NURSERY PAPERS
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GETTING TO THE ROOT OF TREE PLANTING

The success of tree planting starts at the beginning of a tree's life and the eventual impact of nursery production decisions may not be seen immediately. The nursery industry is on a journey to refine a standard for landscape trees, ensuring they thrive for centuries in a greener Australia. This began in April 2015 with the introduction of the Australian standard for tree stock for landscape use (AS 2303:2015). Research is currently underway by the Hawkesbury Institute for the Environment to evaluate this standard and assess the real-world performance of nursery trees grown for landscaping purposes.

Summary

- The standard AS 2303:2015 was formally adopted by Standards Australia in April 2015 following extensive industry consultation.
- Industry called for new research to validate the standard, particularly the root to shoot balance metrics, with a review of the scientific and trade literature and field surveys throughout Australia.
- The list of tree species was identified during meetings of the research committee, made up of selected tree growers, Horticulture Innovation Australia (HIA) and members of Nursery and Garden Industry Australia (NGIA).
- Now halfway through its research cycle, this project is building up a body of data that will eventually contribute to more informed methods and practices to assess the real-world performance of nursery trees grown for landscaping purposes.
- Continued communication to engage growers through the life of the project is planned.

Rootball crown investigation to check for circled roots at surface

THE SIZE INDEX

The current standard, AS 2303:2015, provides a guide for buyers selecting trees to determine if a tree is likely to be good enough to plant out. It gives buyers a way to check for obvious quality problems over different parts of the tree as well as ensuring that the tree's rootball and shoots have the right proportions.

This measure is known as the Size Index, and is like the Body Mass Index that is used to check if a person is in the right weight range.

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

- The calliper – this is the diameter of the trunk measured at 300mm above the root crown, or 50% of the overall height, measured in millimetres.
- The tree height – this is 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:

- Tree height: 2 metres
- Calliper: 50 millimetres
- Size Index: 2 x 50 = 100

A tree with a Size Index of 100 should be in a container with a volume of 70-90 litres when sold, according to the current standard. Expressed another way, a tree in a 70-90 litre container could have a Size Index of 75 up to 137 – so the relationship between container size and Size Index is not exact but more of an allowance to reflect the many root and shoot factors and natural variation in living trees.

Logically, a healthy tree should have a good-sized trunk to support the stem, leaves and branches and these should be in proportion – not too stunted, not too willowy for its species. Likewise, a tree should have an adequately sized rootball to ensure structural support and water and nutrient supply.

But what does this mean in practice and how does this vary by species, climatic region, growing method, pruning or other factors?

Nursery & Garden Industry Australia

This project has been funded by Horticulture Innovation Australia Limited using the Australian Nursery Industry levy and funds from the Australian Government.

Horticulture Innovation Australia

Checking largest branch width at Andreasens Green Kemps Creek NSW

CONTAINER SIZE AND VOLUME

At any given container size, a market-ready tree should have largely filled the container with its roots so that it will not fall apart at planting and leave the roots exposed or loose. It should not be too full, or have roots that have become trapped in a tight circle, or have spent so long in the container that the tree cannot branch its roots outwards into new soil when it is planted.

In practice, this means that the tree's above-ground parts and it's below-ground parts should have grown proportionally and the container size should have been increased by repotting so that the tree has become a 'quality' tree when it is selected for sale.

A STANDARD RELATIONSHIP

The relationship between Size Index and container volume is in the current standard, AS 2303:2015, as a straightforward proportional relationship that says 'the bigger the tree, the bigger the container' with little variation.

TABLE 1: TREE STOCK BALANCE GUIDE DEVELOPED FROM DATA OBTAINED FROM NSW PRODUCTION NURSERIES FOR TREE STOCK IN CONTAINERS

Nominal container volume (L)	Size index range	Nominal container volume (L)	Size index range
20	24–37	150	144–212
25	31–45	160	153–224
30	36–53	200	185–272
35	41–61	230	209–307
40	46–68	240	216–318
45	51–75	250	224–330
50	56–82	285	251–369
55	61–89	300	262–386
60	66–99	350	289–440
65	70–103	400	330–494
70	75–110	500	407–599
75	79–117	600	476–700
85	89–130	750	577–849
90	93–137	1000	739–1087
100	102–150	1200	865–1272
110	111–163	1500	1048–1542
130	128–188	2000	1343–1975
140	136–200	2500	1627–2393

Figure One: the table format data of Size Index ranges as displayed in the Standard AS 2303:2015.

This data is also represented in the following chart and shows a clear proportional relationship with little variation from the trend.

Industry feedback gathered at stakeholder and grower meetings indicated that if a person was selecting trees and using these data as a guide, there would be a strong chance of rejecting otherwise good quality trees. Growers felt that there would be situations where a batch of trees or a particular species rarely or never performed to this trend, as a result of particular seasonal conditions, growth form or other factors.

A lack of information on root to shoot balance at present – particularly as it pertains to varying production regions and species – hampers the integration of these balance metrics into the suite of traits specified in the standard.

While an experienced selector could understand what a tree that is "*healthy, structurally sound, have well-developed roots, have a uniform habit and good balance between the canopy and the rootball*" looks like, there is significant room for interpretation so the standard, particularly the root to shoot balance criterion, does not directly help selectors choose better trees. The root to shoot balance criterion may need some allowance for tree type. It needs to be supported by an evidence-based and simple metric that allows a selector to choose trees efficiently while ensuring they meet quality standards.

Checking tree height at Benara Nurseries in WA

CURRENT STANDARD

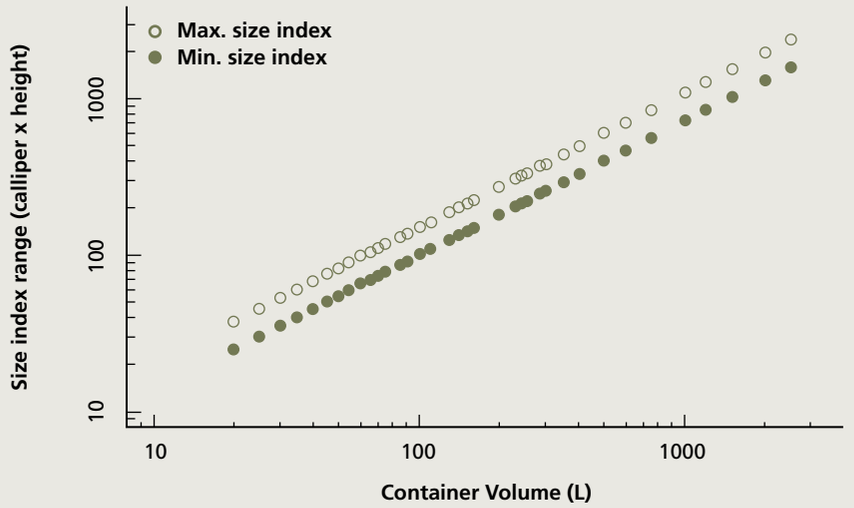

Figure Two: A graphic representation created by the Tree Stock Project researchers of the upper and lower Size Index ranges taken from the Standard AS2303:2015.

OUT AND ABOUT TO OBTAIN TREE STOCK DATA

An initial stakeholder steering committee meeting has been held, and a target list developed identifying 28 tree species and cultivars for assessment across growers and regions.

In 2016, the research team has measured trees in four distinct climate regions of Australia, including New South Wales, Western Australia, the Northern Territory and Victoria. The surveys include a standardised method to collect data from nearly 9700 trees across 117 different tree species/varieties. These measurements have been compared across the entire range of container sizes (20 – 2500 L) specified in AS 2303:2015, as well as with bare-root trees.

Nursery	Region	Trees	Date
Alpine Nursery	Sydney, NSW	919	Apr 26-29
Andreasens (Kemps Creek)	Sydney, NSW	899	May 23-25
Andreasens (Mangrove Mtn.)	Central Coast, NSW	217	May 26
Speciality Trees	Melbourne, VIC	922	Jun 20-22
Mt William Advanced Trees	Melbourne, VIC	1077	June 23-24
Flemings Nursery	Melbourne, VIC	1369	June 27-29
Established Tree Transplanters	Melbourne, VIC	409	June 30-July 1
Darwin Plant Wholesalers	Darwin, NT	821	Aug 8-10
Benara Nurseries	Perth, WA	1208	Sept 12-23
Ellenby Tree Farm	Perth, WA	1081	Sept 12-23
Arborwest Tree Farm	Perth, WA	764	Sept 12-23

Figure Three: Nursery sites visited through September 2016.

THE SAMPLING METHOD

The process to assess a tree is as follows:

1. Measure trunk diameter 300 mm above the root crown (calliper)
2. Measure height of tree using a telescopic height measuring pole
3. Measure the width of the widest branch from the stem outwards to the end of the branch
4. Survey of roots that ranges from basic visual inspection of roots from the root crown to a fully destructive slice sample with the pot removed so that the full rootball can be assessed from the outermost roots to through to the stem.

Dr Court Campany measures calliper at Andreasens Green Kemps Creek

The sampling method also includes visually assessing the above and belowground morphological quality of a representative tree for batches of tree stock that are ready to sell, as specified in Appendix A and B of AS2303.

Researchers evaluate rootball occupancy and root morphology, through either careful removal of a wedge-shaped section of the soil (containers ≤ 45 L) or a top-down inspection of root development of ~150 – 200m into the soil for large containers.

If the representative tree passes both quality assessments, then the size index parameters (height and trunk diameter at 300mm) are measured on a large subset of trees in that batch.

Additional measurements of crown shape and form are collected, as well as leaf thickness for each batch of tree stock.

NEXT STEPS

The next phase of the field trials includes two-week measurement campaigns at six nurseries in South Australia in November 2016.

In early 2017, the team will complete its final interstate visit to Queensland with campaigns at nurseries around Brisbane and Cairns. They will also complete additional site visits within NSW to extend the geographic scope of measurements to include nurseries in Wollongong, Central Coast and Byron Bay.

IMPLICATIONS FOR THE NURSERY INDUSTRY

The aim of this project is to ensure that a drive for tree stock quality across the industry is representative, fair and workable for growers, landscape architects and others selecting and planting trees for Australian landscapes.

This project is building up a body of data that will eventually contribute to more informed methods and practices to assess the real-world performance of nursery trees grown for landscaping purposes. By working alongside growers and others in the industry, the research project can define a more evidence-based standard – one that is trusted and supported as a fair representation of trees being grown in Australia.

This research topic is funded as part of the 'Evaluation of Nursery Tree Stock Balance Parameters' project (NY15001) funded by Horticulture Innovation Australia Limited using the Australian Nursery Industry levy and funds from the Australian Government. Research is being led by the Hawkesbury Institute for the Environment within Western Sydney University. The research team is led by Prof. Mark Tjoelker and includes Dr. Courtney Campany, lead field researcher. The team is supported by David Thompson, Dr. Mike Aspinwall, Dr. Sebastian Pfautsch and Dr. Remko Duursma.

LINKS TO RESOURCES

1. Nursery Papers October 2015 Issue no.9 – Tree Stock Standard AS 2303:2015, Nursery and Garden Industry Australia
2. Standards Australia 2015, AS 2303:2015 Tree stock for landscape use available from *www.standards.org.au*
3. Clark, R. Specifying Trees: A Guide to Assessment of Tree Quality NATSPEC/Construction Information, 2003