Specification manual

A guide to specifying young trees from the nursery

By Appointment
To Her Majesty The Queen
Specialist Container Tree Growers
Barcham Trees PLC, Ely

By Appointment
To His Royal Highness The Prince of Wales
Specialist Container Tree Growers
Barcham Trees PLC, Ely

Trees & Design Action Group

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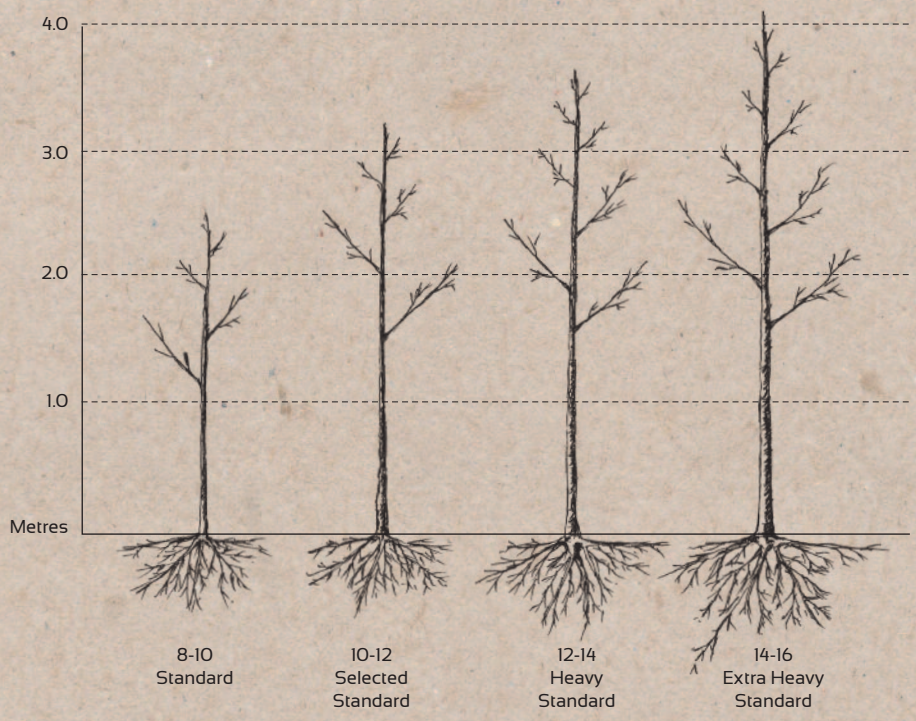

Height and Clear Stem of Nursery Trees

Size of Tree	Circumference at 1 metre	Height of tree	Clear stem
Standard	8-10 cm	2.5-3.0 metres	1.75 -2.0 metres
Selected Standard	10-12 cm	3.0-3.5 metres	1.75- 2.0 metres
Heavy Standard	12-14 cm	3.5 metres	1.75-2.0 metres
Extra Heavy Standard	14-16 cm	3.5 metres	1.75-2.0 metres
		BS 8545 and BS 3936	

1.0

Introduction

The word quality is often used by those purchasing young trees from the nursery. The word is ill defined and can be ambiguous. Knowledge of nursery production systems, the reasons for and the outcomes of production processes are often poorly understood. This lack of knowledge results in specification documents produced to procure young trees often being poorly constructed and inadequate.

The purpose of this specification manual is to explain the nursery production processes involved in the production of young trees. It is intended to highlight the good practice and the bad practice found in the three principle production methods used on UK tree nurseries. It will also provide clear, concise statements which can be used in the drafting of specifications for the procurement and supply of young trees.

The specification manual will feature clear diagrams which can be used to inform and clarify young tree specifications. It offers a Barcham Trees perspective of what is important when constructing young tree specifications and what our nursery aspires to but it is recommended that BS 8545 Trees: From Nursery to Independence in the Landscape (2014), The European Technical and Quality Standards for Nursery Stock (2010) and the National Plant Specification Guide, are also referred to.

For the purpose of this manual, young trees are those produced on a single stem beginning with a stem circumference (girth) of 6-8cm at 1 metre high. All nursery trees produced in Europe are graded by the stem circumference at 1 metre above ground. This is illustrated in the diagram and table opposite.

It is important to note that even the most detailed and comprehensive of young tree procurement specifications cannot compensate for inappropriate species selection.

Keith

Keith Sacre

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2.0

Young Trees

In this section you will find the advantages and disadvantages of the three principle production systems used by UK tree nurseries clearly outlined in table form.

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2.0 Nursery Production Methods

The three principle production methods used in the UK are, bare root, rootballed and containerised trees.

All three of these systems effectively influence root development rather than crown development. All three are, when good practice is followed, effective. Each system has advantages and disadvantages and it is these factors which need to be understood when constructing specifications for the procurement of young trees. The advantages and disadvantages of these are outlined in the table opposite.

Production System

BARE ROOT
(Open ground)

Advantages	Disadvantages
The cost of production is lower when compared with other methods, and this is reflected in the supply cost.	The appropriate time for lifting from the nursery field and transplanting into the landscape is limited to the dormant season.
Bare root trees are lighter than, rootballed, containerised equivalents and are therefore easier and more economical to handle, transport and plant.	Not all species are tolerant of the technique.
They are less likely to contain soil-borne disease than trees supplied with soil.	A significant proportion of fine roots might be damaged at lifting and during transport.
This is the best production system for identifying and correcting root deformities prior to planting in the landscape.	As a general rule, the larger the bare root tree within a given species, the higher the mortality rate, with survivors slow to recover.
	Field soil conditions can limit times of lifting and planting, with frozen, very wet and very dry soils being unsatisfactory.
	Handling and care of bare root trees between lifting and planting is critical to achieving good survival rates. Roots need to be kept moist at all times, and where there is a delay between lifting and planting, the roots need to be heeled in.
	Bare root trees are lifted directly from the field. Each field is part of a crop cycle with lifting occurring over a two/three year period. Often the best trees are lifted first.
	Evergreen trees are rarely moved as bare root specimens.

Production System

ROOTBALL
(ball and burlap)

Advantages	Disadvantages
The lifting and transplanting season is extended when compared to bare root trees.	If the nursery practice is poor then as much as 95% of the root system can be lost on lifting.
Trees that have poor survival percentages when handled bare root can be transplanted successfully.	Actual lifting from the nursery field is limited to the dormant season for all but a very small number of tolerant species.
Trees may be lifted from the nursery field ahead of time and stored above ground if handled correctly. This extends the period for planting beyond the dormant season.	Handling of large rootballs is labour intensive with rootballs being heavy and awkward to transport.
Care between lifting and planting is less critical than for bare root trees as the roots are ideally kept moist and frost-free within the rootball.	If the rootball is broken or allowed to shift during handling and despatch, the chances of tree survival are reduced.
	Field soil conditions can limit times of lifting, with frozen, very wet and very dry soils being unsatisfactory.
	Rootballs are generally more expensive than bare root trees.
	Successful transplanting and longevity in the landscape can be adversely affected if the primary root or root flare is too deep within the rootball as a result of poor nursery production.
	This is the worst tree production system for identifying and correcting root deformities prior to planting.

Production System

CONTAINERISED TREES

Advantages	Disadvantages
The root system is entire and undamaged when it arrives at the planting site.	Additional irrigation might be needed during the post-transplanting maintenance period.
Containerised trees can be planted at any time of the year, although soil conditions in the summer can be a limiting factor.	The organic soil-less compost used in containerised mixes can shrink if allowed to dry out.
The trees are generally easier to handle than rootballed trees.	There is the potential for root circling and subsequent root girdling. This is true of all container production systems irrespective of container type. If a tree is left in a container for too long, its roots fill the pot and become distorted.
The trees are generally easier to store than trees from other production systems.	If lifted for despatch too early there is a risk that root formation in the container will not be complete and compost will fall away leaving an exposed root system at the time of planting.
Post-transplanting stress and shock is reduced to a minimum, consequently achieving earlier benefits from planting.	Some containerisation systems involve the root system being moved from production to despatch packaging. This movement can result in drying out and or root damage.
Containerised trees generally weigh less than rootballed trees, as the growing media used is usually organic rather than soil based.	Containerised trees are generally more expensive than bare root or rootballed trees.
Trees are not lifted directly from the nursery field for despatch and are unlikely to have suffered root damage.	Movement from smaller to larger containers can result in root deformation and delayed failure in the landscape.
Irrigation and nutrition can be regularly monitored and easily adjusted throughout the production process on the nursery and any subsequent storage period prior to planting.	Containerisation can result in the root flare being buried too deep in the container.
Trees are grown in a controlled environment throughout the production process.	

Crown development is consistent whichever of the above production methods is used by the tree nursery.

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At Barcham young trees are our specialism.

We have a pride in our chosen production system and are passionate about our trees enjoying longevity in the landscape.

This guide results from our specialism, pride and passion.

3.0

Tree Health

In this section you will find information about young tree health and the detail which can be specified to ensure young trees from the nursery are 'fit for purpose'

Both morphological and physiological characteristics are itemised.

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3.0 Tree Health

There are numerous methods of assessing tree health on the nursery when selecting young trees. These are largely visual and assess morphological characteristics and are only as effective as the level of expertise of the assessor.

These morphological characteristics are described in Diagram One. (opposite)

Each of these characteristics can be used to construct young tree specifications.

Foliage is a good indicator of the presence of a pest or disease. Abnormal colouration or leaf lesions can indicate nutrient deficiency, poor physiological health, biotic or abiotic stress and the presence of foliar damaging pests.

Any die back in the nursery formed crown can be an indicator of physiological dysfunction, inadequate or interrupted irrigation, poor pruning or reflect the impact of pest and or disease.

Sparse, erratic, uneven and stunted foliage are indicators of physiological dysfunction and stress.

Extension growth is a good indicator of tree health. This should be evenly distributed across the whole crown with growth patterns commensurate with previous growing seasons and typical for the species or cultivar under consideration. Nursery formative pruning may make the comparison of seasonal growth difficult.

Young trees, other than multi stemmed and feathered specimens are produced on a clear stem. Abnormal erratic adventitious shoot formation on this main stem can be an indicator of vascular dysfunction.

Untypical or abnormal flattening on the main stem can be an indicator of root pathogens.

ITEMS WHICH CAN BE SPECIFIED

All foliage should be free of significant leaf lesions or abnormal discolouration.

The crown structure should be free from any dieback.

Foliar density and size should be typical of the species and or cultivar.

Extension growth should be compared with and comparable to the growth of the previous year where this is apparent.

The main trunk/stem of the tree should be free of abnormal excessive adventitious bud development.

The main trunk/stem should be free from any significant untypical flattening.

There should be no epicormic growth emerging from the rootstock of the tree.

A	Ill defined leader and or shoot tip dieback
B	Weak laterals with dieback or poor growth
C	Strong growing laterals which may compete with or obscure the leader
D	Stunted or one sided growth
E	Upright branches which run up through the crown
F	Untypical or abnormal growth
G	Large pruning wounds which show no signs of healthy occlusion
H	Large amounts of epicormic growth on the main stem
I	Epicorminc growth emerging from the understock
J	Disproportionate growth of stock or scion wood in relation to each other
K	Abnormal flattening of the main stem which may indicate a degree of vascular dysfunction
L	Poor annual growth in relation to previous years (this may not be apparent where nursery formative pruning has taken place)
M	Shoot tip dieback
N	Abnormal foliar distortions or areas of foliage missing
O	Areas of abnormal discolouration on the foliage
P	Weak, irregular or untypically small foliage

3.1 Tree Health
Physiological health testing

In addition to the purely visual criteria outlined it is now possible to assess the physiological condition of young trees using simple non destructive scientific tests.

At Barcham we use independent consultants to annually test the physiological condition of young trees on the nursery. The tests used assess chlorophyll fluorescence, chlorophyll content and cell electrolyte leakage. These tests have been demonstrated to reflect, accurately, whole tree physiological health. Over 15,000 trees with ten individual leaf samples taken from each tree are tested each year. As a result we have constructed a nursery benchmark system.

This system has now been calibrated and can be used to assess the physiological condition of young trees on the nursery and subsequently in the landscape.

This system is called the Arborcheck system and is described on the Barcham Trees website www.barchampro.co.uk.

We would suggest that this can be specified.

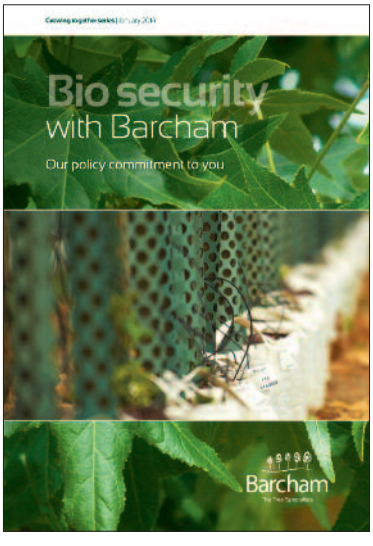
ITEMS WHICH CAN BE SPECIFIED

A statistically significant sample of all tree species on the nursery should have been independently tested for their physiological health, using leaf fluorescence, chlorophyll content and cell electrolyte leakage with results compared to the nursery benchmark to ensure that the trees are in optimum physiological condition and fit for purpose.

The independent report of physiological health testing should be available for inspection

3.2 Tree Health
Bio-security

Many of the imported pests and diseases which threaten the resilience and longevity of tree populations are traceable to UK nurseries. A significant percentage of young trees planted out into the UK landscape, both rural and urban, have spent no more time on a UK nursery than it takes to transfer trees from one lorry to another.



Policy Statements

Barcham Trees will NOT import trees and sell to customers for immediate planting into the UK landscape. All imported trees will be held on the nursery for one full growing season during which time they will be subjected to rigorous inspection for pest and disease. This includes systematic and regular DEFRA visits to the nursery.

In addition to the routine pest and disease control programme implemented on the nursery over 15,000 trees across the entire species range are annually, randomly and independently examined for physiological health using leaf fluorescence, chlorophyll content and cell electrolyte leakage. This report is published and available for public inspection.

Every batch of trees imported onto the nursery has its own Batch Number and can be seen on every Barcham Tree. This Batch Number provides a complete audit trail both from supplying nursery and out into the UK landscape once the trees are sold. This precautionary measure enables a complete recall of any batch of trees in the unlikely event of an outbreak of serious pest and/or disease due to imported tree stock.

This threat to UK bio security can be avoided.

ITEMS WHICH CAN BE SPECIFIED

All imported trees for transplanting into the UK landscape should have spent at least one full growing season on a UK nursery and have been subjected to a full pest and disease programme.

Evidence of this control programme, together with a comprehensive audit trail of when the imported trees were received and how long they have been on the nursery, should be available. This audit trail should extend beyond the nursery after despatch, allowing for a full recall in the event that any pest and or disease problems may subsequently manifest themselves in the landscape.


DAMCON

4.0

Branch, Stem and Crown Development

Irrespective of the production system used the techniques used on the tree nursery are consistent in stem and crown development. Outlined in this section are examples and explanations of good and not so good nursery practice coupled with items which can be specified to ensure young trees are 'fit for purpose'.

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4.0 Branch, Stem and Crown Development

A significant number of young trees are either budded or grafted during the production process.

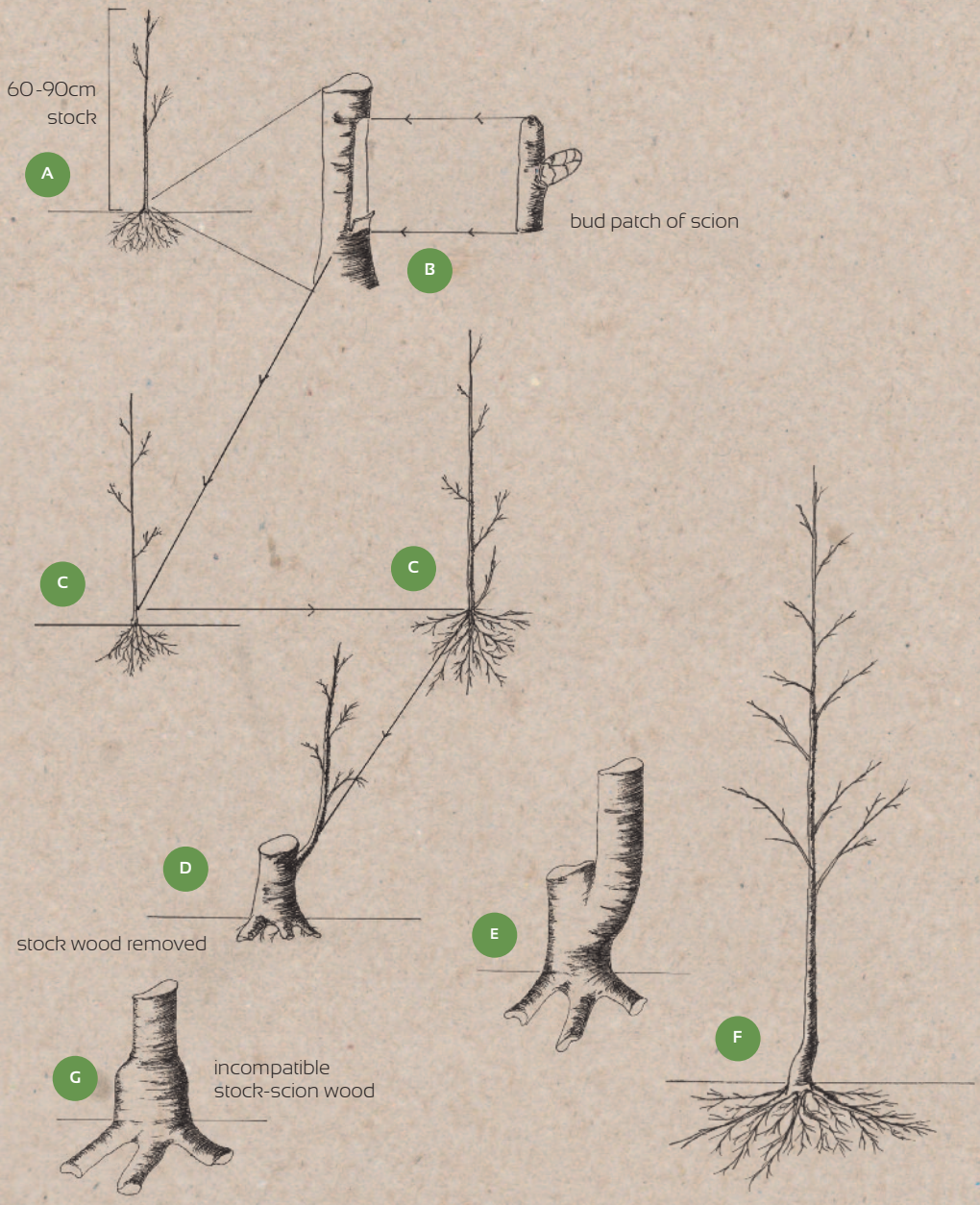
These techniques (as illustrated in the diagram opposite) are used for the production of cultivars of a particular species with the cultivar scion wood budded onto the appropriate understock.

Examples include

- Acer campestre 'Louisa Red Shine' budded onto Acer campestre understock.
- Pyrus calleryana 'Chanticleer' budded onto Pyrus communis.
- Sorbus aucuparia 'Sheerwater Seedling' budded onto Sorbus aucuparia understock.
- Such budding is normally carried out at the base of the stock plant above soil level and can be clearly recognised by a slight bend towards the base of the main stem above the root collar which becomes less pronounced as the young tree develops.
- There will be some species where the scion wood is grafted onto a more mature main stem which may be two or more metres tall.

Examples include

- Chitalpa tashkentensis 'Summer Bells' with Chilopsis being grafted on to a Catalpa main stem.
- Also Fraxinus ornus Meczek.
- Some trees may have been both top and bottom worked which means there are two unions on the same tree, one at the top and one at the bottom.
- An example of this is, Prunus fructicosa Globosa, where Prunus avium is budded onto a Colt understock with fructicosa globosa grafted onto the top to form the crown.
- The compatibility of scion wood and understock coupled with the quality of contact between cambium and other meristematic tissues are essential in the successful formation of a permanent bud or graft union.
- Poor or incompatible bud or graft unions can lead to failure in the landscape, sometimes years after planting has occurred. Such poor or incompatible graft unions can be identified on the nursery where there is a visible differential in growth rates between stock and scion wood resulting in an apparent swelling of either.
- A large amount of epicormic growth emerging from the stock wood can also be an indicator of poor bud or graft union.



A	Understock planted out in nursery field
B	Bud of scion wood inserted in stock wood
C	Bud begins to develop
D	Understock removed leaving scion bud to develop as a main stem
E	Diagram of cut. At no time should the bud union be below soil level
F	Young developing budded tree
G	Swelling at the bud union which may indicate incompatibility. As the young tree develops growth masks the cut area which remains visible as a slight bend at the base of the main stem
H	Disproportionate growth in the area of the bud union is an indicator of imcompatibility between stock and scion wood

Examples of poor bud unions which may result in eventual failure in the landscape.

ITEMS WHICH CAN BE SPECIFIED

Growth between stock and scion wood should be equitable with no disproportionate growth apparent between the two.

The supplying nursery should be able to indicate the understock used to produce any particular cultivar.

At no time during the production process should the bud union have been below soil level.

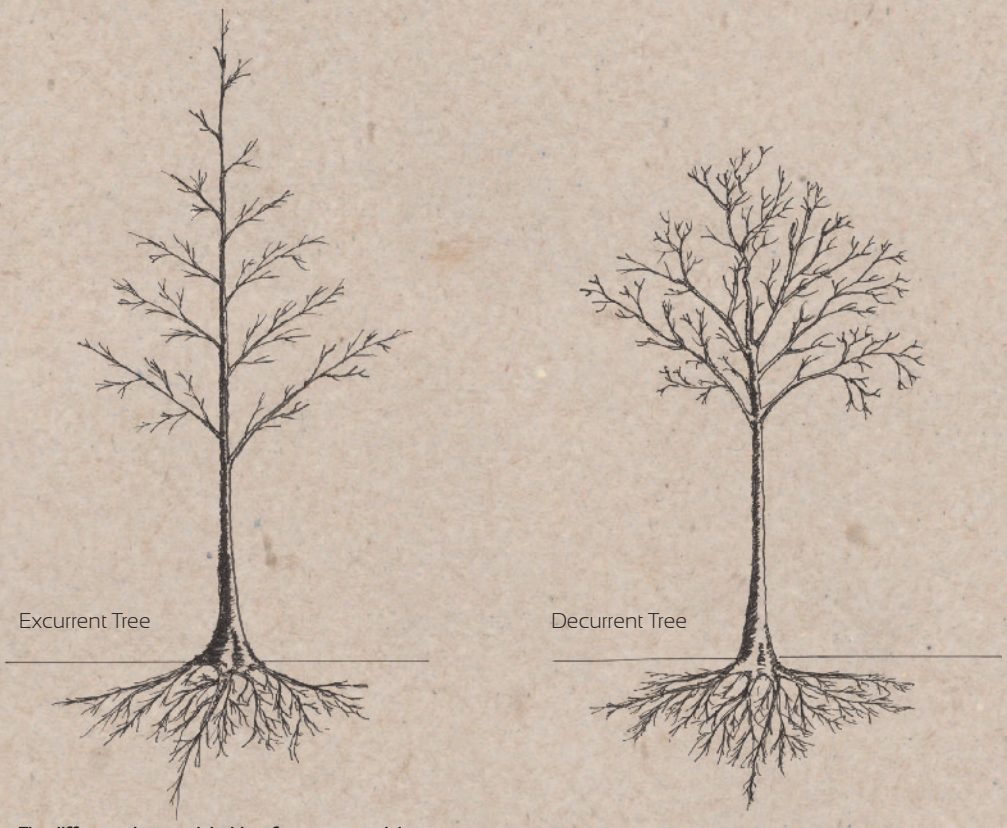
No epicormic growth should be apparent emerging from the stock wood.

While all tree species have clearly identifiable, individual growth characteristics all broadleaved deciduous and evergreen trees can be placed in one of two categories.

Excurrent trees have a naturally occurring straight leader which remains prominent throughout the life of the tree. (for example Liquidamber styraciflua)

Decurrent trees lose leader dominance as they develop. (for example Acer psuedoplatanus).

All best practice nursery production will aim to produce and retain a strong central leader irrespective of whether the natural habit is excurrent or decurrent. Decurrent trees should retain a strong central leader until they have reached two-thirds of their mature height. The leader can be said to be dominant when none of the lateral branches are more than quarter the diameter of the main stem at the branch union. The aim of the nursery is to produce a strong central leading stem while retaining enough photosynthetic capacity to facilitate healthy growth and development.



The difference in growth habits of excurrent and decurrent trees

Failure to achieve the above can result in a weak central stem which is ill defined and ill equipped to support the construction of a well balanced permanent branching system as the tree develops both on the nursery and in the landscape.

To achieve the above some nursery formative pruning will have taken place with lower branches either subordinated or removed. The resultant pruning wounds will be visible on the main stem. These wounds will heal naturally providing the branches removed do not exceed the branch/main stem ratio referred to above and that the branch collar has been retained during the pruning process. Wound healing will be clearly visible with signs of occlusion taking place even though the wound may not be completely healed.

Poor or large pruning wounds may not occlude successfully leaving ingress points for disease, structural weak points or distorted, misshapen main stems which may not recover as the young tree develops.

A	Diagram of well formed nursery tree with defined central leader and well balanced branching system
B	Laterals subordinated to main stem and no more than 25% of diameter of the main stem at branch union
C	Nursery formative pruning with all laterals subordinated to the main leader
D	Diagram of nursery formative pruning cuts
E	Potentially co-dominant laterals subordinated to the central leader in crown development

During the formative pruning process it may have been necessary to prune out the natural leader and train a new dominant leader with all laterals subordinated to that new leader

A poorly healed nursery pruning wound.

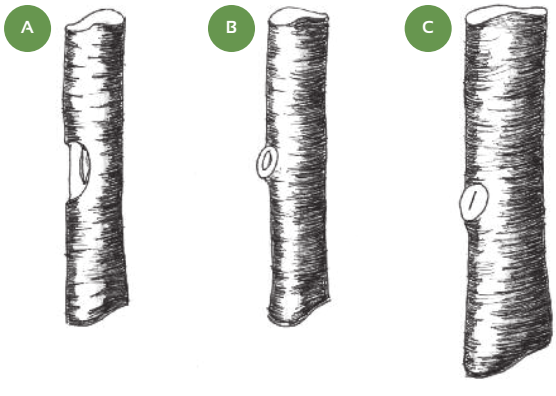
A well healed nursery pruning wound.

Formative pruning on the nursery is designed to produce a strong balanced leading stem capable of supporting the future permanent branching system of the tree'

This permanent structure will not begin to develop until a clear stem of between 2.5 and 3.0 metres is achieved. All branches below this point are temporary and will be removed at some time during the trees development. This does not apply to multi stemmed trees

However it is important that during the nursery process poorly attached branches, branches with included bark and inward growing branches are either removed or subordinated. Failure to address such problems can lead to ill formed crown development, compromised leader formation and structural weakness.

A	Large pruning wound with branch collar removed. Pruning cut indicates branch over 50% diameter of main stem has been removed. Unlikely to heal satisfactorily
B	Acceptable branch removal with branch collar intact and cut less the 25% diameter of main stem
C	Fully occluded wound



ITEMS WHICH CAN BE SPECIFIED

All young trees should have a clearly defined strong leader. All lateral branches should be subordinated to the leader and should never be more than 25% of the diameter of the main stem at the branch union.

All formative pruning wounds should exhibit healthy and continuous bark occlusion with all pruning cuts made leaving the branch collar clearly visible and intact on the main stem.

All branches which are poorly attached, are inward growing or cross and rub other branches should be removed or subordinated to the central stem.

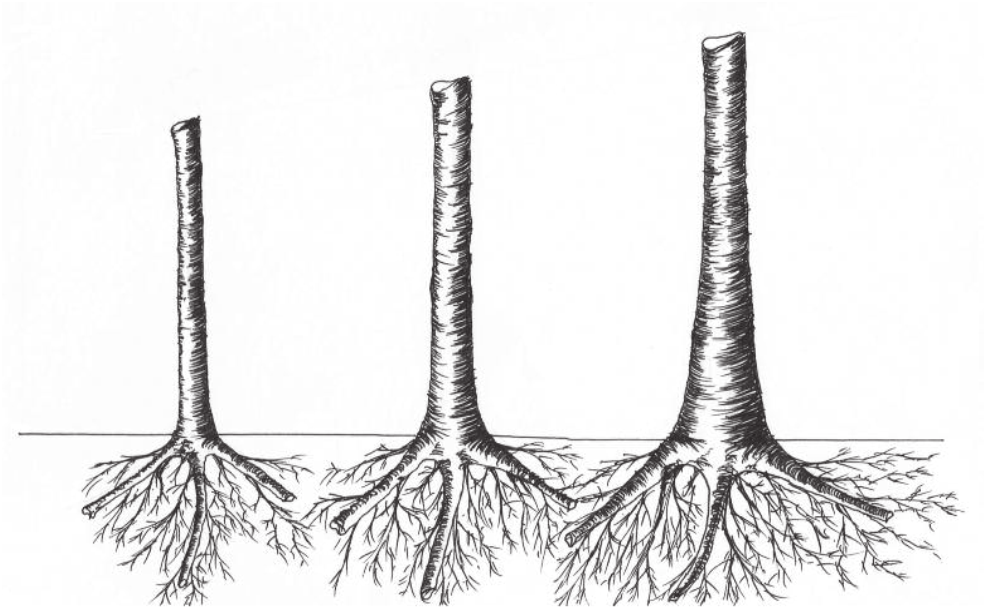
Young trees develop new wood at points of mechanical stress. A certain degree of mechanical stress is beneficial in the production of structurally sound young trees. The spacing of trees on the nursery coupled with the type of support and length of time that support has been left in place impact on the trees mechanical integrity at transplanting into the landscape.

Trees which have been grown too close on the nursery tend to produce elongated central stems. This leads to a proportional disparity between tree height and tree girth. This disparity leads to tall young trees which do not have the mechanical integrity to fully support the developing crown. Such trees when planted in the landscape have a tendency to lean and incur additional stress while trying to correct the imbalance. Such trees are also prone to fracture.

Close spacing on the nursery which impacts badly on both stem and crown development.

Wider spacing on the nursery which allows for full stem and crown development.

Support systems restrict the trees ability to bend naturally which influences the disposition of wood. Such restricted movement inhibits the development of stem taper. Each tree species develops at a different rate and some species have a more developed stem taper earlier. However all trees , during development and uninhibited by external support, exhibit a taper from stem tip to stem base which is regular and defined with the greatest circumference visible at the root flare. Trees which have not developed stem taper are mechanically ill equipped to thrive in the landscape. The result is additional stress and the diversion of often scare resources into correcting this defect.



Stages of stem taper development

Nurseries often use canes and ties in the crown to train leader and encourage balanced crown development. The impact of such support, if left in place for too long, is the same as with stem development with mechanical integrity compromised. All such support should be unnecessary and removed, along with the tie holding that support in place, before planting into the landscape is considered. Ties left in the crown can result in permanent damage occurring often several seasons following transplanting.

Examples of crown developed through formative pruning on the nursery

ITEMS WHICH CAN BE SPECIFIED

All young trees should exhibit a clearly defined stem taper appropriate to the species and evident from crown tip through to root flare.

All young trees should have a proportionate and balanced height/stem girth ratio appropriate to the species.

At the point of despatch all trees should being wholly self supporting and free from any extraneous canes or ties in the crown.

5.0

Root system development and management

The three production systems used predominantly in the UK all affect young tree root development in some way. A series of root modifications occur irrespective of the system. Each of these has the potential to impact positively or negatively on transplant success.

This section highlights good and not so good practice for each of the three systems and provides items which can be specified specifically.

5.0 Root system development and management

The nursery production method chosen primarily effects the development of the young trees root system. It is important that there is an understanding of best practice for each of the systems and what is actually specifiable and why. It is only by understanding nursery best practice and the problems which occur post transplanting into the landscape that successful procurement specifications can be written.

Irrespective of the final production system all trees are at some stage lifted from the nursery bed or field. The process of lifting from the nursery field inevitably leads to the root system being damaged or modified.

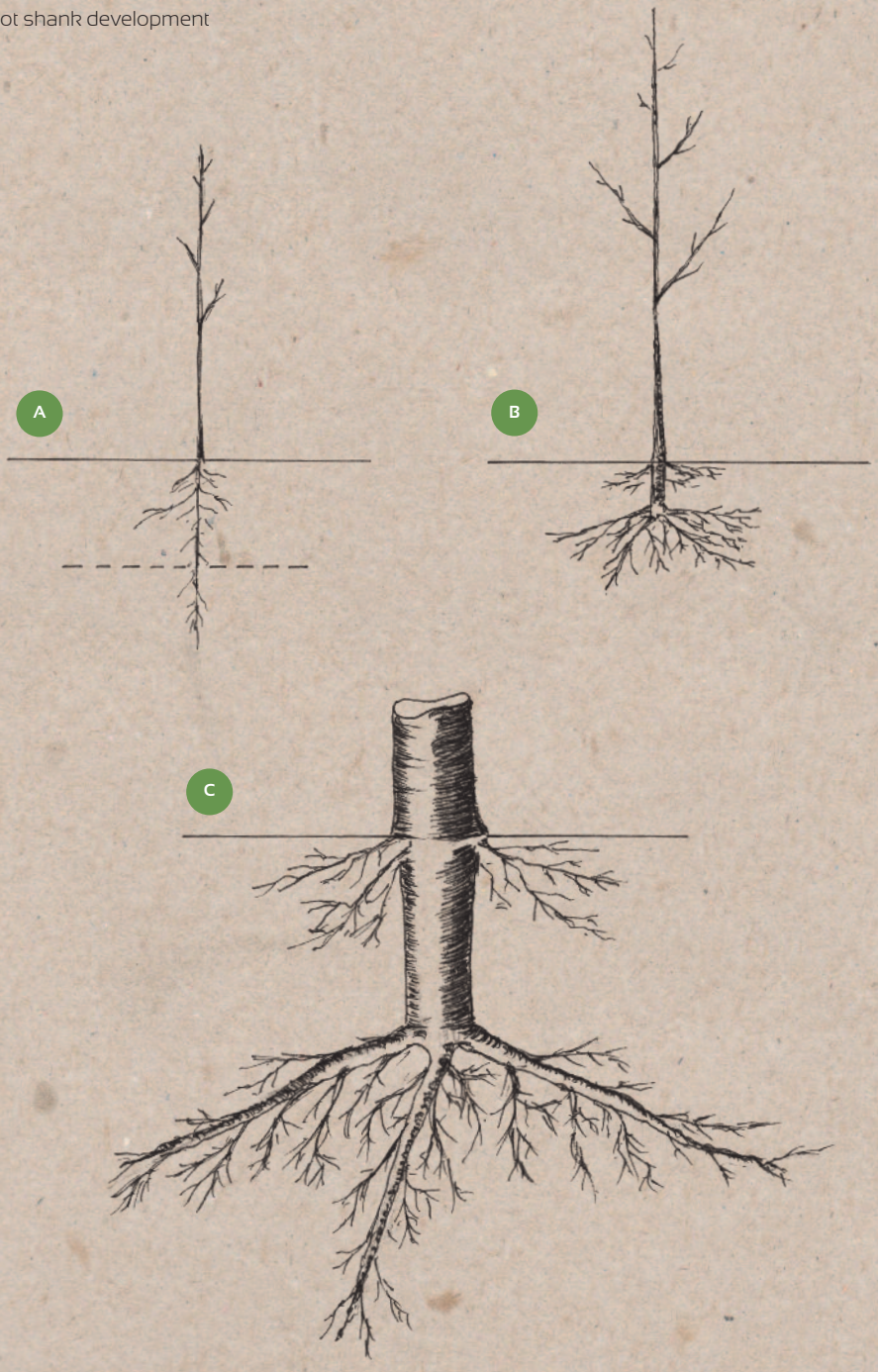
Cuttings laid out in the nursery.

A nursery seed bed.

The earliest modification occurs when the seedling is lifted from the seedbed. The naturally occurring tap root is severed during the process. At the point where the lifting cut is made an adventitious lateral root system is formed which is deeper than the lateral root system which would have formed had the young tree remained undisturbed. This adventitious root system is often more vigorous than that developing just below the root flare. The root area between the adventitious and naturally occurring lateral root system is known as the root shank. It has been recorded that even if the bud union and the root flare are clearly visible the adventitious root flare may be 300mm below the soil surface when trees are lifted from the nursery for transplanting into the landscape.

With the adventitious root flare too deep the likelihood of deep planting into the landscape is increased. Research has demonstrated reduced growth on some species when planted as little as 80mm too deep.

Root shank development



A	Nursery seedling in the seed bed
B	Seedling undercut and replanted. Proliferation of the new root development at the cut point
C	Root shank development between natural laterals root system and adventitious root system formed at the cut joint. This tends to be more vigorous

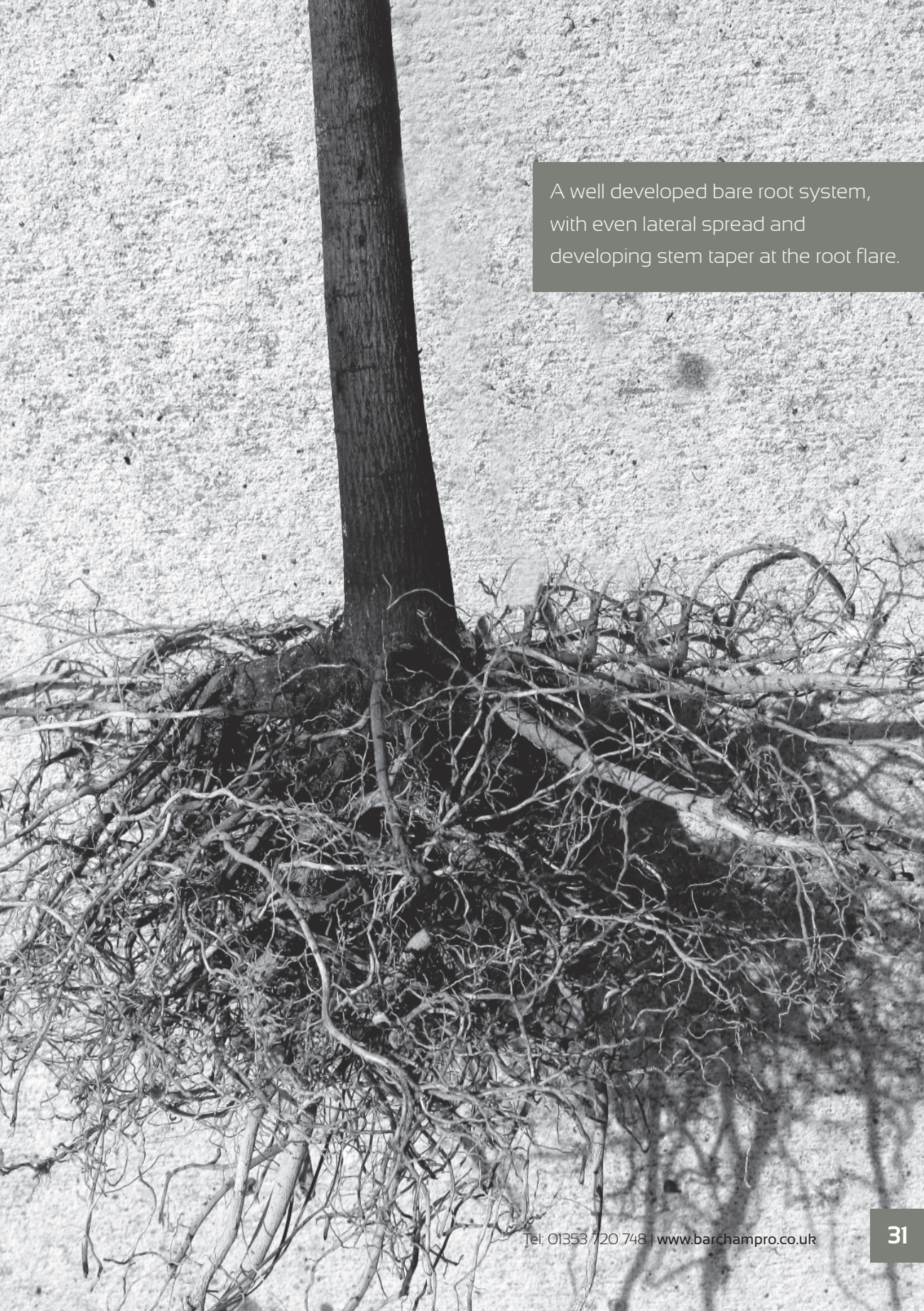
The seedlings produced can be either grown on to mature specimens or be used as understock for the production of clonal cultivars.

A similar process occurs when trees are produced from cuttings with prolific root development occurring at the base of the cutting where callous has formed. The root system can also be deeper than would be desirable.

Root initials developing at the base of a cutting.

Potentially deep root systems formed on a cutting.

The depth of the primary lateral root system is important as, when it is potentially coupled with deep planting, eventual failure in the landscape is likely. Unfortunately the length of the root shank and the depth of the adventitious root system where this occurs can only be examined easily on bare root trees.



A well developed bare root system, with even lateral spread and developing stem taper at the root flare.

5.1 Root system development and management

Bare Root Trees

It is very difficult to produce a definitive description and universal specification for the root system trees as they vary enormously with each tree having its own individual characteristics.

Examples of varying root formations of different species.

1	Platanus hispanica
2	Crateagus monogyna Stricta
3	Tilia platyphyllus Rubra

All root systems exhibit certain characteristics which are peculiar to the species under consideration. Even within a species there is variation. Providing generalised guidance is difficult but it is fair to suggest that all bare root systems ideally display a good lateral root spread, with at least four obvious and well developed lateral roots evenly spread around the stem circumference. (This cannot be a precise definition).

The method used by nurseries to line young trees out in the field can produce a wholly one directional root system which has been colloquially described as 'the hockey stick root system.' Once this type of system has thickened the one dimensional characteristic is retained throughout the life of the tree. This can be easily identified and avoided.

Idealised root system

A Idealised bare root system

B/C One directional root system caused by nursery production

Examples of one directional root systems.

Trees with one directional root systems and or a lack of evenly spaced lateral roots are more likely to be unstable as they develop in the landscape.

Bare root trees provide an opportunity to examine root structure and while it is difficult to provide definitive guidelines the depth of the adventitious root flare as described above needs to be considered. Overly vigorous adventitious root development at the lower end of the root shank can contribute to failure in the landscape especially if coupled with deep planting.

It is possible to indicate the expected diameter of the root spread of bare root trees as illustrated in the following table: The amount of fine root is important for the absorption of water and nutrients after transplanting into the landscape.

Root Spread for bare root tree stock

Young tree height in metres	Diameter of root spread in millimetres
2.5 to 3.0	450
3.0 to 3.5	550
3.5 upwards	700

While some damage is inevitable when lifting bare root trees from the nursery field it is important that the root system retains a significant amount of fibrous root to facilitate early development in the landscape.

When selecting bare root trees, the vigour as well as the structure of the root system needs to be considered. A simple iodine test can be performed to confirm the presence of stored carbohydrate. The darker the stain the higher the carbohydrate content present. Stored carbohydrate is essential to stimulate new root growth following transplanting into the landscape.

ITEMS WHICH CAN BE SPECIFIED

All root systems should be typical for the species and should display a well-balanced radial root system comprising of at least four obvious and substantial lateral roots

Root systems should not be predominantly one directional

All bare root systems should meet the height size parameters as outlined in the table above.

All bare root systems should have a significant amount of fibrous root commensurate with the species

Bare root trees on the nursery trees should have several lateral roots near the soil surface.

A simple iodine test should be carried out to assess the amount of stored carbohydrate present.

5.2 Root system development and management

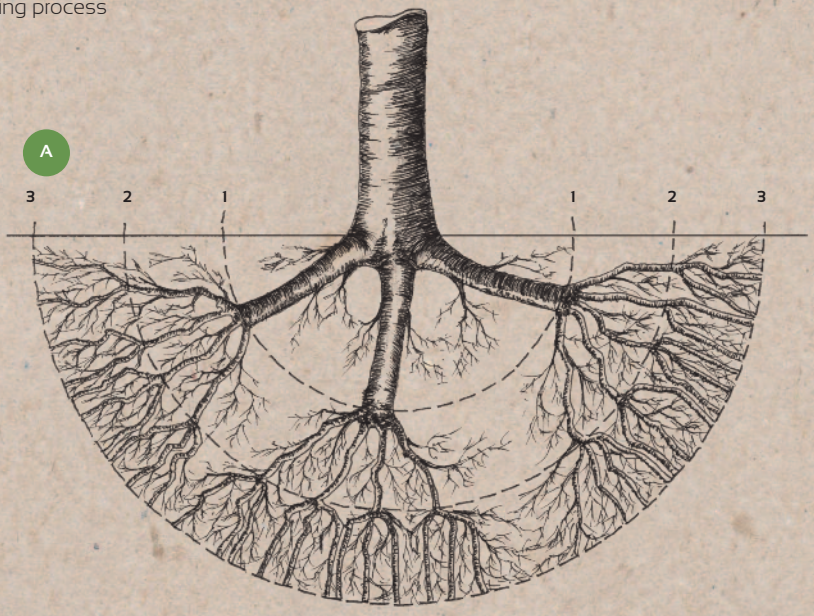
Rootballed trees

The rootballing of trees is a process. This process involves the regular undercutting or transplanting of field grown trees. During each undercutting or lifting sequence the root system is cut. New prolific root growth is apparent at the cut points. Unfortunately evidence as to whether this practice has been carried according to best practice is hidden inside the rootball and cannot be easily inspected. On lifting from the nursery field for despatch the resultant soil ball is wrapped in hessian and supported by non galvanised wire mesh.

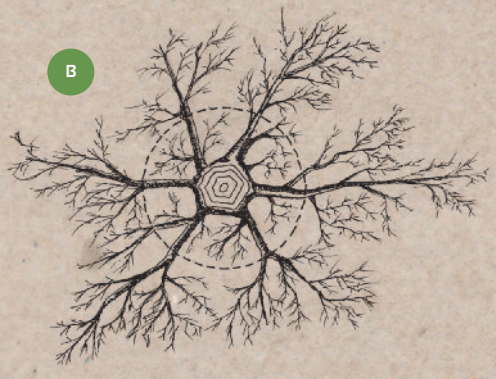
Illustrations of well formed rootballs.

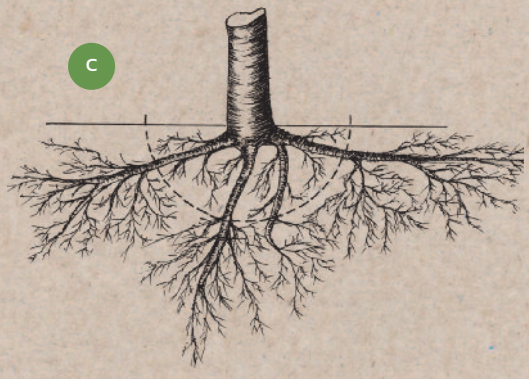
An indication of bad practice is undue movement of the soil ball in relation to the stem of the tree. If one can be moved independently of the other then further investigation would be advisable.

Undercutting process



At each undercutting root will be lost but this is more than compensated for by the vigorous root initiated.





A	Diagram of undercutting process and the impact of the process on root development
	1: first cut
	2: Second cut
	3: Third cut
B/C	Impact of not undercutting. Note the amount of fibrous root left in the ground

The following table indicates the size of rootball and the number of times it should have been undercut/transplanted on the nursery.

Rootball table

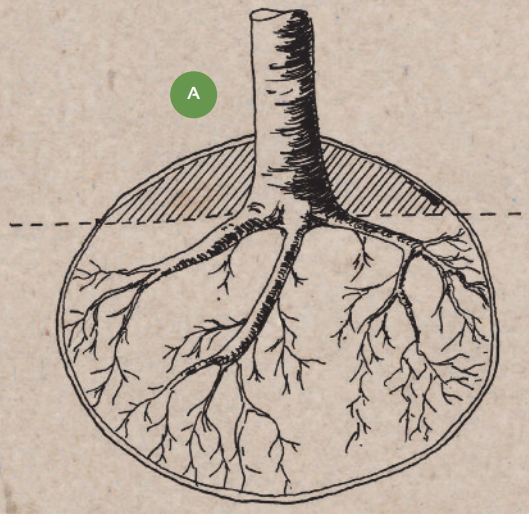
Girth of tree measured at one metre in centimetres	Minimum diameter of rootball in millimetres	Minimum number of times transplanted/undercut on the nursery
8-10	300	-
10-12	300	-
12-14	400	3
14-16	450	3
16-18	500	3
18-20	550	3
20-25	600	4
25-30	700	4
30-35	800	4
35-40	900	5
40-45	1000	5
45-50	1200	5
50-60	1300	6

The lifting of trees from the nursery field to produce rootballs where this best practice has not been followed can result in as much as 95% of the trees root system being left in the ground. A rootball which has a smaller diameter in relation to tree girth than recommended in the table above is unlikely to have been prepared according to best practice and will have had a significant percentage of its root system left in the nursery field.

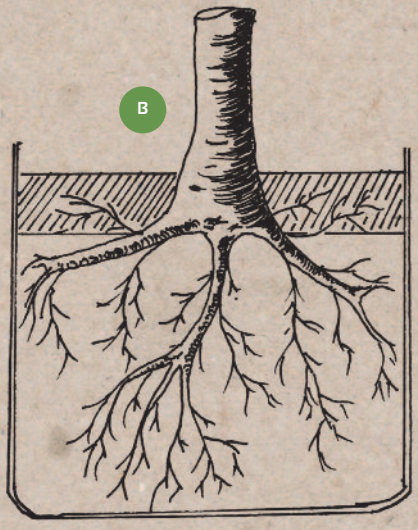
A badly prepared root system from inside a rootball, note the lack of development associated with the undercutting process.

Poor practice in the preparation of a rootball is likely to result in poor performance in the landscape or failure.

Mounding of soil/compost above root flare as a result of nursery production



Unless removed both result in root flare being too deep at planting into the landscape.



A	Soil mounded during production process results in root flare buried and lifted inside rootball.
B	Deep planting in the container results in root flare being buried and fibrous root growth in compost above root flare.

ITEMS WHICH CAN BE SPECIFIED

All rootballed trees (SIZE/STEM GIRTH) should have been transplanted or undercut (NUMBER) and have a diameter of (MEASUREMENT) (see table on left)

The root flare should be clearly visible at the surface of the rootball

The final root pruning cut should be at least 200-300mm from the exterior of the rootball

The soil ball should not move independently of the central stem.

5.3 Root system development and management

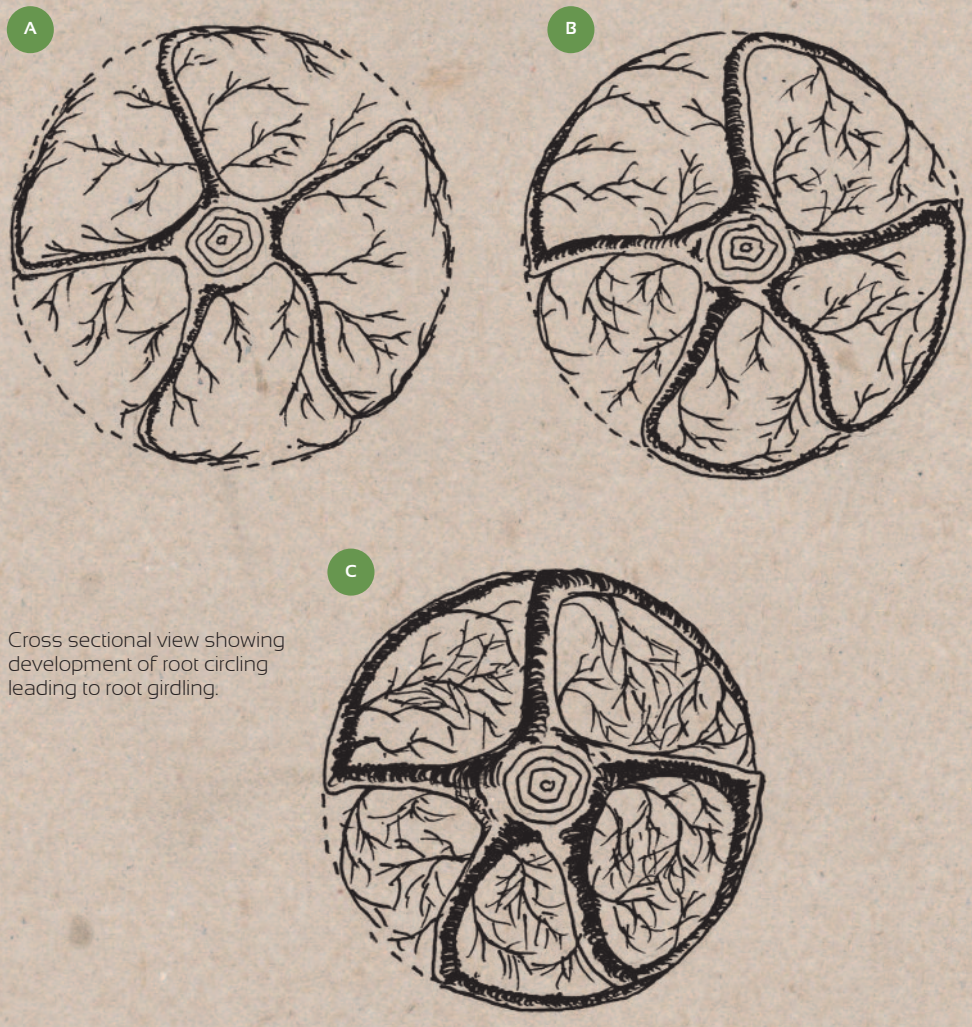
Containerised Trees

Containerised trees are produced when young trees are lifted from the nursery field and containerised. The period between containerisation and despatch is used to re build the root system following the inevitable damage incurred at lifting. The system ensures that root systems are undamaged and fully functional when the young tree arrives at the planting site.

A Example for irreparable root circling developed in a seedling liner.
B Root circling on a more mature specimen

The major problem with containerised trees occurs when the tree is left in the container for too long. When this happens the root system circles around the outside of the container and in extreme cases will girdle completely. This can happen at any stage in a young trees development and from the smallest to the largest of containers.

Despite many claims to the contrary root circling and eventual girdling will occur in all container production systems if the young tree is left in the container for too long.



Cross sectional view showing development of root circling leading to root girdling.

A,B,C Illustrates stages in the development of circling/girdled roots in a container

Stages in the development of circling/girdling roots with an extreme case illustrated at the end.

The only satisfactory method of ensuring this has not happened is to enquire of the supplying nursery as to how long the tree has been in a container. This is often referred to as 'shelf life'

Circled or girdled roots when planted in the landscape can lead to instability as lateral root development is restricted and in extreme case self strangulation. This often leads to failure, which can often be dramatic, several years after planting.

Another problem occurs when the tree's root flare is buried too deep in the container at containerisation. On occasions this results in matted fibrous root development in the extraneous compost above the root flare.

The presence of this matted fibrous root above the root flare can exacerbate deep planting.

ITEMS WHICH CAN BE SPECIFIED

All containerised trees should be free of root circling or root girdling

All nurseries supplying containerised trees should be able to specify the 'shelf life' date of individual or batches or trees.

The beginnings of the root flare of all containerised trees should be clearly visible on the surface of the container.

A. Close up of peripheral roots on a well developed containerised root system

B Example of well formed root system from containerised production.

ITEMS WHICH CAN BE SPECIFIED

Where trees are transferred from smaller to larger containers evidence should be provided to demonstrate that any root defects/circling roots have been shaved from the container ball prior to re-containerisation.

Containerised trees should never be confused with container grown trees. Containerised trees are trees lifted from the nursery field and grown on in containers for a limited period of time. Container grown trees have been grown in containers for the whole of the production period. The trees are moved from container to container as they develop. Any root defects created in the smaller container are transferred to the larger container. This can lead to structural weakness in the root system once transplanted into the landscape with failure occurring at the point when tree roots were transferred from on container to another.

Where trees are moved from smaller to larger containers any circling or defective roots should have been shaved off leaving only lateral roots in evidence before re-containerising.

The Trees and Design Action Group is pleased to be associated with this Specification Manual produced by Barcham Trees. It provides valuable technical guidance and supplements the recommendations made in the latest TDAG publication, Trees in the Hard Landscape: A Guide for Decision Makers (pg.144) and BS8545 Trees: From Nursery to Independence in the Landscape, with regard to specifying young trees from the tree nursery.

It is essential that trees planted, particularly in the harsh urban environment, are fit for purpose and this can only be achieved if specifications are written with understanding and with sufficient rigour. This guide provides a blueprint which can be followed and will be of great benefit for all built environment professionals whose work will gain from a better knowledge of how to provide the right specification for trees.

Trees & Design Action Group

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