PART THREE

A holistic tree selection process – putting it all together

By Stephen Frank and Kirsten Raynor

Left, above: Purple-Leaved Dutch Elm (*Ulmus* × *hollandica* 'Purpurascens') - Northern Highway, Wallan.

Below: Lemon-scented Gums (*Corymbia citriodora*) along High Street Road, Glen Waverley Photos: Stephen Frank

By using the information provided by climate suitability modelling (CSM), plant trait and physiology experiments, horticultural and ecological information systems, and an understanding of urban environments and their limitations to tree growth, it should be possible to develop a rigorous tree selection process.

Gerhold and Porter (2007) developed a logical five-step process for selecting a species or cultivar of tree. It provides an organised way of dealing with the various types of information needed for making thorough selections. Climate suitability would be considered under point 2.

1. Define the purpose of the tree in the landscape
2. Evaluate existing and predicted site conditions that will affect the selection
3. Consider arboricultural practices that can impact the tree
4. Develop selection criteria based on purpose, site, and managerial impacts
5. Match characteristics of candidate trees to the criteria to identify suitable species and/or cultivars, leading to the final selection

A thoughtful, thorough analysis in matching species characteristics to selection criteria is more important than the sequence in which the steps are considered. There is also variability of the importance of individual criteria in the selection process (Behrens, 2011).

In this sorting process a long list of candidate species is reduced to a small number that meet important constraints. The number of alternative species from which the final choice can be made will depend on the severity of these constraints.

Diversity considerations

It is important that a diversity of trees, both in age and species, be maintained across urban areas to promote resilience to climate variability, resistance to pests and diseases, and management of resource allocation (normalising of budgetary requirements). How does one achieve this?

A simple answer is to plant lots of trees. Indeed, plant lots of different kinds of trees. Through a process of elimination, species that are better adapted to the site conditions will come to the fore. However, in cities where there are varied microclimates, a limitation on available spaces for trees and often restricted resources, there is not the luxury of using the process of elimination on a bulk scale.

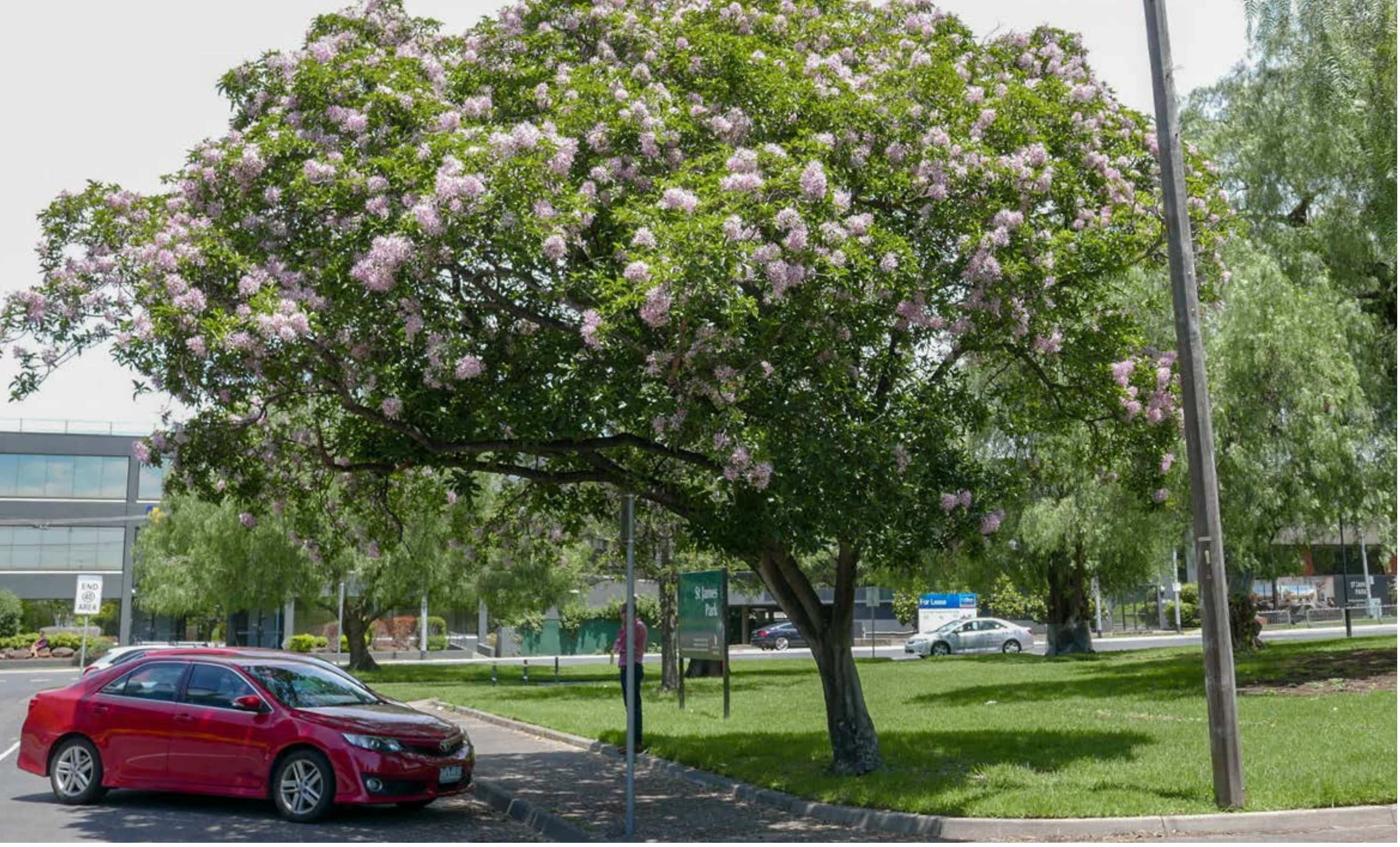
Species diversity should be related to the diversity of site conditions, predicted climatic changes and functional requirements, rather than to simple numerical standards (Richards, 1993). Diversity targets should be set as high as realistically possible but with the understanding that urban environments are typically difficult, with limitations on the number of species that perform well in those environments. Species that are proven performers should not be replaced by underperforming trees or taxa that have not undergone sufficient scientific scrutiny to establish their suitability for the purpose (Watson, 2018).

Species diversity will generally evolve based on the dynamic nature of tree removal and replacement works. As trees are replaced over time there will be natural changes in species/variety availability, environmental conditions or planting sites and in community expectations.

The following factors will dictate species diversity:

- Existing landscape character
- Proven adaptability/tolerances and suitability of species
- Availability of selected tree species
- Personal and community preferences over time
- Ability to fulfil functional requirements
- Predicted changes to climate and environmental conditions

In street tree populations, stability depends primarily on the longevity of individual trees and enough numbers of successfully planted replacements. Species diversity contributes to the stability of a street tree population only to the extent



Above: Cape chestnut (*Calodendrum capense*) located in St. James Park, Hawthorn **Right:** Chestnut-leaved Oak (*Quercus castaneifolia*) along Cudgewa Valley Road, Cudgewa. Photos: Stephen Frank

that individual species or cultivars prove successful. Therefore, species diversity must be used cautiously to maintain a population likely to be adapted to the diverse and changing street environments of an area.

Consider planting principles that improve diversity at the local scale, such as:

- Planting a single species on a street but not planting that species in connected streets
- Planting multiple species of similar form and appearance on a single street
- Planting a high diversity of species in parks where growing conditions are easier
- Planting trees with diverse life-expectancies and planting over a long period of time to promote age diversity
- Planting trees of diverse genetic stock to promote resistance to pests and disease; and,
- Planting a diversity of species in layers (understorey to overstory) to promote vertical structure and biodiversity (Diamond Head Consulting, 2017)

Performance monitoring of new tree species in urban landscapes

Long-term success of tree selection under a climate change scenario will be reliant on an increase in our knowledge of individual taxa's response. Effective plant selection is often limited by poor understanding of the physiological or morphological mechanisms that provide a plant with resilience (Wahid, et al., 2007), and/or how they might respond in cultivation or in varied microclimatic conditions. Equally, waiting to see what thrives and what struggles does not work in the commercial reality faced by most landscape managers. A faster acquisition of knowledge of a tree's response to stress is critical in allowing landscape managers to critique and refine their own selection process.

To more quickly ascertain the success of introducing new species or selections a tree vitality monitoring process for newly planted (small) trees and developing trees in urban landscapes needs to be established. The monitoring process should be based on an objective, scientifically validated technique. Ideally, a monitoring program is run independently of the planting initiators, to remove any measurement bias.

There are a number of scientific methods that have been used over the past few decades to monitor tree vitality. Visual tree assessment of crown condition and tree height and diameter at breast height are relatively objective and it is well established that there is a "lag-time" between decreased physiological function and its expressed effects on growth (Johnson, Moore et al., 2013). In the process of testing the suitability of tree species for a particular area, this gap in time leads to a waste of resources and increased inertia in decision making regarding the suitability of species.

To expedite this process other technologies could be utilised.

Chlorophyll fluorescence measures the amount of light re-emitted by the photosynthetic system. When the system is sub-optimal, re-emission of light is greatest. Chlorophyll fluorescence is considered one of the most sensitive measures of environmental stress in plants (Johnson, Moore et al., 2013). Different values obtained during the measurement period can be analysed to indicate the type of stress likely to have caused the reduction in photosystem efficiency (Percival, 2004).

Success of a measuring system also depends on how easily it can be performed in the field. Handheld chlorophyll fluorescence meters have been developed that allow field-based measurements, non-destructive sampling and that are not sensitive to time-of-day variations. Results are also available immediately.

It should also be obvious, given the earlier themes in this article, that any monitoring program should have an initial site assessment to ascertain environmental limitations to growth. Subsequent plant growth measurements can then provide information about the ongoing performance of the tree, relative to the limitations of the site. Soil moisture and soil bulk density measurements should be taken at the same time of any growth measurements. Changes in soil moisture or compaction levels will influence tree vitality, so it is important to rule such variables out or to understand their role if we are trying to quantify the suitability of a tree selection for a locale.

Climate change is intensifying and accelerating the need to refine our selection of trees for the urban environment. Intensification of urbanisation and the associated reduction in adequate growing conditions was always going to limit the choice of tree selection. Careful consideration of current data, future projections, management realities and species attributes are important aspects of the selection process. Scientific analysis of species' adaptability and physiological suitability to differing sites and conditions will refine the process and allow a quicker introduction of a suitable and diverse planting palette.

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