

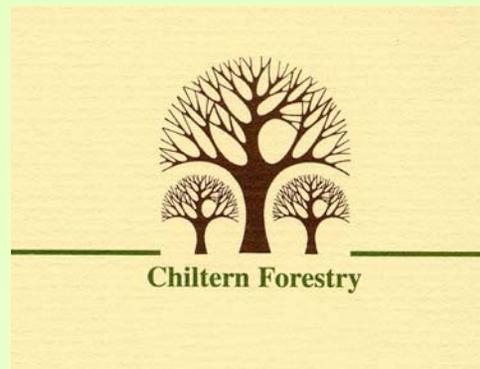
Growing Valuable Broadleaved Tree Species

COST Workshop on Wood Quality

Silvicultural Perspective

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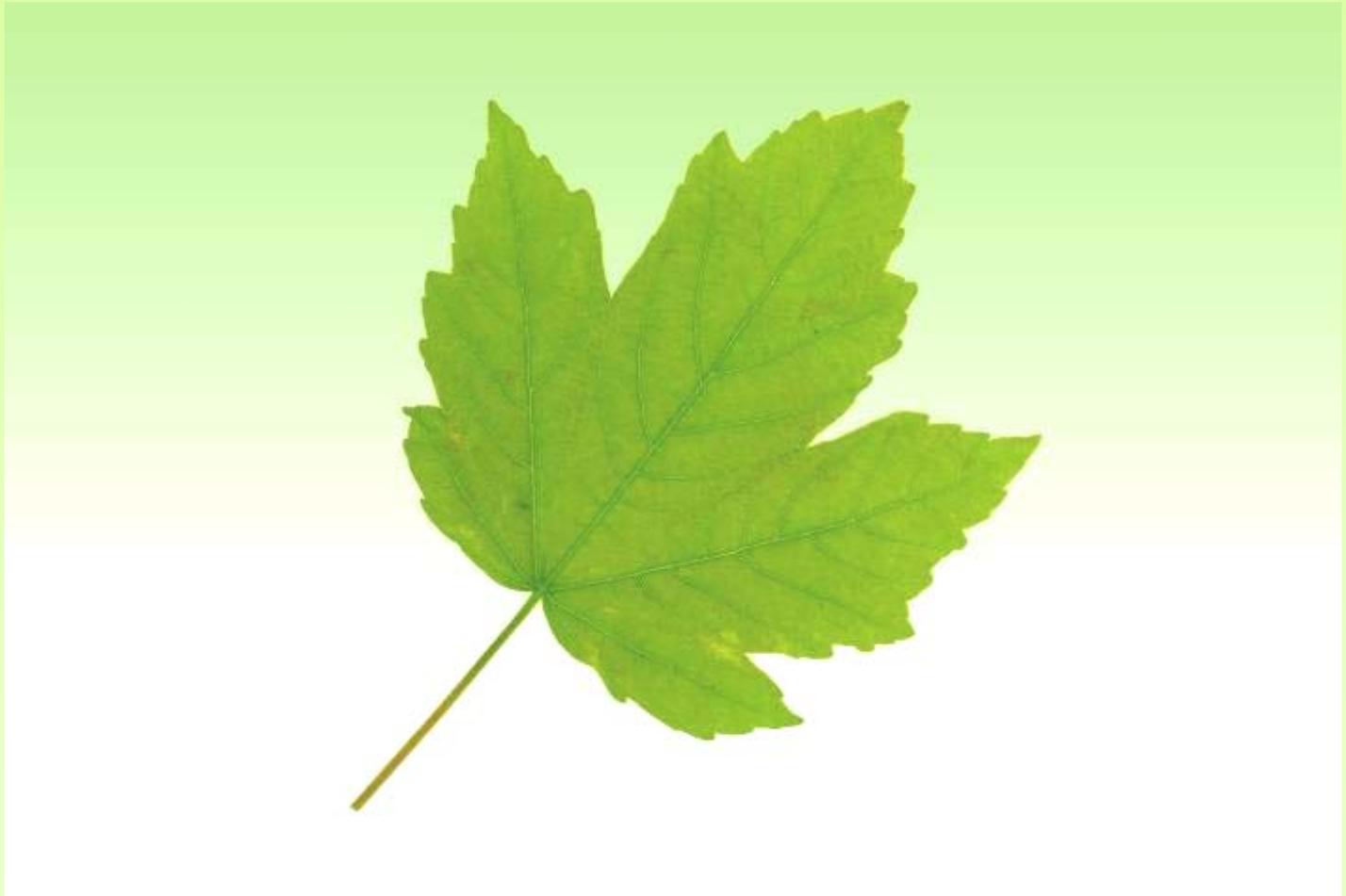
Oxford, UK



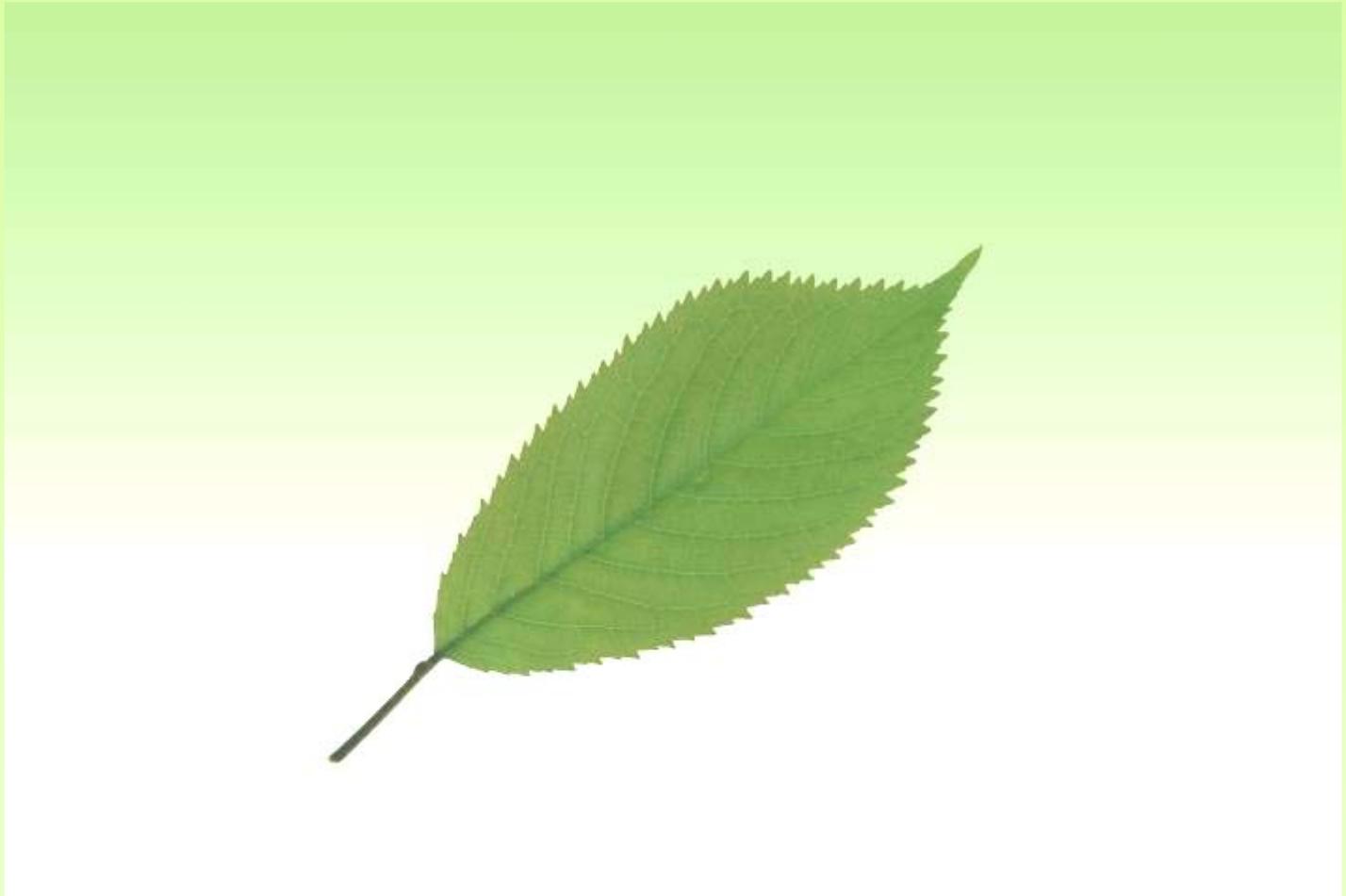
Fraxinus excelsior. Ash



Acer pseudoplatanus. Sycamore



Prunus avium. Wild Cherry



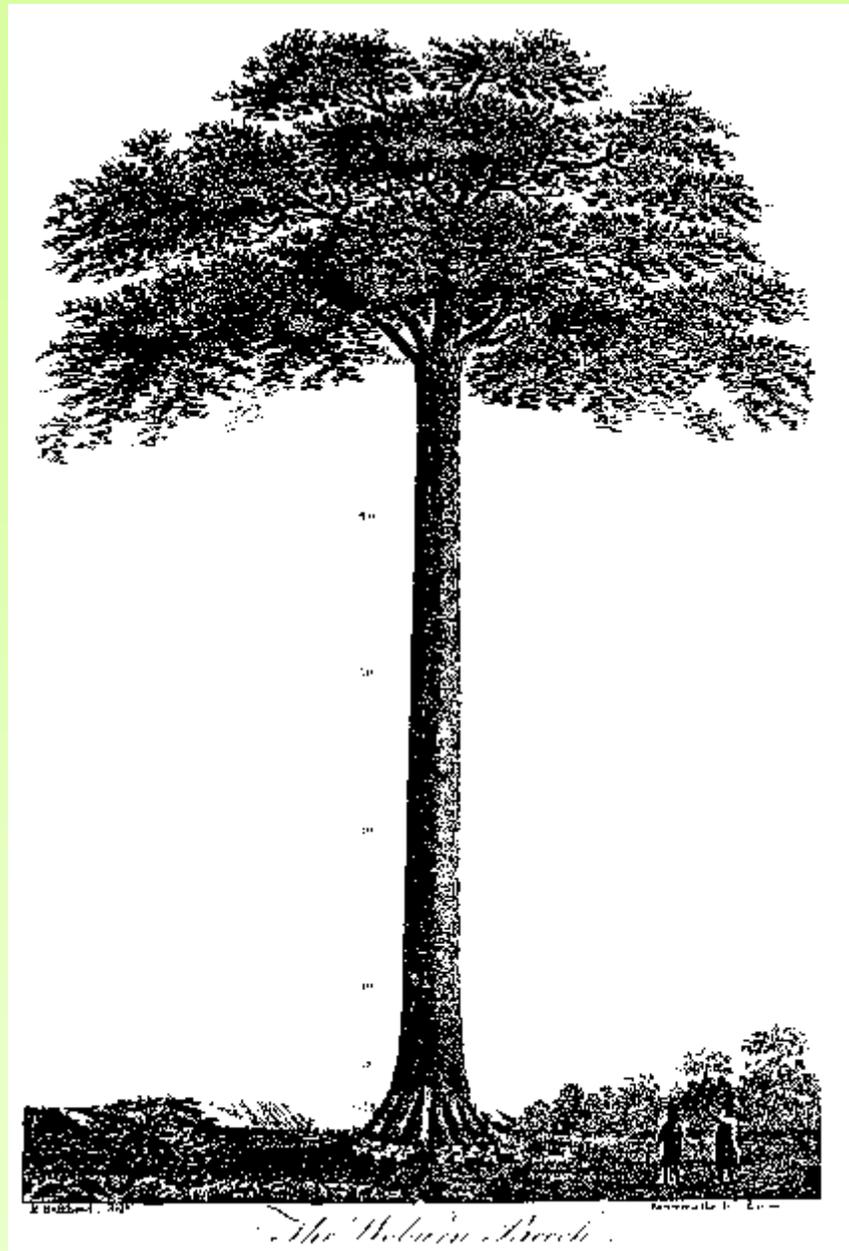
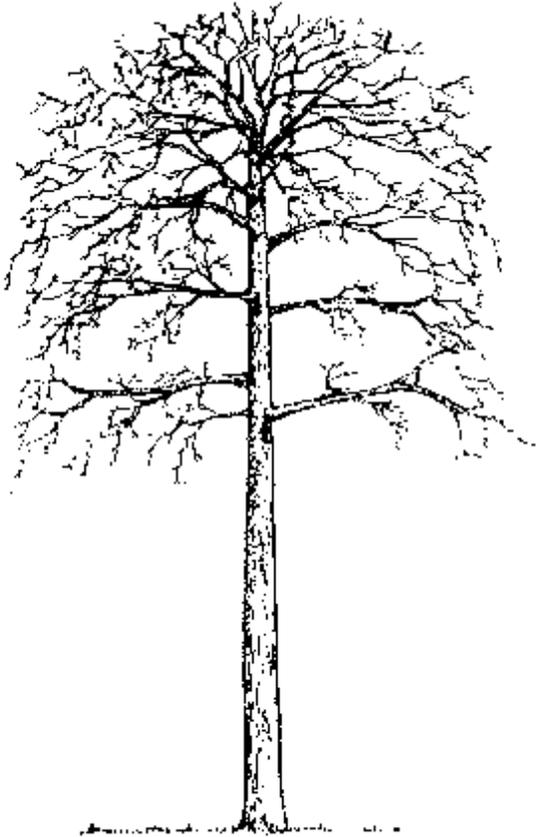


Illustration from *The Forest Pruner* by William Pontey 1808

The ideal tree



- Healthy balanced crown
- Strong apical dominance
- Flat branch angle
- No forking
- Light branching habit
- Good crown to stem ratio
- Straight clean stem
- Minimal taper
- Well rooted

Site requirements for growing quality timber

Species	Soils	Site	Light	Altitude	Climate
Ash Fraxinus excelsior	Deep, moist, free draining, fertile, over chalk/ limestone, nitrogen rich Ph 6.5 - 8	Frost free, sheltered	Light demander except as seedling	Where suitable site conditions prevail	Sunlight hours, rainfall and temperature seem to have minimal influence in the UK
Sycamore Acer pseudoplatanus	Deep, free draining, over chalk/ limestone or acid brown earths Ph 5.5 - 7.5	Frost free, sheltered	Initially shade tolerant, light demander after sapling stage	As above	As above
Wild Cherry Prunus avium	Deep, moist, fertile, deep clay loams over chalk/ limestone Ph 5 - 6.5	Sheltered	Initially shade tolerant, light demander	As above	As above



Mercurialis perennis

A good site indicator for Ash

Timber production

Species	Age of max. mean annual increment	Average yield m ³ /ha/pa	Rotation lengths years	Cumulative volume production m ³ /ha	Average density of wood at 15% moisture Kg/m ³	Major timber defects	Main end uses
Ash Fraxinus excelsior	40-50	4-10	50-70	300-650	710	Blackheart	Veneers Furniture Sports Equipment Tool handles
Sycamore Acer pseudoplatanus	38-50	6-12	45-70	400-750	630		Veneers Furniture Turnery
Wild Cherry Prunus avium	40-55	6-10	50-75	450-700	630	Green ring Spiral grain Heart rot	Veneers Furniture Turnery

The ideal log

- Straight grained
- Knot free
- Heart centred
- Even annual ring width
- No defects
- Good colour
- Minimal taper
- Suitable length for market

Major pests and diseases affecting timber quality

- Ash (*Fraxinus excelsior*)
 - Bacterial canker (*Pseudomonas savastanoi*)
 - Ash bud moth (*Prays fraxinella*)
- Sycamore (*Acer pseudoplatanus*)
 - Sooty bark disease (*Cryptostroma corticale*)
 - Grey Squirrel (*Sciurus carolinensis*)
- Wild Cherry (*Prunus avium*)
 - Bacterial canker (*Pseudomonas syringae*)
 - Heart rot (*Armillaria melia*)
 - (Heterobasidion annosum)
 - (Phaeolus schweinitzii)
 - Cherry blackfly (*Myzus cerasi*)
 - Silver leaf (*Chondrostereum purpureum*)
- All species
 - Hare (*Lepus europaeus*)
 - Rabbit (*Orytolagus cuniculus*)
 - Deer (*Capreolus capreolus*)



American Grey Squirrel

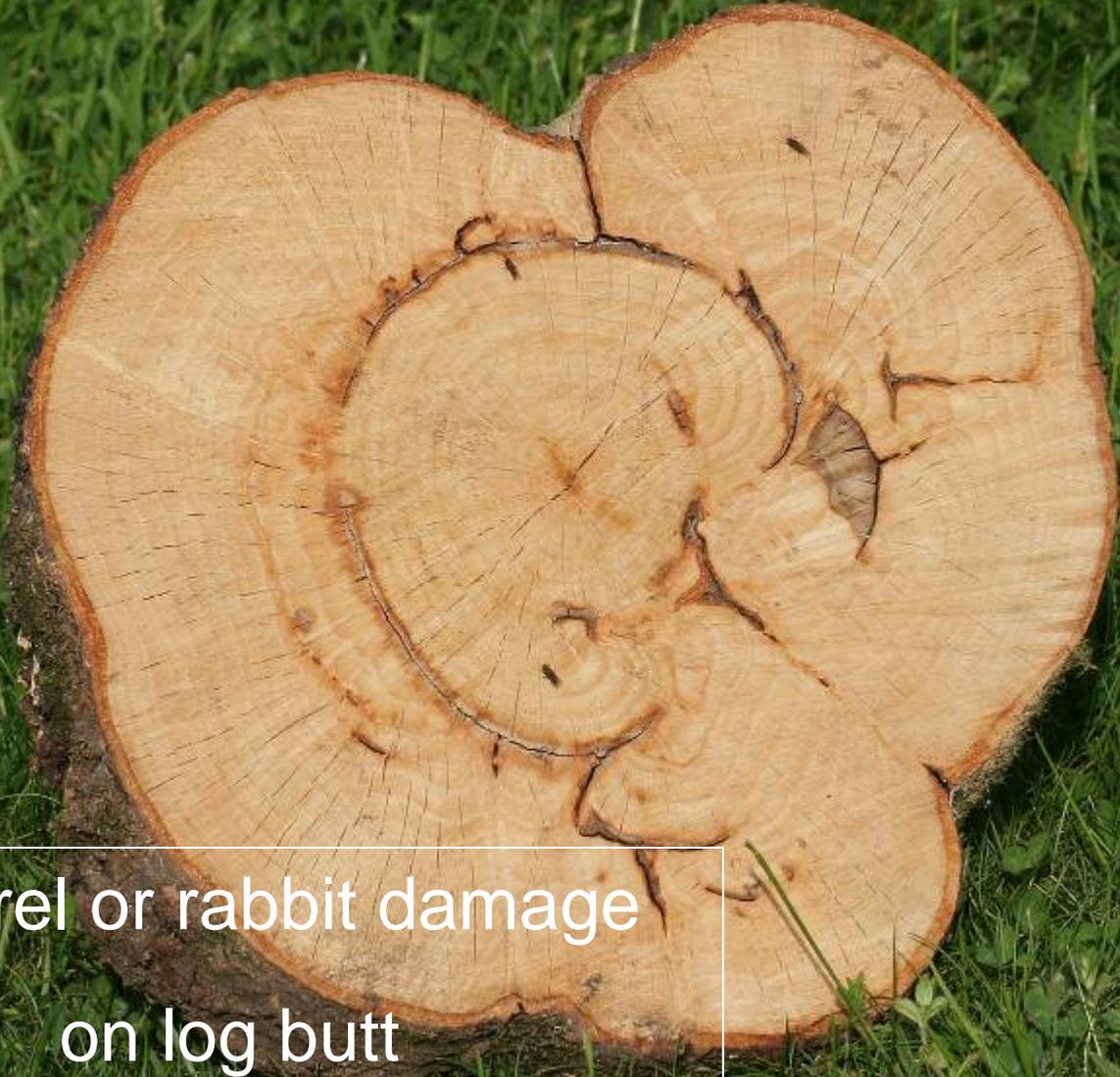
Scirus carolinensis



Bark stripping by
the Grey Squirrel

A photograph of a forest scene. In the foreground, a tree trunk shows significant damage, with large sections of bark missing, revealing the lighter wood underneath. To the right of the tree, a vertical marker is visible, consisting of a white base and a red top section. The background is filled with many other trees, some with green leaves and others without, suggesting a mixed forest. The ground is covered with green vegetation and fallen leaves.

Grey squirrel
damage

A cross-section of a log butt, showing the internal wood structure. The wood is light brown and shows several distinct, irregular holes and tunnels, characteristic of squirrel or rabbit damage. The log is resting on a green lawn.

Squirrel or rabbit damage
on log butt

Silviculture – To establish and produce high quality timber.

Planting

- Species suited to the site
- Good genetic stock from registered seed source
- Plants from reputable nursery
- Correct handling and planting technique
- Plant at correct time of year
- Stocking- at least 2500 trees/ ha
- Suitable protection and/ or pest control
- Good maintenance
- Early formative pruning
- Thin at right time
- High prune as required

Natural regeneration

- Sufficient quality seed trees
- Species suited to the site
- Good seed year
- Suitable ground preparation and weed control
- Suitable protection and/ or pest control
- Stocking- at least 11000 seedlings/ ha
- Good maintenance
- Early formative pruning if required
- Thin/ re space at right time
- High prune if required

Management

- The three species grow well together in intimate mixtures as well as with other broadleaved species
- They grow on a wide range of sites, but only the highest quality timber will come from the ideal site
- Similar rotations to conifers, therefore a conifer nurse will not necessarily be required. However Larix would be a well matched species if desired
- Suited to Group or Single tree selection systems as well as clear cut and new planting
- Essential to thin at correct time, all have poor recovery from delayed interventions
- Retain a deep crown, 1/3 the height of the tree to retain vigour and optimise returns
- They all have strong apical dominance, and are best grown in an almost free growth environment
- Because of the above it would be possible to have lower stocking densities than other broadleaved species, particularly if genetic improvements are achieved

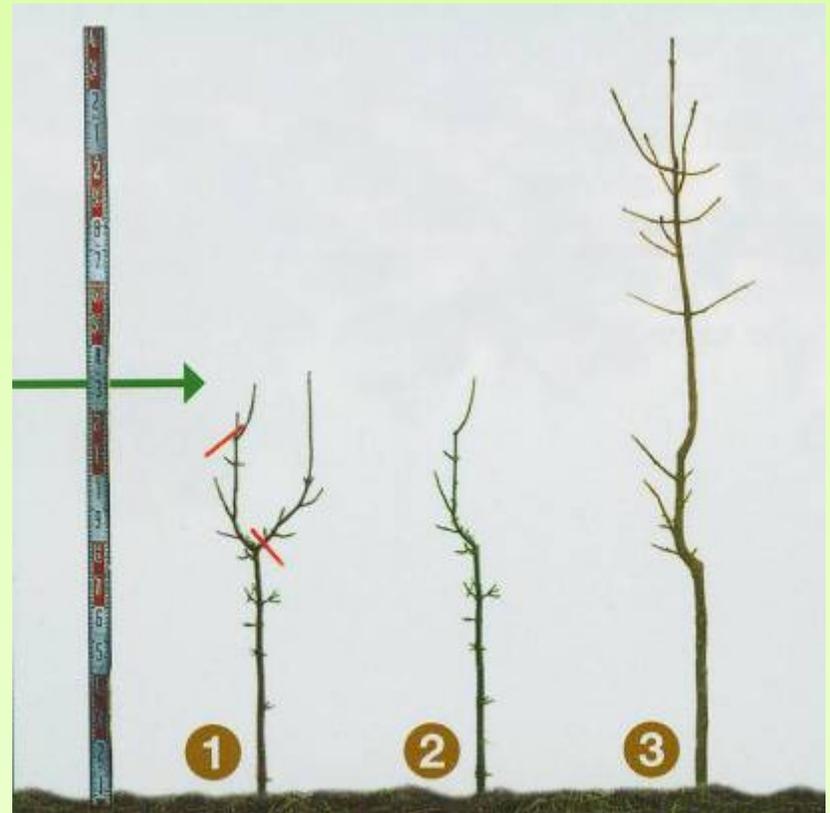
Pruning

Objectives- To remove both live and dead branches from a tree's stem to produce knot free high quality timber

Formative pruning

- Start pruning 3 to 4 years after planting
- Prune up to 50% of timber producing species evenly spread across the plantation
- Branches should be removed before they reach 2cm diameter at the stem
- Prune every one or two years until the tree reaches 3 to 4 metres
- Up to this height the crown to stem ratio should be $\frac{1}{2}$ to $\frac{1}{2}$
- Over this height the ratio can be $\frac{1}{3}$ crown $\frac{2}{3}$ stem
- Aim to retain apical dominance on one leader
- Prune at correct time of year

- 1 Before pruning
- 2 After pruning
- 3 Two years later





Ten year old Ash and Cherry
pruned to 2.0-2.5 metres



Eight year old unpruned
Cherry at 1100 trees/ ha



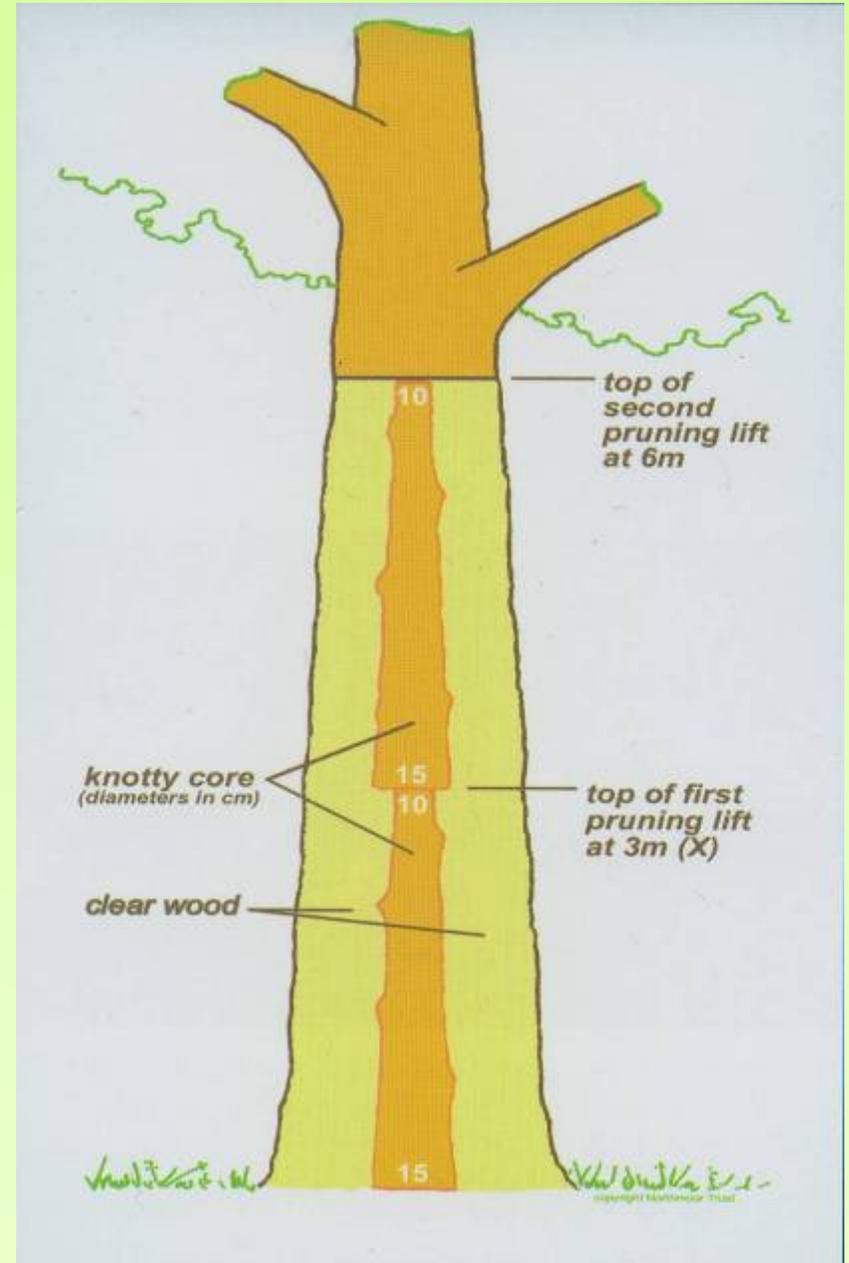
Eight year old Cherry
pruned too late



Occluding pruning wounds on Cherry
infected with bacterial canker

High pruning

- Prune before stem is 15cm in diameter
- Prune up to a stem diameter of 10cm
- Once this 10cm reaches 15cm repeat the process
- Prune up to 6 metres (About the maximum height achievable from ground level)
- Aim to remove all branches before they reach a maximum of 5cm diameter at the stem
- Retain 1/3 live crown
- Prune at correct time of year
- To be cost effective prune no more than double the number of final crop trees



Tree improvement (Breeding)

The approach to assessing the economic benefits of tree improvement involves the calculation of genetic gain.

Genetic gain = selection differential x heritability

- **Key traits assessed:**
 - Stem straightness
 - Branching habit
 - Timber properties
 - Disease resistance
 - Pest resistance
 - Growth rates
- **Improvement strategies:**
 - Simple recurrent selection
 - Simple mass selection
 - Mass selection with progeny testing
 - Selection and mass vegetative propagation
 - Mass vegetative propagation and testing

Tree improvement - Silviculture

- Traditionally improvement programmes have been based on extensive provenance and progeny testing
- More recently clonal techniques have been used. This approach offers more rapid genetic gains to be achieved
- Trees have generally been grown on sites not suitable for agriculture, by definition poorer soils and terrain. However with the political aims of reducing agricultural production, better sites should be available. Theoretically It will be possible using improved stock to grow high quality timber, in shorter rotation times, at wider spacing and lower establishment costs
- Improved returns need to be demonstrated to convince landowners to invest, for currently the costs are higher (plants x3 more expensive)
- To invest in expensive improved trees without high quality management is not cost effective
- Improved genetic materials will not perform to their optimum without the best management
- Silviculture, selection and breeding each have the potential to improve quality, but need to work together to obtain the best results
- However it is the management that will ultimately determine the financial returns

A wide-angle photograph of a field under a cloudy sky. The foreground and middle ground are filled with numerous young, green cherry trees planted in a regular grid pattern. The trees are surrounded by a mix of green grasses and taller, brownish-tan weeds. In the background, a line of more mature trees and a distant horizon are visible under a bright, overcast sky with scattered white clouds.

Improved Cherry clones planted
at 156/ ha (final spacing) in mixture

Thinning selection

Species	Final crop trees/ ha. Less if large diameter in an even aged system
Ash Fraxinus excelsior	120 - 150
Sycamore Acer pseudoplatanus	140 - 170
Wild Cherry Prunus avium	140 - 160

- Initial selection 3-4 times the number of final crop trees
- Start selection when top height is 6-10 metres
- Clean/ re space natural regeneration when top height is 3-5 metres

Selection criteria

- Good stem form
- Good vigour
- No deep forking or steep angled branches
- Disease free
- Strong apical dominance

Log quality classes

Log defects	Veneer	Grade 1	Grade 2	Grade 3
Sweep	None	None	< 10% of top diameter	< 20% of top diameter
Spiral grain	None	None	5cm in 4 metres	5 cm in 3.5 metres
Sound knots	None	Up to 5 cm diameter	Up to 7.5 cm diameter	Up to 10 cm diameter
Dead knots	None	None	None	Up to 5 cm diameter
Knot frequency	None	One per 2 metre run	One per 1.5 metre run	No restriction
Butt rot	None	None	5% of butt diameter	15% of diameter
Blackheart	None	None	25% of diameter	50% of diameter
Ring shake	None	None	None	Not occurring beyond 50% of the radius from the core
Star shake	None	None	None	Extending no further than 50% of radius from core
Position of core	Centred	Well centred	Well centred	Reasonably centred
Worm holes	None	None	None	None

Timber prices €per m3 roadside 2005

Ash	Veneer	1 st quality	2 nd quality	3 rd quality Pallet/ chip/ firewood
>50cm	No market	66	10	0-4
40-49cm	No market	47	10	0-4
35-39cm	No market	28	6	0-4
Sycamore				
>50cm	112	66	10	0-4
40-49cm	No market	57	10	0-4
35-39cm	No market	38	10	0-4
Cherry				
>50cm	187	103	No market	0-4
40-49cm	No market	84	No market	0-4
35-39cm	No market	28	No market	0-4



New planting- trees in 60cm
guards, surrounded by 2m
deer fence

Establishment and tendering costs in south east England on agricultural land

Contract costs Euro per hectare 2005

Operation. Year 0 - 15	Scenario 1. Rabbit protection	Scenario 2. Deer fence and rabbit protection
Establish- Plant 2250 trees/ha Fence. Year 0	1675	1675 1420
Maintenance- replace losses-weeding- guards. Year 1-4	1075	1075
Formative and High pruning to 6 metres. Year 3-15	235	235
Planning/ management for 15 years	500	500
Totals	3485	4905
Grant aid on arable land over 15 years	4358	4358
Grant aid in forest over 15 years	361	361



Ash seedlings
at 20,000 + per ha



Ash saplings
at 15,000 + per ha



Thirty-five year old Ash
naturally high pruned



Three age classes of Ash and
Sycamore in an intimate mix



High quality Ash log with
eight metres of clear stem

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