

# NURSERY PAPERS

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## TESTING THE TREE STOCK STANDARD

The Australian standard for producing quality landscape trees ensures a nationally consistent benchmark for quality tree stock for landscape use.

A component of the current standard focusing on root to shoot balance criteria can be influenced by the climate trees are grown in, the species of tree, the treatment they receive in the nursery, and regional differences in their performance.

In 2016-2017, researchers assessed 13,820 trees in 23 wholesale nurseries to see how well *Australian Standard 2303:2015 Tree Stock for Landscape Use* applies to trees of different species and climates in nurseries across the country, with specific emphasis on tree stock balance and size index equations.

This Nursery Paper looks at the findings of their research and their recommendation that the current standard be modified.

### Summary

- AS 2303:2015 has three sections for quality assessment of containerised trees – above-ground testing, below-ground testing, and evaluation of root to shoot balance
- Although use of AS 2303:2015 is not mandatory, it is likely to be increasingly called upon to ensure tree quality at the point of sale, to minimise the risk of poor form and growth with new landscape and green infrastructure projects
- Tree stock balance is influenced by watering, nutrition, climate, species variation and nursery practices, which prompted industry to call for this research to validate this aspect of the standard.
- The project recommended modifications to AS 2303:2015 to ensure that quality assessments accurately describe the natural biological diversity of tree stock produced in Australia
- Project outcomes will be communicated via a national roadshow *Taking Stock: Findings from Australian Landscape Tree Stock Surveys* in six state capitals beginning in late 2017. A 'How-To' guide and online tool incorporating the new information will also be produced.

### BACKGROUND

Trees for landscape use are often in the ground for decades, so the quality of tree stock and real-world performance are critical to their longevity and the reputation of the industry.

The quality standard AS 2303:2015 was adopted in April 2015 to provide a specification to determine if a tree is good enough to plant out. During the development of the standard, industry called for further research to validate root to shoot balance metrics which would then be used to initiate a review of the standard in light of the research outcomes.

Proper balance between root and shoot systems is critical for establishment of tree stock as it impacts on the initial structural stability of a tree and the relationship between water uptake and loss.

However, the balance of root to shoot in tree stock is affected by nursery practices such as container style, root system management, irrigation, fertilisation, root pruning and growing media, as well as prevailing climate and time since re-potting.

Tree quality grading may differ among similar species from different nurseries, even when they are produced from the same seed source and over the same growing season, which makes the development and implementation of unified tree stock balance assessment criteria challenging.



# THE RESEARCH

Between April 2016 and January 2017, a team from Western Sydney University's Hawkesbury Institute for the Environment travelled to each mainland state and territory, visiting 23 wholesale nurseries and collecting data on nearly 14,000 containerised trees, sampling 159 tree varieties.

In addition, a worldwide literature review was undertaken to investigate the factors affecting root to shoot balance in containerised trees and the importance of root to shoot balance for outplanting success.

The principal questions that the project addressed were:

1. Does the evaluation of root to shoot balance in nursery stock via Size Index capture sufficient natural variation across the large diversity of 'ready for dispatch' trees in Australian nurseries?
2. Which of the two components of Size Index (height, calliper) are the most variable across species grown and container volumes used during nursery production?
3. How much variation in Size Index (and its components) can be attributed to different growing climates and nursery practices?



## Nursery visits

Multiple nurseries were visited in each region, except for a single nursery in the Northern Territory, to collect data that provided both regional and national coverage.

Batches of tree stock that were currently ready for sale were identified with nursery production managers at each site.

Batches were tested to pass all other above and below-ground assessment criteria as specified in AS 2303:2015.

From these batches, tree stock in containers  $\geq 18$  L were selected for measurements. Priority was given to tree species that were available in multiple container sizes.

The team compiled an extensive database of tree height and calliper measurements used to calculate Size Index across all of Australia's major landscape tree market regions.

Additionally, the 30-year mean annual temperature (MAT) and precipitation (MAP) were obtained for each nursery site.

AS 2303:2015 uses a measure known as the Size Index, which is similar to the Body Mass Index that indicates whether a person is in the right weight range.

It is calculated by looking at two parts of the tree:

- The calliper – the diameter of the trunk measured 300mm above the root crown, or 50% of the overall height, measured in millimetres
- The tree height, or the height of the tree's above-ground parts from the ground-level/top of the rootball to its highest growing point, measured in metres.

The tree's Size Index is measured by multiplying the tree's height in metres by the calliper, so that a height of 2 metres x a 50mm calliper = a Size Index of 100.

The resulting size index is then compared to a table of ranges which correspond to an associated container size or rootball size.



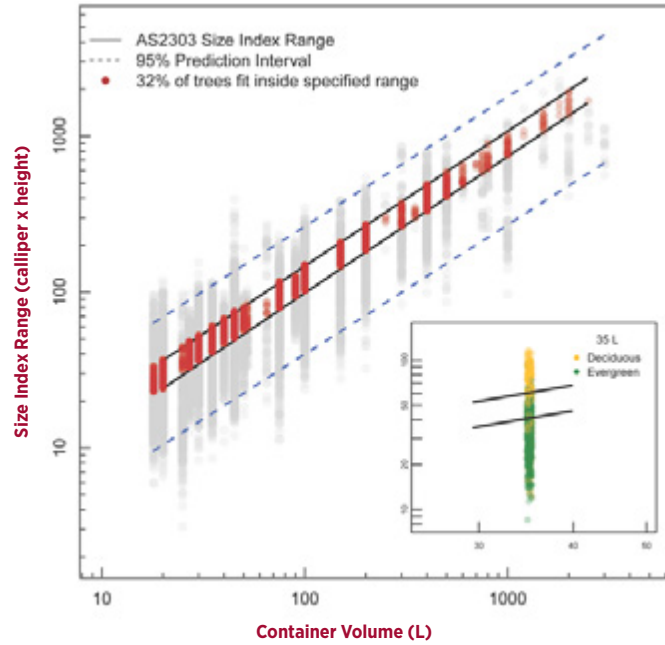
## Literature review

Many current international nursery tree standards include assessment criteria for different classifications of tree stock (e.g. spreading, upright, evergreen, deciduous), whereas AS 2303:2015 provides a single guideline for all tree stock.

If large natural variation in Size Index occurs across species, climate regions or in response to nursery practices, the currently specified acceptable values in AS 2303:2015 may not adequately capture tree stock balance.

Likewise, if variation in height and calliper and thus Size Index is quantifiable in terms of tree stock species type or climate zone, then this information may be useful in revising or tailoring acceptable ranges in the standard to provide more refined guidelines.

The final report, available on the Nursery & Garden Industry Australia website, contains a copy of the literature review: Courtney E. Campany et al. (ND). *A review of root to shoot balance in containerized nursery tree stock: nature vs nursery.*



- Black lines represent the minimum and maximum acceptable range as specified in the existing AS2303.
- Grey circles represent each of the 13,820 trees measured.
- Red circles represent only the trees that fit in the specified range.
- Blue dotted lines indicate where 95% of the measured trees would fit.
- The inset shows the difference between deciduous and evergreen trees in smaller sized containers.
- If only 32% of trees fit into the current standard, there is potential that industry could be rejecting 68% of trees that are otherwise healthy and good quality.

**Figure 1.** Above-ground size index across a range of container sizes for trees measured across 23 Australian nurseries,

## KEY FINDINGS

Based on the research findings, the current specified range of Size Index in relation to container volume in AS 2303:2015 does not adequately capture the natural variation across the large diversity of 'ready for dispatch' trees, i.e. meeting all mandatory requirements under the current standard, in Australian nurseries.

- Small, non-native, deciduous trees in containers less than 50L tended to have greater Size Index values than native evergreen trees
- Small to medium trees in containers up to 500L showed the greatest variability in Size Index, which is mostly due to the differences in species
- Larger trees in containers over 500L typically had a smaller Size Index range than the current standard

- Only one third of trees measured fitted within the current standard's data range across all container sizes of 18 to 3000L
- 45% of trees measured fall under the acceptable minimum limits of the current standard
- 23% of trees measured fall over the acceptable maximum limits of the current standards
- The differences between species was more important than climatic or nursery differences in explaining the variation in Size Index
- Neither mean annual precipitation nor mean annual temperature significantly affected measured Size Index values, despite large differences in these climatic variables among nursery sites.



## NEXT STEPS

A submission has been made by Nursery and Garden Industry Australia to Standards Australia, requesting a review of AS 2303:2015 in light of the independent research findings.

The findings from the tree stock research program will be communicated to industry, key stakeholders and customers in a series of 2-day events in six capital cities during 2017, in a roadshow titled *Taking Stock: Findings from Australian Landscape Tree Stock Surveys*.

The research team will also present to a range of industry conferences in 2017 and 2018.

A 'how-to' guide for customers, and associated online tool, will be produced. This will include photography and graphical representation of data and in-field tree stock quality assessment processes.

## IMPLICATIONS FOR THE NURSERY INDUSTRY

The measurements taken across Australia show that landscape trees have a much greater variation in Size Index than the currently adopted standard indicators.

For people selecting trees, it is likely that they are now rejecting trees based on a standard that is too limited for real-world tree production. For growers, such an arbitrary classification process means that there is unnecessary loss of good quality tree stock along with wastage of the associated time, energy, money and resources used in their production.

The research has also provided a rare opportunity to develop a rich data set specific to Australian tree stock production nurseries. This data could be used in future research to examine how climate, species and nursery practice contribute to variations in tree stock size and influence tree quality.



The project *Evaluation of Nursery Tree Stock Balance Parameters (NY15001)* has been carried out by Western Sydney University's Hawkesbury Institute for the Environment with funding from Horticulture Innovation Australia Limited using the research and development nursery levy and funds from the Australian Government.

## LINKS TO RESOURCES

Western Sydney University project page: [www.bit.ly/TreeStocks](http://www.bit.ly/TreeStocks)

Download the current standard, AS 2303:2015:  
<https://infostore.saiglobal.com/store/details.aspx?ProductID=1796682>

Final report, *Evaluation of Nursery Tree Stock Balance Parameters NY15001*:  
[https://www.ngia.com.au/Story?Action=View&Story\\_id=2357](https://www.ngia.com.au/Story?Action=View&Story_id=2357)

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