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QUALITY TREES = QUALITY STREETSCAPES

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I contend that the success of a tree in the landscape is determined by four factors:

1. selecting a tree that will match the edaphic, climatic and site (height, width) restrictions,
2. selecting the tree that has the quality to grow into the tree you need,
3. carefully maintaining the tree during its period of establishment, and
4. providing appropriate maintenance through the tree's life.

If a good design can be part of this equation as well, then the resulting streetscape will be fantastic, but an excellent design without the appropriate horticultural and maintenance considerations is bound to fail. Trees have an æsthetic function in the landscape, but this function cannot be fulfilled unless the tree is growing well in its site.

The factors which make up an appropriate quality tree are discussed below. These factors should be considered by any purchaser of trees for urban use. Purchasing the correct quality of tree will ensure that a successful outcome can be achieved. The methods identified for achieving these quality outcomes may seem prescriptive, and many managers can recall high quality streetscapes where these methods have not been followed; but the techniques for growing appropriate quality trees listed below give the purchaser surety of that quality.

Cost at purchase is a significant factor for many streetscape managers. I contend that a $20-40 premium at purchase for the best quality tree will result in many $100s saved over the life of that tree. Implementing the techniques for growing appropriate quality trees in the nursery will cost the grower more than if not introduced, but this extra nursery cost will save the streetscape manager money later on.

Quality techniques in the nursery are a component of a total quality management system for the streetscape. If streetscape managers choose trees of this correct quality, the client requirements in the streetscape can be more readily achieved.

The quality of the tree's genes

With introduced tree selections, tree buyers frequently can purchase a tree based on its cultivar name, expecting that all the trees of a certain cultivar will be asexually propagated from a single parental source plant. Also, there is a widespread perception that exotic trees are always what the label says they are.

I have experienced many problems associated with tree naming. My colleague Jill Kellow and I investigated *Pyrus ussuriensis* a few years ago, and discovered that all the trees (save 1 here in Adelaide at Mt Lofty) labelled *P. ussuriensis* were in fact a selection of *Pyrus calleryana*. This mis-naming led to many streetscapes full of poor-growing, short-lived pears (Kellow & Will, 1995). I am equally convinced that through some mix-up, many of the *P. calleryana* 'Bradford' are in fact the cultivar 'Red Spire' (and *vice versa*). In Melbourne, arborists have made much money from the mis-named *Alnus jorullensis*, which is actually the much-larger-growing *A. acuminata* ssp. *glabrata*.

There are a number of seed raised cultivars grown in the streetscape, including the so-called “digitate” Plane Trees. Trees sold as *P. orientalis* ‘Digitata’ come from a number of sources, and the buyer has to go beyond a simple cultivar name in understanding the growth form of the trees purchased. Some growers are offering the Hillier’s selection of *P. orientalis* ‘Digitata’, as well as the closely-allied ‘October Glory’ selection of *P. orientalis* insularis-type (*see* Spencer, 1997, for a discussion of these Plane selections).

With Australian trees, things become muddier still. Many of the best-known Australian trees grow over wide ecological/geographic ranges, and seedlings from one ecological zone may not be appropriate for another ecological area, even though the species itself is endemic to that area. Selecting seedlings from the same geographic area or from a similar ecological zone will probably give better streetscape results.

Many eucalypts are promiscuous breeders, and will freely interbreed with related species when they are in close proximity. As seed propagation is necessary, seed collected from these cross-breeding trees will not yield offspring similar to the parent selected. For this reason, seed collected from genetically-appropriate seed orchards or from known, isolated wild stands is essential.

Propagation practice

Techniques for growing high quality trees begin at the propagation phase. Most nursery growers will identify that poor quality tubestock, transplants or seedlings will inevitably lead to poor quality finished trees. The best technique for managing poor quality transplants is to throw them away before you waste money trying to improve them.

I believe that the best deciduous trees are produced by budding known and compatible scion varieties onto known rootstock selections. This production practice gives the opportunity for the grower to get a straight trunk without excessive staking, and will also give repeatable outcomes when the same scion:rootstock combinations are used. Budding also gives the possibility for specialised rootstocks to be used, but this refinement will only occur when tree buyers are sophisticated enough to insist on them.

It is more difficult to implement high quality production with seedling propagation. Many trees propagated by seed have seedling growth patterns that make transplantation difficult until the seedling is approximately 400mm tall, and the seedling rootball is appropriately developed. This requirement for later transplanting goes against traditional nursery practice, where seedlings are pricked-out of a community seedling tray and transplanted into a tube. Research has shown that pricking out of eucalypt and acacia seedlings will often lead to “j” rooting of the seedling, as the pricking-out process invariably leads to root malformation when the seedling is “tucked into” its new growing media (May, 2002). To overcome this potential root deformation, seed should be direct-sown in individual tubes that are large enough to support the growth of the tree until it is ready for transplantation. Further, if multiple seedlings germinate in each tube, the excess seedlings should be cut off rather than pulled out, to minimise root disturbance of the remaining seedling.

Transplanting seedlings too early may result in root distortion, but equally, transplanting pot-bound seedlings may also lead to a tree with serious root deformity. The grower must design a growing system, whereby he/she can get appropriately

sized seedlings that have a large and vigorous root systems without any distortion or malformation.

Tree buyers should be aware of the propagation system that a grower has used, as the propagation phase will directly affect the quality of the finished tree.

Growing systems: root structure

There are three growing systems typically used for growing trees: bare-root, balled-in-burlap (b&b) and container-grown. Each growing system has its advantages.

Bare-root trees are grown in-ground, root-pruned, and lifted when dormant. Buyers will find bundles of 5 or 10 trees, possibly heeled-in or refrigerated until sale. These trees have these advantages:

- you are not paying for soil or growing medium, either its value or the cost to transport it to site, and
- you can examine the tree roots to see if appropriate for the size of the above-ground portion of the tree.

Bare-root production has the following limitations:

- harvest time and planting season are restricted to just a few months in winter, as the tree must be fully dormant before lifting,
- the root systems on these trees are fragile and must be kept hydrated to avoid tree death,
- care must be taken during transport to avoid root damage,
- establishment irrigation must be very carefully timed as there is little lee-way for error (trees can die very quickly if not watered exactly when needed), and
- only some taxa of deciduous trees will respond well to bare-root transplantation into the streetscape.

Balled-in-burlap production (from now on, b&b) is a production system where trees are grown in-ground, root-pruned to achieve a fibrous and compact root ball, and then harvested when dormant with a surrounding soil ball. This soil ball is covered in hessian (= American “burlap”) and shipped. This production system has these advantages:

- many taxa respond well to this transplantation technique,
- trees, once harvested, can be held for a few days-to-weeks before planting, and
- this technique is easily adapted for any size tree.

B&b growing systems have these limitations:

- root-pruning, through undercutting, is essential for the development of a compact root ball, and this is rarely carried out as often as necessary in Australia,
- the harvest period is restricted to several months in winter,
- the cost of purchasing and transporting soil can be extremely high,
- the root balls are fragile, and care must be taken during transport, and
- the buyer cannot examine the root ball to check for root distortion before purchase.

Container growing is most commonly used in Australia because:

- most taxa respond well to container growing,
- there is a 12 month harvest/sales/potential planting season per year,
- containers are easily shipped with minimal damage to the root balls,
- growing media can be readily formulated for best tree growth, and
- buyers can examine root systems at purchase.

There have been many reports of problems with root deformation associated with root spiralling and root distortion in container growing systems. Gilman (1997) and May (2002) thoroughly discuss these issues, and give prescient recommendations. I am unsure whether there is a single system that will eliminate all root distortion, but in reading the literature and observing tree root systems, I believe that these are the most important factors for "root conscious" production:

- There needs to be adequate root mass to support the shoot mass; in other words, the container has to be large enough to support the growth of the tree growing in it. I recommend:
    - 15-20 litre root volume for a 1.5 to 2.0m tree
    - 40-50 litre root volume for a 2.1-3.0m tree
    - 75-100 litre root volume for 3.1-4.0m tree.
- That some form of root control system be used, whether copper based paint or air pruning. Ridges in the straight-sided plastic containers are not enough on their own to control root growth with trees. An advanced "root conscious" growing system will use both ridges or other physical control as well as air or chemical root pruning.
- The profile of the container needs to be broad and shallow rather than tall and deep to ensure oxygenation both in the nursery and in the streetscape as the majority of tree roots are found in the upper 200mm of container-grown trees.

Canopy and trunk development

Again, see Gilman (1997) for an excellent discussion of all factors associated with tree canopies and trunk formation for non-Australian taxa.

Eucalypts are notoriously difficult to grow straight and strong-trunked. I believe that staking eucalypts for some time in their growth is essential in gaining an acceptably-straight trunk, but I also am convinced that these stakes need to be removed as soon as the trunk is straight. This stake removal (when associated with appropriate canopy pruning) will give a straight-trunked tree with adequate trunk taper and strength. As a general rule, I believe that stakes should be removed after active tree growth has slowed for the year, as the hardening-off phase of the tree's growth will also give greater trunk taper if there is no stake. Also, I believe that most trees should be unstaked for a minimum of six weeks before delivery, to assure trunk strength and that the tree can stand up without any staking in the streetscape.

Canopy pruning is also difficult with many Australian taxa, especially when planted as trees <2.0m tall. With many of these trees, the canopies that are planted will not be the canopies that remain in the streetscape. Also, as these trees are seedling-produced, they frequently will show the juvenile growth form of that tree (especially true in eucalypts and *Angophora*), and will be atypical of the adult tree. There are a few

guidelines that are important with selecting canopies on seedling-grown Australian trees:

- there must be no co-dominant leaders (bifurcations),
- canopies should be light enough to be supported by the trunk without staking,
- the canopy should be radial, and not arising from a single place (whorl) on the trunk,
- there should be no obvious crossing or deformed branches, and
- there should be adequate foliage on the canopy to allow for ample photosynthesis and quick growth in establishment.

In discussing the canopy and trunk development of many Australian and other evergreen trees, I have mentioned the necessity for a "hardening off" phase in production. In this phase, the tree stops active extension growth, tissues lignify, leaves fully cuticularise and the trees accumulate sugars (and sugars are converted to starches). I believe that trees are best transplanted after hardening off, as they withstand movement into the harsher streetscape from the nursery with less wilting. Unfortunately, growers cannot time when they want to harden plants off, as temperature is frequently the major factor contributing to extension growth. I recommend that streetscape managers fit their planting times to suit the growth state of the plant, rather than trying to keep trees alive if not hardened off properly.

Pests and diseases

Plants of a reasonable quality for the streetscape will show vigorous and healthy growth. There should be no signs of leaf discolouration, leaf necrosis or trunk cankers. It is unlikely that trees grown in containers will show signs of the root-rot disease, *Phytophthora cinnamomi*, as the pinebark-based soil media used in container growing are suppressive of this disease. The only way that these growing media can support root-rot fungi is after a significant period of waterlogging. Buyers should note if there are areas of the nursery where trees are standing in water. If tree buyers notice containers standing in water, they should avoid buying any tree from that nursery. (Brereton, IN Will, 1999)

Weeds are the major pest problem with quality tree production. When buyers visit nurseries, they should immediately notice the weed loads found throughout the nursery. I can honestly say that weed-free nurseries rarely produce poor quality trees; conversely, it is rare to find good quality stock coming from a weedy nursery. Many nursery weeds, including Willow Herb (*Epilobium* sp.) and Flick Weed (*Cardamine hirsuta*) must be controlled throughout the tree's growth, as hand removal before sale will not remove the problem. Seeds of these nursery weeds will germinate, and take necessary water from the tree during establishment.

Some insect and mite pests must be avoided, but minor infestations of Lerp Psyllids (*Cardiaspina* sp.) on eucalypts and Eriophyd/Erinose Mites on other Australian trees are acceptable. These endemic pests will somewhat disfigure the tree's foliage, but have little overall effect. Infestations usually occur when growing a large number of the same tree taxa close together, and will not re-infect new growth in the streetscapes.

Summary & recommendations

I recommend that streetscape managers or tree buyers consider the following checklist when purchasing trees:

- is the tree the cultivar/variety/seed source that you want, and are the trees true-to-type?
- has the selection been propagated in the optimal manner and without root distortion?
- is the growing system appropriate for the time of planting and establishment maintenance?
    - if bare-root or b&b, have the trees been root-pruned appropriately and is the root system adequately large?
    - if b&b or container-grown, is the root profile appropriate or too deep?
    - if b&b or container-grown, is the soil mass appropriate for the root and shoot mass?
    - if container grown, have the containers been selected to reduce root deformities?
- is the canopy appropriate for the size of tree and does it have a well-formed structure?
- does the trunk show an appropriate taper from 100mm above ground to 1400mm?
- is the tree free of disease, weeds and excessive pest damage?

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