity value

The bark of older trees usually is grey white and the secondary branches are not pendulous, but the Downy birch is attractive and deservedly popular.

Conservation

The two birches support over 200 insect species so are important sources of food for birds.

Timber value

Used for furniture, turnery veneer and pulp. Posts are pressure treated with preservative and used for fencing. It is also a good firewood.

Economic appraisal

An under-rated and neglected species, especially in the uplands. A valuable improver of infertile sites and useful nurse for frost-tender species. As with Silver birch, extensive pure stands are not advocated but both birches are suitable for the edges of plantations and small groups through them.

Silver birch, Pendulous or Warty birch *Betula pendula* (*B. verrucosa*)

Many cultivars are available including leaf variants and pendulous forms. See also *B. pubescens*.

Sources of seed and plants

Silver birch is found in most parts of Britain but is rarer in the wetter west where it is replaced by *B. pubescens*. It grows pure and in mixture with Pedunculate and Sessile oak, rowan and Scots pine. Progeny testing shows that careful selection of parent trees followed by cross-breeding leads to production of cultivars with rapid rates of growth, straight stems and good habit of growth. Hybrids between *B. pendula* and *B. pubescens* occur.

Silviculture

A light-demanding pioneer species that colonises fertile heathlands after burning is stopped, and soon appears naturally on felled woodland sites. When grown in mixture it can damage the leading shoots of nearby trees by the whipping action of its pliant branches.

Soil types

Prefers brown earths of sandy or loamy texture but tolerates podsoles and sands, gravels and steep scree slopes. Is less common on shallow soils over chalk.

Establishing and tending

Requires care in transplanting and containerised plants should be used on difficult reclaimed sites. Silver birch fruits freely and coppices strongly.

Rate of growth and yield

Young trees grow quickly with single, straight stems and small upward slanting branches to form a slender, conical crown. In pure stands and well-tended mixtures the stem is straight and cylindrical. Grows rapidly up to 20 years, stops after 50 years and rarely lives more than 60 to 70 years. Commonly attains heights of 10 to 12 metres in 20 years, 15 to 18 metres in 30 years and 22 metres in 50 years with stem diameters of 40-50 cms.

Protection and resistance

The rust fungus *Melampsorfidium betulinum* is troublesome in the nursery and *Polyporus betulinus* is associated with the deterioration of old birches. Hardy to late spring and early autumn frosts and winter cold. Silver birch is not often damaged by rabbits or grey squirrels. It is wind firm, resistant to exposure (so useful in shelterbelts) but does not withstand salt-bearing winds. Silver birch is moderately resistant to atmospheric pollution and can be planted in towns and industrial areas. It is semitolerant of pulverised fuel ash and can be used in reclaiming derelict land.

Timber properties

A diffuse-porous timber with fine texture, white to light brown in colour and bright. The sapwood is not distinguishable from heartwood. The weight averages 660 kg/m³ making it similar to beech in strength and to ash in toughness. Silver birch kiln dries fairly rapidly with some tendency to distort; it air dries relatively quickly. Clear timber is classified as good for bending and satisfactory for staining and polishing. The heartwood is perishable but is permeable to preservative.

Timber value

Used for furniture, turnery veneers and pulp. Posts are pressure-treated with preservative and used for fencing. It is also a good firewood.

Amenity value

The smooth silvery-white bark, pendulous secondary branches and pleasant autumn colour make it popular for amenity planting in urban and rural settings.

Conservation

Silver Birch supports over 200 insect species, so is an important source of food for birds.

Economic appraisal

An under-rated and neglected species, especially in the uplands. A valuable improver of infertile sites and useful nurse for oak and frost tender conifers. Extensive pure stands are not advocated but it is suitable for the edges of plantations and in small groups through them. All sizes of timber can be sold but sawlogs and veneer logs must be free of knots and irregular grain.

Gean, Wild cherry, European cherry *Prunus avium*

See also Bird cherry, *Prunus padus*.

Sources of seed and plants

Grows throughout most of Britain, but is commonest in south-east England, the Welsh borders and eastern side of Scotland; rare in the extreme north. The finest trees and stands are found in south-east England and north-east Scotland. Seed trees must have straight, persistent stems and small branches.

Silviculture

A light-demanding tree often grown in mixture with ash, beech, Pedunculate oak and Wych elm. Sometimes planted in pure stands.

Soil types

Prefers warm, deep, heavy but permeable loams overlying chalk or limestone, but will tolerate clays, acid brown earths and shallow soils over chalk.

Establishing and tending

All common sizes of planting stock establish well. Fruits regularly and produces suckers freely.

Rate of growth and yield

Young trees grow quickly with whorls of short, upwardslanting branches to give a conical crown. In woodlands the stem is straight and cylindrical. Grows rapidly up to 40 years then increment falls off. Essentially short-lived, healthy trees older than 90 years are uncommon. Commonly attains heights of 18 to 25 metres and stem diameters of 60 cms.

Protection and resistance

Myzus cerasi, the cherry aphid, can cause leaf curl and stunted growth in nurseries and gardens; Bacterial canker caused by *Pseudomonas mors-prunorum*, produces lesions and can result in dieback of shoots and stem. Late spring frosts damage the flowers. On exposed sites the tree soon loses its shape but it can be used in shelter belts and it withstands atmospheric pollution. The horizontal structure of the bark protects gear from severe damage by grey squirrels.

Timber properties

A diffuse-porous wood with fine, even texture, pale pinkishbrown in colour and darkening on exposure to light. The sapwood is moderately well-defined and the heartwood is moderately durable. Generally straight grained, the density is classed as medium (600 kg/m³ at 12% MC) and the timber is almost as strong as beech. It is very good for wood bending, good for turning and good for staining and polishing. Dries fairly readily but with a pronounced tendency to warp.

Amenity value

Among the most attractive native trees with white, sweetscented flowers in spring and crimson leaf colour in autumn. Suitable for urban roadsides and edges of plantations.

Conservation

The cherries are relished by many birds.

Timber value

Decorative; generally used in small sections. Very suitable for cabinet and furniture making, panelling, decorative joinery and turnery.

Economic appraisal

Need not be confined to lowland sites but is best grown on warm permeable soils in mixture with ash, beech, sycamore and larches on a rotation of 40 to 50 years. Must be thinned and preferably pruned to produce straight cylindrical boles which are suitable for sawn timber and veneers.

Hawthorn (May, Quickthorn, Whitethorn) *Crataegus monogyna*

The Midland hawthorn *C. laevigata* grows in broadleaved woodlands of central and south eastern England.

Sources of seed and plants

Native through all of England, lowland Wales, Ireland and Southern Scotland it has been widely planted elsewhere in Britain. Grows together with ash, dogwood, elder, Field maple, hazel, holly, elm and Pedunculate oak in hedgerows. Seed should be collected from well-grown bushes in old hedgerows, which have not been clipped for several years so that the habit of the bushes can be judged.

Silviculture

A light-demanding, pioneer species, it does not withstand heavy shade, soon becoming drawn and leggy.

Soil types

Is found on all but the poorest acid soils. It colonises open chalk downland, grows well on clay soils and tolerates dry soils over sand and gravels.

Establishing and tending

All common sizes of nursery stock establish well but on very severe sites young container-grown plants should be used. Hawthorn fruits regularly and coppices strongly.

Rate of growth and yield

Grows rapidly when young and, if uncut, will attain 15 metres in height. Hawthorn is long-lived and can attain stem diameters of 15 cms. The variation in habit, thorniness and fruitfulness is great.

Protection and resistance

Fire blight caused by the bacterium *Erwinia amylovora* causes dieback. Hawthorn withstands severe cold in open windy places, including exposure to salt winds so is a useful windward margin for shelterbelts. It tolerates atmospheric pollution and can be planted in towns and industrial areas. Because it withstands clipping at almost any time of year and layering, it is the most widely-used hedging shrub.

Timber properties

A diffuse-porous wood, yellowish grey in colour with a tinge of red. The grain usually is straight and the texture fine and even. Hawthorn is only available in small sizes. Heavy in weight (average 650 kg/m³ seasoned), it is hard and strong. It dries slowly and can be used for turning. Hawthorn has also been used for engraving and is as good as European boxwood for this purpose.

Amenity value

When uncut, hawthorn is an attractive shrub with sweet scented blossom and rounded crown of dense branches gracefully pendulous at the ends.

Conservation

The flowers provide food for many insects, including beetles and hoverflies. The berries are eaten by many birds during autumn and winter.

Timber value

Not available in sufficient quantity or large sizes.

Economic appraisal

Not a timber tree but deservedly popular as a hedging plant and an important constituent of shelterbelts. Its tolerance of a wide range of soils and site conditions enables it to hold its place, but it would repay selection for habit of growth, fruit characters and resistance to salt bearing winds.

Hazel *Corylus avellana*

The cobnut or filbert *C. maxima* was introduced in 1759 and is grown in Britain for its large nuts.

Sources of seed and plants

Hazel is native to almost all parts of Britain. It occurs commonly as an understorey to Pedunculate oak because of the former prevalence of the coppice-with-standards system of silviculture. In hedgerows it is associated with ash, alder, Field maple, hawthorn, holly and hornbeam. The best cobnut plantations are in Kent and Surrey.

Silviculture

Shade-enduring it also casts a dense shade. Grows in mixed deciduous woodlands and hedgerows. Simple hazel coppice is still worked in southern England.

Soil types

The most productive coppice is found on fertile soils derived from chalk and limestone but hazel will tolerate acid brown earths of moderate depth and damp clay soils.

Establishing and tending

All common sizes of nursery stock establish well. Hazel fruits regularly and coppices strongly.

Rate of growth and yield

The multi-stemmed form is the result of coppicing. If left uncut it grows quite rapidly to 10 metres and then stops. Well-managed coppice on fertile soil will yield 1 to 2 dry tonnes per hectare per year on rotations of 15 to 20 years. For material for wattle hurdles a rotation of 10 years is appropriate.

Protection and resistance

Hazel is not seriously damaged by insect pests or diseases but the nuts are attacked by weevils of the genus *Balaninus*. It is hardy to late spring and early autumn frosts, resistant to drought and is a useful shrub for completing farm shelterbelts. Hazel is damaged by rabbits. In towns, people foraging for the edible nuts can cause damage.

Timber properties

A diffuse-porous wood with fine texture, pinkish white in colour with dark lines. The grain is straight. Hazel is only available in small sizes, up to 10 cms diameter. The timber is composed mainly of sapwood. Of medium density (average 640 kg/m³ seasoned) hazel rods dry rapidly. The freshly cut rods split and bend readily. The wood is not durable.

Amenity value

An attractive shrub with distinctive catkins in early spring.

Conservation

A valuable food for small mammals and birds. 73 species of insects are associated with hazel.

Timber value

Coppice rods are used to make wattle hurdles and for slack cooperage, baskets, pea sticks and bean rods. Hazel makes good firewood and charcoal.

Economic appraisal

Hazel coppice is still worked in Hampshire, West Sussex and West Surrey but the traditional markets have declined and craftsmen capable of working hazel are not common. The main justification for growing it is as a valuable underwood in broadleaved woodlands and shelterbelts, and for edible nuts.

Holly *Ilex aquifolium*

Numerous cultivars are available, including many leaf colour variants.

Sources of seed and plants

Holly is a native found throughout most of Britain up to a height of 550 metres but is less common in the uplands of Scotland. It occurs commonly in the shrub layer of broadleaved woodland and in hedges in association with ash, aspen, beech, dogwood, goat willow, hawthorn, hazel and Pedunculate oak. Seed should be collected from tall trees with straight stems and narrow crowns.

Silviculture

A shade enduring tree which is a regular constituent of natural Scots pine forest in Scotland and broadleaved woodland but can also form pure woods.

Soil types

Has a wide tolerance of soil types including clays, peat, shales, sands, gravel and chalk.

Establishing and tending

Requires careful transplanting. Individual trees bear largely male or female flowers and the latter fruit at irregular intervals. Holly coppices strongly.

Rate of growth and yield

Holly is most at home in the wetter, milder west of Britain and on fertile soils can grown steadily to a height of 20 metres, retaining a straight stem and narrow crown. Elsewhere it commonly attains heights of 10 metres with stem diameters of 15 to 20 cms.

Protection and resistance

The Holly leaf miner *Phytomyza ilicis* can spoil the appearance of the leaves. Holly is damaged by late spring frosts but withstands drought. It will tolerate moderate atmospheric pollution and so can be planted in towns and industrial areas; but where pollution is severe it may lose some of its leaves in winter. It withstands regular cutting and grazing so is used for hedges in urban and rural areas.

Timber properties

A diffuse porous wood, white or greyish white in colour with a fine even texture. The sapwood is not distinguishable from the heartwood. The grain tends to be irregular. Holly produces a heavy timber averaging 780 kg/m³ seasoned and is harder than most native woods. It is inclined to distort in drying and kiln drying is not recommended. Clear timber is good for turning and staining and polishing. The heartwood is perishable.

Amenity value

The flowers are fragrant and in autumn and winter the scarlet berries contrast vividly with the mass of dark green glossy leaves.

Conservation

In most years the berries are soon eaten by birds. The leaves and bark are good browse for deer in winter.

Timber value

Holly timber is available in limited quantities and small sizes only. It is suitable for turnery and inlaid work in furniture.

Economic appraisal

Not a timber tree but a valuable understorey tree in broadleaved woodland and coniferous forest and an excellent amenity shelter and hedging tree in urban and rural areas.

Hornbeam *Carpinus betulus*

Many cultivars are available, including pendulous and pyramidal forms.

Sources of seed and plants

Native to England south of a line from the Wash to the Bristol Channel. It has been planted in most parts of Britain and thrives in Wales, northern England and on the eastern side of Scotland. The best trees are found in Kent and Sussex where hornbeam usually grows in mixture with beech, hazel, Pedunculate oak, Wild cherry and Wych elm. Seed should be collected from trees with straight persistent, cylindrical stems.

Silviculture

Strongly shade bearing and also casts a dense shade. Hornbeam is occasionally planted pure but is essentially a tree of mixed woodland.

Soil types

Usually grows well on damp but not wet clays. It will thrive on acid brown earths and soils derived from chalk and limestone.

Establishing and tending

Hornbeam requires care in planting. It fruits freely and coppices strong.

Rate of growth and yield

Young trees usually grow slowly with slender, closely spread branches forming a rounded crown. In woodlands the stem is moderately straight but tends to be buttressed, fluted and oval in section. On fertile soils it grows more rapidly to heights of 15 to 20 metres with stem diameters of 90 to 120 cms and boles up to 6 metres long. Hornbeam is not long lived and trees older than 150 to 200 years are often in decline.

Protection and resistance

Resistant to late spring frosts so it can be planted in frost hollows where beech would not succeed. It is moderately tolerant of atmospheric pollution but can be planted only in towns with cleaner air. Hornbeam is useful in the shrub layer of shelterbelts but is only moderately resistant to exposure. Because it tolerates clipping it makes an excellent thick hedge which retains its leaves during the winter. It is not often damaged by grey squirrels.

Timber properties

A diffuse porous wood, fine and even in texture, it is dull white in colour and marked with greyish streaks and flecks due to the broad medullary rays. The sapwood is not easily distinguishable from the heartwood. Commonly crossgrained the timber is classed as heavy (750 kg/m³ seasoned) and is as strong as beech. Hornbeam dries well and fairly rapidly. Clear timber is very good for bending, good for turning and for staining and polishing. The heartwood is perishable but permeable to preservatives.

Amenity value

A moderately tall, elegant tree with good yellow autumn colour. Its good qualities are becoming recognised in northern English towns and cities.

Conservation

The fruits are attractive to birds and squirrels. Only 28 species of insects are dependent on hornbeam for food.

Timber value

A hard, tough timber that finish very smoothly so is used in musical instruments, turnery, pulleys, skittles and Indian clubs.

Economic appraisal

Hornbeam may be used in place of beech on clay soils or where hardness to frost is required. It has good qualities as an amenity tree and for hedging. It is sometimes grown beneath oak to control epicormic branch growth on the oak stems.

Horse chestnut *Aesculus hippocastanum*

A. x carnea is a hybrid between *A. hippocastanum* and the American *A. pavia* which bears red flowers. It is a smaller tree and tolerates poorer soils.

Sources of seed and plants

Introduced to Britain before 1616, Horse chestnut has been widely planted but is more common in southern England than elsewhere. The finest trees are found south of a line from the river Mersey to the river Humber. Seed trees should have straight, persistent stems and relatively narrow crowns.

Silviculture

A shade enduring species which has been planted in mixed broadleaved woodlands. A useful understorey to oak on clay soils.

Soil types

Horse chestnut grows best on deep, moist, fertile loams overlying chalk and limestone but it tolerates shallow calcareous soils, clays and deep acid brown earths.

Establishing and tending

All common sizes of planting stock establish readily. It fruits regularly and coppices strongly.

Rate of growth and yield

Grows quickly when young, with strong branches to form a broad, rounded crown well provided with foliage. The diameter increment is particularly rapid. In woodlands the stem is straight and cylindrical. Attains heights of up to 30 metres and diameters of 50 to 80 cms. Not long-lived, Horse chestnut is often in decline after 180 years.

Protection and resistance

Parkland trees can suffer root damage from poaching by cattle and the entry of *Phytophthora* species to the roots can kill trees. A leaf spot caused by *Guinardia aesculi* can be troublesome. Rather frost tender but recovers well from late spring frosts. It can tolerate atmospheric pollution so can be grown in towns and industrial areas. Horse chestnut can be severely damaged by boys foraging for the 'conkers'. It should be kept away from public roads because the copious leaf fall can cause vehicles to skid.

Timber properties

A diffuse porous wood, creamy white or yellowish in colour, with very fine, uniform texture. The sapwood is not easily distinguishable from the heartwood. Inclined to be cross grained or wavy grained. Of medium density (570 kg/m³ seasoned). Horse chestnut dries readily with little degrade. Clear timber is good for bending and turning and satisfactory for staining and polishing. The heartwood is perishable but permeable to preservatives.

Amenity value

One of the most beautiful flowering trees of the largest size. It is one of the earliest to flush in spring and also one of the earliest to shed its leaves in autumn when there is a brief but attractive show of yellow, gold and brown.

Conservation

The nuts are attractive to deer.

Timber value

A soft, white wood which machines easily, turns well and can be used for paper pulp. It does not burn well in an open grate.

Economic appraisal

A popular tree for parks and avenues where there is ample space for development of the crowns and flowers. A quick growing tree in woodlands and a useful component of mixed broadleaved woods where it shades out thorn throws a rich, heavy litter and keeps the stems of oak free of epicormic branches.

Sweet chestnut *Castanea sativa*

Several cultivars are available including leaf variants and trees with conical habit.

Sources of seed and plants

Native to the Mediterranean countries, Sweet chestnut was introduced to Britain before Norman times. It has been widely planted in the lowlands of England being important in the coppice plantations of Kent, Sussex and Hereford. The finest trees and stands are found in the Midlands and southern counties of England and it grows well in south-west England; healthy trees are also found in Scotland.

Silviculture

A moderate shade bearer often grown in pure stands. Sweet chestnut must be thinned early and regularly to produce straight, cylindrical stems. Many branches are lost by natural pruning.

Soil types

Grows best on well-drained, fertile and slightly acid sandy loams. Unsuitable for wet soils and soils derived from chalk or limestone.

Establishing and tending

Sweet chestnut requires careful planting. It produces ripe fruits after warm summers and coppices strongly.

Rate of growth and yield

Young trees grow quickly with whorls of upward-slanting branches to produce a conical crown. It is grown as coppice on rotations of 15 to 20 years and commonly yields 4 to 6 dry tonnes per hectare per year. Sweet chestnut is long-lived, attaining an age of 400 years. Forest trees commonly reach 24 metres in 50 years with stem diameters of 40 cms. Single stemmed trees exceeding 30 metres in height and with stem diameters of 150 cms or more are known but these usually have "ring shake" and the timber is then of little value.

Protection and resistance

The chestnut blight *Endothia parasitica* is always a potential cause of damage; the Ink disease due to *Phytophthora* species is associated with high soil moisture content. Sweet chestnut is very frost tender and is damaged by air pollution. It is deep rooting and wind firm but does not withstand constant wind exposure. It is frequently damaged by grey squirrels but is less often damaged by rabbits.

Timber properties

A ring porous species with a coarse texture and yellowish brown in colour. The sapwood is narrow and clearly distinguishable from the heartwood. Usually straight-grained but the timber of old trees may have spiral grain and ring shake. Owing to its acidic nature the timber accelerates corrosion of metals in contact with it; also stains when in contact with metals. Clear timber is good for bending and satisfactory for staining and polishing. The heartwood is durable and extremely resistant to penetration by preservatives.

Amenity value

A splendid, erect and well-foliaged tree with distinctive flowers in August.

Conservation

The nuts provide food for pheasants.

Timber value

Resembles oak in appearance but is lighter and more easily worked. Used for furniture, coffin boards, fencing, gates and for casks. Coppiced chestnut is durable and used for cleft fencing, stakes and hop poles.

Economic appraisal

A good productive species for England south of a line from the river Mersey to the river Humber. Should be grown pure or in mixture with larch or beech and oak on rotation of 50 to 60 years to stem diameters of 35 to 45 cms so that the timber is free from ring shake. Sweet chestnut coppice is still worked in Kent, Sussex and Hereford.

Small-leaved lime *Tilia cordata*

The Common lime *T. x vulgaris* is a hybrid between *T. cordata* and *T. platyphyllos*

Sources of seed and plants

Native to England and Wales where it sometimes grows in small pure stands but mainly occurs in secondary mixed woodlands with ash, hawthorn, Field maple, the birches, oaks, Wildy cherry and Wych elm. It also grows with the Large-leaved lime *T. platyphyllos* in the Peak District of Derbyshire and the Wye Valley. The best trees and stands are found in the English Lake District, Welsh borders, Midlands and Lincolnshire.

Silviculture

Moderately shade bearing, it also casts a heavy shade; can be grown pure or in mixture with ash, sycamore, beech, Pedunculate and Sessile oak, hornbeam and Wild cherry. Soil types Occurs naturally on soils derived from chalk and limestone, but also succeeds on well drained sands, loams and clays.

Establishing and tending

Requires careful planting. Production of viable seed depends on warm summers but it can be propagated by cuttings. It coppices strongly.

Rate of growth and yield

Young trees grow quickly with small upward slanting branches to form a conical crown. In well-tended woodlands the stem is straight, cylindrical and epicormics are rare. Small-leaved lime commonly reaches heights of 25 to 30 metres with stem diameters of 30 to 45 cms and boles of 15 metres. If grown for biomass it could produce 3 to 4 dry tonnes per hectare per year on rotation of 15 to 20 years.

Protection and resistance

Verticillium wilt can cause damage in the nursery. Small-leaved lime tolerates cold winters and is hardy to late spring frost. It is resistant to wind so can be used for shelter; and to atmospheric pollution so can be planted in towns and industrial areas. Because of the tough, stringy bark it is not often damaged by grey squirrels and although deer browse Small-leaved lime they do not often damage the bark.

Timber properties

A diffuse porous wood, uniformly white or yellow in colour, turning pale brown on exposure. The texture is fine and uniform and the grain is straight. The sapwood is not easily distinguishable from the heartwood. Of medium density (540 kg/m³ seasoned) lime kiln dries well and fairly rapidly with some tendency to distort. Clear timber is moderate for bending, good for turning and satisfactory for staining and polishing. The heartwood is perishable but permeable to preservatives.

Amenity value

A handsome well-shaped tree for parks and other open spaces and hedgerows, but not for car parks and roads because of the "honey dew" secreted by leaf aphids. Conservation The flowers produce abundant nectar attractive to bees.

Timber value

A soft, white wood easy to machine and carve. Used for brush making, turnery and plywood.

Economic appraisal

A productive species which has been neglected because it is difficult to produce nursery stock. Should be grown extensively for its all-round utility for timber, amenity and conservation. Lime timber would be more extensively used if graded logs were available in large quantities. Should be grown in mixed woodlands on rotations of 50 to 60 years.

Field maple or Common maple *Acer campestre*

See also *A. platanoides* and *A. pseudoplatanus*

Sources of seed and plants

The sole maple native to Britain, it is largely confined to England and Wales, where it grows in hedgerows and mixed woodlands in association with ash, blackthorn, Goat willow, whitebeam, hazel, Pedunculate oak, gean and Wych elm. The frequent cutting of hedges means that the tallest trees are normally found in woodlands. Most nursery transplant lines include trees with erect tree-like habit as well as more shrubby forms.

Silviculture

Shade-enduring and often found in the shrub layer of oak woodland, it grows well in hedgerows and appears early in the succession of vegetation on chalk grassland which is reverting to scrub and woodland.

Soil types

Succeeds on well-drained clay soils over chalk and limestone but tolerates shallow calcareous soils and acid brown earths of pH 5.5. or above.

Establishing and tending

Establishes readily; fruits moderately well and coppices strongly.

Rate of growth and yield

Grows quite rapidly for 20 to 25 years to make a neat compact tree 10 to 15 metres tall. Then height growth often ceases, maturity is reached in 50 years and older trees are often in decline.

Protection and resistance

Cryptostroma corticale, the sooty bark disease, has been reported on Field maple. It is hardy to late spring frosts and also resistant to atmospheric pollution so can be planted in towns and industrial areas. The tolerance of clipping makes it suitable for hedges and low screens.

Timber properties

The timber, although darker in colour, is similar to that of sycamore.

Amenity value

A handsome small tree with neat habit and deep yellow to orange leaf colour in autumn.

Conservation

The flowers provide a good food source for insects and small mammals eat the seeds.

Timber value

Rarely available in large sizes and mainly used for firewood. Economic appraisal
Not a timber-producer, but useful on the edges of plantations and for the outside rows of shelterbelts. Also has value as an understorey to oak on calcareous soils in England and Wales. Field maple should repay selection for a more tree-like habit.

Norway maple *Acer platanoides*

Many cultivars are available, including leaf colour variants, upright and globular-crowned forms. See also *A. campestre* and *A. pseudoplatanus*

Sources of seed and plants

Introduced to Britain in 1683, it has been most commonly planted in southern England and south Scotland but also grows well in east Scotland. The best trees are found south of a line joining the river Mersey to the river Humber. Seed trees must have straight persistent stems and small branches.

Silviculture

A moderate shade bearer, occasionally planted pure, it grows best in mixture with beech, the oaks and limes and should also be tried in mixture with larch. It is much used on the edges of plantations.

Soil types

Grows best on deep soils over chalk and limestone but tolerates shallow soils; also succeeds on acid brown earths of moderate depth.

Establishing and tending

All common sizes of nursery stock establish well. Norway maple fruits and coppices moderately well.

Rate of growth and yield

Young trees grow quickly with pairs of upward-slanting branches to give a rounded crown. In woodlands early thinning is essential to favour straight-stemmed trees and pruning to 6 metres is desirable. It grows at a similar rate to sycamore for 30 or 40 years and then is overtaken, but heights of 18 to 20 metres and stem diameters of 35 to 40 cms are common at 50 years. Not so long lived as sycamore.

Protection and resistance

The dense mass of foliage makes Norway maple suitable for screens and shelterbelts but it is less resistant than sycamore to salt laden winds. It is generally hardy to late spring frosts and resistant to atmospheric pollution so can be planted in towns and industrial areas. Norway maple is severely damaged by grey squirrels.

Timber properties

The timber is in all respects similar to that of sycamore. Amenity value
A handsome ornamental tree with yellow spring flowers followed by bright green leaves that turn to golden yellow, red and brown in autumn.

Conservation

The flowers are much favoured by honey bees.

Timber value

Norway maple can be used for flooring, furniture, turnery and veneers. Small round wood sells well for firewood.

Economic appraisal

A productive species, superior to sycamore on shallow calcareous soils in southern Britain but inferior to sycamore in northern Britain and must be restricted to well-drained, fertile, acid brown earths. In the south it should be grown in mixture with larch, ash and gean on a rotation of 45 to 60 years. Control of grey squirrels is essential.

Pedunculate oak *Quercus robur*, *Q. pedunculata*

See also Sessile oak *Q. petraea* and Red oak *Q. borealis*.

Sources of seed and plants

It may not be a true native but has been widely planted in Britain for a very long time and is the most common broadleaved tree in the hedgerows and woodlands of England. It is widespread elsewhere in Britain up to elevations of 480 metres. Good trees and stands are found in many parts of the country. Acorns of Pedunculate oak must be collected from stands included in the National Register of Seed Sources under EEC rules.

Silviculture

A strong light demander and pioneer species, Pedunculate oak is often grown in mixture with larch, Norway spruce, alder, beech, hornbeam, lime and sycamore. Is also the common over storey in coppice with standards.

Soil types

Grows best on deep, clay loams, well supplied with water, but not waterlogged. Tolerates heavy clay soils.

Establishing and tending

All common sizes of planting stock establish well. Fruits at irregular intervals. Coppices strongly.

Rate of growth and yield

Grows slowly at first and plastic shelters are being used to protect young trees from browsing and speed up early growth. Care must be taken to favour trees with straight, persistent stems free from epicormic shoots. Under conditions of "free growth" stem diameters of 45 cms are achieved at 70 years. Pruning is used to produce clear stems or beech, hornbeam and Horse chestnut are used to keep the stem free of epicormic branches.

Protection and resistance

Oak mildew *Microsphaera alphitoides* must be controlled in the nursery. *Tortrix viridana*, the oak leaf roller moth, can repeatedly defoliate trees in older stands causing loss of vigour.

Pedunculate oak suffers severely from late spring frosts but mainly produces a second flush of leaves. It is wind firm and withstands exposure but does not tolerate atmospheric pollution. It is browsed by deer and damaged by grey squirrels.

Timber properties

The timber is similar but darker and less easy to work than Sessile oak. The control of epicormic shoots is essential to prevent degrade of the timber. Like Sessile oak, the timber is somewhat acidic which tends to promote corrosion of materials, especially iron and steel, in contact with it under damp conditions. Blue-black stains are liable to appear on the timber in these circumstances.

Amenity value

A handsome, well-proportioned tree.

Conservation

The oaks support 284 species of insects. The acorns are eaten by jays, mice, squirrels and deer.

Timber value

Good quality oak is used for furniture, panelling, high class joinery and exterior work. It cleaves well and lower grades are used for fencing, gates and mining timber. All grades are used in boat building.

Economic appraisal

As with Sessile oak, the site must be suited to the growth of quality timber. The use of shade-bearing species is a well tried method for controlling epicormics and producing long, clear lengths of stem.

Sessile oak *Quercus petraea*, *Q. sessiliflora*

See also Pedunculate oak *Q. robur* and Red oak *Q. borealis*.

Sources of seed and plants

Widespread in Britain but most common in south western England and Wales, Lake District and western Scotland, sometimes growing on sites over 400 metres elevation. The finest trees and stands are found on the Welsh borders. Acorns of Sessile oak must be collected from stands recorded in the National Register of Seed Sources under EEC rules.

Silviculture

A strongly light demanding and pioneer species, Sessile oak is often grown in mixture with larch, Norway spruce, beech, hornbeam, lime and sycamore. Such mixtures need constant attention to produce good crops of oak.

Soil types

Grows to the largest sizes on deep, porous, light-textured brown earths. Tolerates clay soils but timber quality suffers on sites with pronounced fluctuations of the water table.

Establishing and tending

All common sizes of planting stock establish well. Fruits at irregular intervals. Coppices strongly.

Rate of growth and yield

Grows slowly at first and plastic shelters are being used to protect young trees and speed up early growth. Reaches 10 metres in 30 years and 20 metres in 70 years with stem diameters of 30 to 45 cms depending on thinning intensity. Isolating the crowns of dominant trees greatly increases diameter growth. In well-tended stands the stems are straight and branches slant upward to form compact crowns. A long-lived tree which remains healthy for 400 years or more.

Protection and resistance

Oak mildew, caused by *Microsphaera alphitoides* must be controlled in the nursery. *Tortrix viridana*, the oak leaf roller moth, causes less defoliation on Sessile oak than Pedunculate oak. Liable to damage by late spring frosts on wet sites and frost cracks can appear on the stems of older trees. Wind firm and tolerates exposure, so forms the backbone of shelterbelts. It is browsed by deer and damaged by grey squirrels.

Timber properties

A ring-porous wood, yellowish brown in colour. The sapwood is light and distinct from the heartwood. Generally straight grained, the characteristic ornamental silver grain is due to broad medullary rays. Oak is strong (average 720 kg/m³ seasoned) and dries slowly with a marked tendency to split and crack. Clear timber is very good for bending and good for staining and polishing. The heartwood is durable and extremely resistant to preservatives.

Amenity value

A handsome and well-proportioned tree with a less spreading crown than Pedunculate oak.

Conservation

The oaks support 284 species of insects. The acorns are food for jays, mice, squirrels and deer.

Timber value

Good quality oak is used for furniture, panelling, high class joinery, decorative veneers and exterior work. It cleaves well and lower grades are used for fencing, gates and mining timber. All grades are used in boat building.

Economic appraisal

The site must be sufficiently fertile to allow the growth of straight trees, there must be regular tending to favour the best stems and the associated species in mixed crops must provide revenue while the oak is maturing.

London plane *Platanus x acerifolia*

A hybrid between *Platanus orientalis* from Asia Minor and *P. occidentalis* from eastern North America. It is a very variable tree in Britain and several cultivars are available.

Sources of seed and plants

Believed to have originated in Oxford around 1663, it has been widely planted and grows best in southern England but also grows well as far north as Edinburgh. London plane normally is propagated from cuttings. The shoots should be taken from trees with straight stems and small branches.

Silviculture

A light demanding tree which throws a light shade. It is not often grown in plantations, although some of the smaller London squares are quite densely stocked with trees.

Soil types

Does best on light loams but tolerates deep clays if well drained and neither too acid nor lime rich.

Establishing and tending

Requires care in planting. Does not often set viable seed in Britain. It coppices strongly.

Rate of growth and yield

Young trees grow quickly with alternate upward pointing branches to give a rounded crown. It grows rapidly up to 50 years and commonly attains heights of 30 metres with stem diameters of 90 to 120 cms and clear boles of 9 metres. Trees remain healthy for more than 200 years.

Protection and resistance

The most widespread and serious disease is *Gnomonia veneta*, which kills leaves and twigs. London plane is damaged by late spring frosts but it is resistant to atmospheric pollution and to drought. As the stem expands the bark is shed in flakes leaving a pattern like a jigsaw puzzle whose pieces vary in colour from pale cream through green to dark brown. London plane does not withstand exposure to wind.

Timber properties

A diffuse porous wood with fine, even texture and light colour resembling beech. The sapwood is not normally distinct from the heartwood. Usually straight-grained the numerous broad medullary rays produce a highly decorative lacelike figure. Of medium density (620 kg/m³ seasoned), the timber dries fairly rapidly but tends to distort. It is very good for bending and good for staining and polishing.

Amenity value

The large smooth leaves, patterned bark, the flowers and fruit and habit of London plane make it an outstanding ornamental for towns and cities.

Conservation

In Britain it acts as host to very few insects.

Timber value

Used for veneer, particularly for panelling. A decorative wood used for inlaying fancy boxes.

Economic appraisal

Has been almost exclusively planted as an ornamental tree in parks and squares. Its rapid growth makes it worthy of wider use in woodlands in the lowlands of England as a producer of a valuable decorative wood, a suitable rotation being 60 years.

Rowan or Mountain ash *Sorbus aucuparia*

Many cultivars are available, including erect forms and those with foliage and berries that differ from the normal.

Sources of seed and plants

Grows throughout Britain but is less common in Lincolnshire and East Anglia. It is found at elevations exceeding 800 metres and up to 1000 metres. Rowan reaches its best development in the valleys of the Scottish rivers Dee, Spey and Tay. Seed should be collected from trees with erect habit and stiff upward pointing shoots that can bear the heavy crops of berries.

Silviculture

A light-demanding pioneer which can also tolerate shade. It commonly forms the understorey in older plantations of Scots pine and is found naturally in the native pinewoods of Scotland.

Soil types

Prefers light-textured, acid brown earths and can grow on the more fertile peats, but does not tolerate waterlogged conditions.

Establishing and tending

All common sizes of planting stock establishes well. Fruits regularly and coppices strongly.

Rate of growth and yield

Young trees grow quickly to give a much branched and rounded crown. In woodlands the stem is occasionally straight and cylindrical but browsing usually prevents this. It can grow to 10 metres and occasionally 17 metres in height with stems 30 to 40 cms diameter.

A short-lived tree, the maximum age recorded is 120 years.

Protection and resistance

The leaf rust, *Gynosporangium juniperi* can shorten the life of leaves. Hardy to late spring frosts and early autumn frosts and can withstand droughts. Very tolerant of wind and one of the most valuable species for shelter. It is moderately resistant to atmospheric pollution and can be planted in towns and industrial areas. It is severely browsed by deer.

Timber properties

A diffuse porous wood, the sapwood is reddish-white in colour and broad in width, while the heartwood is light brown. The texture is fine and even. The timber is heavy (average 725 kgs/m³ seasoned) and hard. Rowan dries slowly. The timber is good for turnery. It does not split easily and is perishable.

Amenity value

One of the most beautiful native trees, attractive in leaf, flower and fruit.

Conservation

The berries are taken by birds, especially of the thrush family.

Timber value

Rowan is usually available in small sizes and rarely in large sizes. It is used in furniture and for turnery and carving and makes good firewood.

Economic appraisal

Not a timber tree, but excellent in shelterbelts and as an understorey tree. It also has a special place in providing amenity in towns and cities, along waterways and on the edges of plantations. Also considered to be a soil improver.

Sycamore *Acer pseudoplatanus*

Many cultivars are available, including leaf colour variants. See also *A. campestre* and *A. platanoides*.

Sources of seed and plants

Introduced to Britain in 13th century, sycamore has been widely planted and reaches its best development in northern England and Scotland. It has been planted on upland sites up to 480 metres. Seed must be collected from well-tended plantations where care has been taken to select and favour trees with straight, persistent stems and small branches.

Silviculture

A moderate shade bearer often associated with beech, ash and gean. Sometimes planted pure but grows best in mixture with larches and broadleaves.

Soil types

Prefers well drained soils over chalk and limestone but grows well on acid brown earths of moderate depth. Will tolerate dry soils but not wet clays.

Establishing and tending

Establishes readily, but young trees cannot withstand competition from strong grass growth, which must be killed. Sycamore fruits and coppices freely.

Rate of growth and yield

Young trees grow quickly with short pairs of upward-slanting branches to give a rounded crown. In woodlands early thinning is essential to favour straight-stemmed trees and pruning to 6 metres is desirable. Sycamore grows rapidly up to 50 years and commonly attains heights of 18 to 20 metres and stem diameters of 35 to 40 cms bh. Maximum height in Britain is 40 metres.

Protection and resistance

Rhytisma acerinum, the tar spot fungus, occurs in the nursery and although unsightly is not serious. *Cryptostroma corticale*, sooty bark disease, can cause serious damage. Sycamore is moderately hardy to late spring frosts. It is severely damaged by grey squirrels. Provided the soil is fertile it withstands exposure to salt-laden winds and has been planted for shelter as far north as Caithness, Orkney and Shetland. It is resistant to atmospheric pollution, moderately tolerant to pulverised fuel ash and often colonises old coal mine waste heaps.

Timber properties

A diffuse porous wood, white or yellow-white in colour, with natural lustre and fine, even texture. The sapwood is not distinguishable from the heartwood. Usually straight-grained, but sometimes curly or wavy-grained, producing an attractive figure. Of medium density (610 kg/m³ seasoned), sycamore kiln-dries well and fairly rapidly, but when airdried is inclined to stain. Clear timber is very good for bending, turning, staining and polishing. The heartwood is perishable but permeable to preservatives.

Amenity value

Much planted for amenity in urban and rural areas.

Conservation

The flowers are rich in nectar and attract bees, which produce a good, light honey.

Timber value

Sycamore is in demand for flooring, furniture, turnery and veneers. It also sells well as firewood.

Economic appraisal

A productive species for northern Britain on sites up to 480 metres, with calcareous soils or on well drained acid brown earths. It should be grown in mixture with larches, ash and gean on rotations of 45 to 60 years to produce straight, cylindrical sawlogs and veneer logs. Control of grey squirrels is essential.

Common walnut, European walnut *Juglans regia*

The American or Black walnut, *J. nigra*, is more of a forest tree and grows to greater sizes than the Common walnut. It has similar site requirements.

Sources of seed and plants

Native to south eastern Europe but naturalised in Britain. It was more commonly grown during the 19th century but fine trees are still found in southern England on sheltered sites.

Silviculture

Light demanding and intolerant of competition, it should be grown in "orchard" lines rather like poplar.

Soil types

It requires deep, moist fertile soils derived from chalk and limestone. It will tolerate deep brown forest soils, but not clays.

Establishing and tending

Requires care in planting. "Stumped" plants in which roots and shoots are cut back have been successful. Walnut bears ripe fruit after good summers.

Rate of growth and yield

Young trees grow quite quickly with upward-slanting branches to form a rounded crown. Heights of 15 to 20 metres are attained in 60 years and if a wide initial spacing is adopted, stem diameters reach 35 to 40 cms. A long-lived tree with a life span of up to 400 years.

Protection and resistance

The bacterial blight caused by *Xanthomonas juglandis* can be troublesome in the nursery. Walnut is very sensitive to late spring frosts. It requires shelter and does not thrive on sites exposed to wind.

Timber properties

A ring porous timber rather coarse in texture, variable in colour with a greyish brown background marked with irregular dark streaks. The grain is straight or sometimes wavy and the sapwood is distinct from the heartwood. The timber is similar to beech in density and strength (average 640 kg/m³ seasoned). Walnut dries well though rather slowly. It is apt to stain when in contact with iron in damp conditions. Clear timber is very good for bending and turning and excellent for staining and polishing. The heartwood is moderately durable and resistant to preservatives.

Amenity value

A splendid, well-proportioned tree with spherical, spreading crown and abundant foliage which gives good colour in autumn.

Conservation

No information is available.

Timber value

Used as veneers or in the solid for high quality furniture. Highly figured veneers are derived from the stumps, burrs and crotches of some trees. Also used for the stocks of guns and rifles.

Economic appraisal

Should be grown in "orchard" fashion on deep fertile soils on sites south of a line from the river Mersey to the river Humber, where the crops of walnuts will supplement production of the valuable timber. Suitable rotations are 80 to 100 years depending on the fertility of the site. Branchwood makes good firewood.

Common whitebeam *Sorbus aria*, Wild service-tree *Sorbus torminalis*, Swedish whitebeam *Sorbus intermedia*

There are many cultivars, which include single-stemmed pyramidal forms, and leaf variants.

Sources of seed and plants

Whitebeam is native to southern England and Ireland but has been widely planted throughout Britain. It grows naturally in association with ash, beech, dogwood, Field maple, hawthorn and Wych elm. Wild service-tree is native to England and Wales and is common only in Kent and Sussex. The associated species are similar but also include rowan, Wild cherry and the oaks. Swedish whitebeam has been cultivated for a long time in Britain.

Silviculture

Whitebeam and service-tree are light demanding pioneers but the latter can endure some shade. Whitebeam colonises chalk scrub and often survives the transition to woodland.

Soil types

Whitebeam occurs naturally on soils derived from chalk and limestone but has been planted on deep acid brown earths. Service-tree grows on clays. Swedish whitebeam is similar to rowan in its requirements.

Establishing and tending

All common sizes of planting stock establish well. All these species fruit regularly and coppice strongly. Service-tree also suckers freely.

Rate of growth and yield

All three species grow quite rapidly at first. Service-tree is the slowest of the three in growth. Whitebeam is the largest tree and reaches 20 metres and sometimes more in height; the other two are smaller. The crowns of all these trees are well provided with foliage, crown width and shape varying with species and cultivar. Whitebeam grown in open scrub generally has a broad crown.

Protection and resistance

Whitebeam has few damaging insect pests and diseases. All three species are resistant to wind exposure and also tolerate salt-bearing winds and so can be used as edge trees for shelterbelts. Whitebeam and Swedish whitebeam tolerate air pollution and so can be used in towns and industrial areas.

Timber properties

Common whitebeam and Wild service-tree both produce a diffuse-porous wood, with fine even texture. The colour is usually yellowish brown or yellowish red but some whitebeam yield white timber. Usually straight-grained, of medium density (630 kg/m³ seasoned), the timber dries slowly with a tendency to split. The heartwood is perishable.

Amenity value

Common whitebeam is the characteristic tree of chalk hills, beautiful in flower and fruit, with white undersides to the leaves. Wild service-tree is rarer but when well grown is very handsome. Swedish whitebeam is another attractive tree in leaf, flower and fruit.

Conservation

They are all hosts to numerous insects and provide food for birds.

Timber value

The timber can be used for turnery and miscellaneous specialised purposes such as handles of cutlery and musical instruments. It makes good firewood, but is rarely available in large sizes.

Economic appraisal

Not timber trees but they are much used and are deservedly popular in exposed and smoky places in towns and industrial areas.

White willow *Salix alba*, Crack willow *Salix fragilis*

Cultivars include the Cricket bat willows *S. alba* cv. 'Coerulea', 'Foreman Essex', 'Kew Strain', 'Lockinge' and 'Oath'. Other tree willows include 'Belders', 'Liempde' and 'Tinaarlo'.

Sources of seed and plants

White willow is most common in England and less so in south west England, Wales, northern England and Scotland. Associated species include Black alder, Downy birch, Osier, Crack and Grey willows. Cricket bat willow is mainly grown in East Anglia. Crack willow has a similar distribution to White willow but is found further west and is more frequent than White willow in Scotland.

Silviculture

All the tree willows are light demanding and must have space to develop their crowns in full exposure to light.

Soil types

They are found alongside streams and rivers and are planted beside open ditches on deep, stiff alluvial loams or fertile boulder clays. Crack willow is more tolerant of poor soils.

Establishing and tending

Planting stock is produced from unrooted "sets" or rooted hardwood cuttings.

Rate of growth and yield

Fast growing, erect trees attaining heights of 20 to 25 metres. The Cricket bat willows have straight stems and small upward-slanting branches forming pyramidal crowns. The cultivar 'Liempde' has a narrow crown. White willow can produce stems with diameters of 100 cms but Cricket hat willows are felled when the stem diameter reaches 50 cms.

Protection and resistance

The watermark disease *Erwinia salicis* stains the timber making it valueless; the willow borer *Cryptorrhynchua lapathi* may carry the bacterium. The willows are damaged by late spring frosts which are one cause of stem cankers. They withstand exposure to wind and cv. 'Liempde' is suitable for tall windbreaks. They do not tolerate atmospheric pollution. They are rarely damaged by grey squirrels, but must be protected from cattle.

Timber properties

A diffuse-porous wood with fine, even texture. The sapwood is mainly white in colour and the heartwood pinkish. Straight grained and light in weight (450 kg/m³ seasoned) the wood dries well and fairly rapidly but local pockets of moisture are apt to persist. Clear timber is poor for bending and satisfactory for staining and polishing. The heartwood is perishable and resistant to preservatives.

Amenity value

The elegant habit and white undersides of the leaves of White willow are matched by the blue-grey leaf colour of Cricket bat willow.

Conservation

The native willows support 266 species of insect. They are browsed by red deer.

Timber value

A light and easily worked timber used for artificial limbs, chip baskets, plywood, particle board and paper pulp.

Economic appraisal

A useful group of trees, easy to raise and establish, visually attractive providing quick screens or shelter belts and producing a good general purpose timber on sites not suitable for poplar. Tree willows should not be planted close to the foundations of buildings.

Goat willow *Salix caprea*, Grey willow *S. cinerea*, Basket willow *S. triandra*, Common osier *S. viminalis*,

The cultivars include 'Aquatika gigantea Korso', 'Bowles hybrid', 'Dark French', 'Dasyclados', 'Mullatin', 'Northern Ireland', 'Sericans' and 'Viminalis'.

Sources of seed and plants

The oval-leaved Goat willow grows throughout Britain, extending up to 840 metres in Scotland. The closely related Grey willow has a similar distribution but does not grow above 600 metres. Common osier, notable for its narrowleaves, is widespread in the lowlands and does not grow above 400 metres. Basket willow is closely related to the Common osier and is restricted to the south-east and midlands of England.

Silviculture

All four species and their hybrids are light demanding pioneers. Goat willow occurs in woodland clearings, alongside rides and in hedgerows.

Soil types

All, especially the osiers and Basket willows, require moist or wet conditions and grow best on alluvial soils with high pH. Goat willow tolerates drier sites and Grey willow will grow on acid brown earths.

Establishing and tending

Planting stock is produced by rooting hardwood cuttings derived from stool beds; all four species coppice strongly.

Rate of growth and yield

The four species and hybrids will become small trees up to 10 metres tall, but are mainly grown as shrubs 2 to 3 metres tall. They grow quickly and yields of dry matter averaging 15 to 20 dry tonnes per hectare per year have been produced in trial plots by the cultivars 'Bowles hybrid', 'Dasyclados', 'Mullatin', and 'Viminalis'.

Protection and resistance

The willow leaf beetles *Galerucella lineola*, *Phyllodecta vitellinae* and *P. vulgatissima* damage Basket willow and osiers. Species and cultivars which tolerate exposure to salt winds are Goat willow, 'Bowles hybrid', 'Dasyclados', 'Reifenweide' and 'Sericans'. Goat willow is suitable for cold, high sites. Cultivars which tolerate atmospheric pollution and also improve soils are Goat willows, 'Bowles hybrid' and 'Sericans'. An ornamental cultivar is 'Dark French'.

Purple willow *Salix purpurea*, Violet willow *S. daphnoides*

Cultivars, including hybrids, include 'Abbeys', 'Helix', 'Forbyana' and 'oxford violet'. *Salix irrorata* is an exotic from south western America.

Sources of seed and plants

Purple willow is native to Britain and widely distributed but only locally common. It requires wet places and grows on alkaline fens and most alluvial soils of calcareous origin. Violet willow is not a native. It forms a small tree 10 or 12 metres tall. Planting stock of Purple and Violet willow is produced by rooting hardwood cuttings derived from stool beds; they coppice strongly.

Protection and resistance

Cultivars of Purple and Violet willow are valuable for sites exposed to salt-bearing winds - 'Abbeys', 'Forbyana' and 'Helix'. The cultivar 'oxford Violet' has been used to plant spoil heaps in north west England. *Salix irrorata* is a garden shrub providing purple stem colour in winter.

Notes on some additional species

Grey alder, *Alnus incana* is an exotic from Europe and the Caucasus which has been well tested in Britain. It grows well and is much used for shelterbelts and reclaiming derelict land. It tolerates poor soils but requires them to be dryer than does Black alder. Not suitable for thin chalk soils.

Italian alder, *Alnus cordata* is a handsome tree from Corsica and south Italy. It has been grown in Britain since 1820. It has been successful on exposed sites but does best on the sides of streams and ponds and other sites near to water.

Red alder, *Alnus rubra* is native to western North America. It has a long natural range from Alaska to California and should have good potential in Britain on upland sites but it has not yet been thoroughly tested and should be used with care, especially on difficult sites.

Common dogwood, *Cornus sanguinea*. A deciduous suckering shrub, widespread in England and Wales where it is found along the margins of woodlands and scrub, particularly on chalky soils. Notable for its pleasing red stems in winter.

Southern beeches, *Nothofagus obliqua* and *N. procera*. Two fast grown species with good habit of growth and showing great promise. The testing of provenances to obtain hardiness to frost continues and the full potential and limitations of these handsome trees should soon be known.

Poplars currently approved for grant aid from the Forestry Commission are:- *P. x canescens*; *P. x euramericana* 'Eugenei', 'Gelrica', 'Heidemij', 'I-78', 'Robusta' and 'serotina'; *P. tacamahaca* x *trichocarpa* 32; *P. trichocarpa* 'Fritzi Pauley' and 'Scott Pauley'.

Bird cherry, *Prunus padus*. A small, attractive native shrub suitable for planting in Scotland and northern England on acid brown earths for amenity and on the margins of coniferous shelterbelts. Regenerates from seed and also suckers.

Red oak, *Quercus borealis*. A quick growing tree suitable for light sandy soils. It withstands atmospheric pollution and produces a general purpose hardwood timber. It has grown well in the Midlands of England and has proved valuable for reclaiming derelict industrial sites. *Acorns* must be collected from stands recorded in the National Register of Seed Sources under EEC rules.

False acacia or Locust tree, *Robinia pseudoacacia*. A leguminous tree that has root nodules and can fix atmospheric nitrogen. It tolerates poor, dry light soils, whether calcareous or acid and can also withstand atmospheric pollution. So it is a valuable tree for reclaiming derelict land.

Elms, *Ulmus* species. Until cultivars resistant to the Dutch elm disease have been produced and thoroughly tested, it is better to plant alternative species for woodlands and hedgerows, for example ash, beech, hornbeam, Small-leaved lime, Large-leaved lime, Norway maple, the oaks, Sweet chestnut, sycamore, White willow and also trees of smaller stature such as the alders, birches, Wild cherry, rowan, Whitebeam and Wild service-tree.