Which Plant Where

Climate ready street tree trials

A best practice guide

FEBRUARY 2022

ACKNOWLEDGEMENT OF COUNTRY

We acknowledge Aboriginal and Torres Strait Islander peoples as the First People and traditional custodians of the land and waters of this place. We express our gratitude in sharing this land, our sorrow for the personal, spiritual and cultural costs of that sharing, and our hope that we may walk forward together in harmony and the spirit of healing.

This "How-to" guide for climate ready street tree trials was developed in collaboration between the Which Plant Where (Macquarie University, Western Sydney University) and TREENET.

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treenet

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INTRODUCTION

WHICH PLANT WHERE

Street trees are on the front line of urban forest service delivery, supporting neighbourhood character, human health, waterway health, biodiversity, tourism and business vitality. In order to deliver these benefits, street trees must be well suited to the local conditions. Currently, urban ecosystems are experiencing unprecedented levels of warming and shifts in rainfall patterns due to climate change, which means tree species selections that have succeeded in the past may fail to do so in the future. Therefore, it is vital that climate ready tree species for urban greening are identified to ensure the resilience of urban environments to climate change. This can be achieved through street tree trials.

This "how to" guide provides an easy-to-follow, step-by-step plan to designing and implementing a scientifically rigorous trial of street tree species in an urban context. The aim of this guide is to assist tree nurseries and local councils to consistently apply basic scientific principles so that:

- tree species' suitability to changing local conditions can be tested, measured and evaluated
- a participative, co-designed approach to street tree trials can be implemented
- results can be compared with similar trials in other locations
- councils, tree growers and other agencies can collaborate to extend trials into new areas
- knowledge can be shared to increase species diversity and enhance urban forest resilience

INTRODUCTION

There are six easy steps that need to be followed to ensure that your street tree trial is a success. Collectively, these steps will ensure that trials are scientifically robust and results can be easily shared.

1. Defining your outcome
2. Selecting a species
3. Identifying your trial site
4. Designing and planting your trial
5. Monitoring
6. Data sharing

02.
STRATEGIC PLANNING

Why

Start with the Why!
Why are you undertaking street tree trials and what questions do you want answered?

STEP 1: DEFINING YOUR OUTCOME

1.1 – The Why
Start with the Why! This will help you define the outcome. What is your vision? What are your goals? What questions do you want to answer? Basically, what do you want to achieve? For example, you may be planning your future urban forest and want to identify new species that will be climate-ready. The questions are endless. However, to gain valuable insights and answer your questions correctly, you need robust data. This will take good planning and preparation.

1.2 – Time commitment
Before beginning a trial, it is important to realise that it will require a significant time commitment over multiple years (minimum 2 years). It is better to decide prior to the start of the trial whether such a time commitment is feasible. Although a trial is a significant time commitment, the long term benefits of having a thriving urban forest in your urban area will make the effort more than worthwhile.

STEP 2: SELECTING YOUR TRIAL SPECIES

2.1 – Find species that are climate ready (Know the future climate for your area)
Many parts of Australia are experiencing unprecedented levels of warming and shifts in rainfall patterns. Changes in these two climate factors can have a profound effect on the survival and success of urban tree species. Therefore, it is important to select a trial tree species that may not only withstand current climatic conditions but future projected conditions as well. The 'Which Plant Where' online plant selector tool is an easy way to determine how particular species will survive under predicted future climate of your area. The tool uses climate projections that can then be used to identify locations with current conditions that match those forecast for your area. Species occurring naturally or succeeding as street trees in those locations may be good candidates for trialling in your area.

2.2 – Be aware of your space constraints
Space in urban areas is often constrained by impervious surfaces (e.g. roads, footpaths) and other infrastructure (e.g. water, sewerage, electrical). Therefore, it is important to select a trial species that will fit within these space constraints. Further, it is important to remember that in urban areas small trees are spaced at 5 to 7 m intervals, medium trees at 7 to 10 m and large trees at 10 to 15 m. In the long-term, this foresight will minimise maintenance costs (e.g. pruning, removal and replacement) and infrastructure damage (e.g. lifting and cracking of footpaths and roads).

2.3 - Know your species diversity
Plant species diversity is important for improving the structure and function of urban forests. It increases resilience to stresses such as drought, pests and disease, provides food and shelter for fauna, and has aesthetic benefits. For these reasons, an emphasis should be placed on increasing the species diversity within your urban area when selecting a trial species. This is as easy as surveying the species that are already present in the locality and then selecting trial species from an unrepresented or under-represented genus or family.

2.4 - Engage and expand your networks
There is often a wealth of useful information already out there that can help you decide what species to trial. It is worth chatting with neighbouring councils, local bush regeneration groups, growers, botanic gardens and community gardening groups to find out what species have already been trialled in the area and the lessons learnt from those trials. This could save a lot of time and money in the long term, or at the very least, provide some helpful information.

STEP 3. IDENTIFYING YOUR TRIAL SITE

3.1 - Select a site that is like for like
When selecting a site for your trial, it must be representative of the site in which you intend to eventually plant the species being trialled. Soil type, water availability and space constraints are all important factors to consider when selecting a site. For example, sites in urban areas are normally characterised by a turfed verge bound by impervious surfaces. Therefore, it may inappropriate to trial a prospective species for a site like this in an open field.

3.2 - Select a mix of high profile sites and low profile sites
Trial species are exactly that, a trial. This implies that there is a degree of uncertainty regarding whether trees will survive and thrive. Some trial trees won't survive, so it is best that trial sites are dispersed across both low trafficked areas (e.g. cul-de-sacs) and more frequented sites. Before beginning a trial, it is worth undertaking some community engagement to explain the rationale of the trial to the community; creating a sign or placing a tag on the tree highlighting that is it part of a trial can also help inform the community and provide an opportunity to take stewardship of the tree and potentially monitoring the tree.

3.3 - Be flexible
Space in urban areas is often at a premium, so it is important to strike a balance between finding the perfect site and being flexible to ensure your trial can get off the ground. In many cases, being opportunistic may be the only realistic way to secure a site.

03.
DESIGN & IMPLEMENTATION

How

Replication, replication, replication is the key to good science and robust data.

STEP 4. DESIGNING AND IMPLEMENTING YOUR TRIAL

4.1 – Treatments
Treatments are things you may wish to test, such as watering regime, mulching and fertiliser addition. For example, if you want to trial a species that has been identified as drought tolerant, you may want to test plant performance under different watering conditions (or treatments). To test this, get 20 plants of the same species. 10 will be the "control" plants and receive business as usual. 10 will be the "treatment" plants and receive (for example) 50% less water.

4.2 – Controls
If you have a treatment (e.g. watering regime, soil amendments) as part of your trial's experimental design, it is important that you also have "control" plants to determine the effect of the treatment/s. Control plants should ideally have the same number of replicates as the treated plants.

4.3 - Replication, replication, replication
Replication is the key to good science. Why? Plants from the same species still display some degree of genetic variation. This means that even when you grow plants under the same environmental conditions, they will still vary in their growth and appearance. To capture this variability, multiple individual plants per treatment are required. This is called replication, with each plant within a treatment called a replicate. Ideally, the more replicates you can plant, the better, as it will increase the amount of variability you capture and hence your certainty of the result. However, given the space constraints within the urban areas, it is often not feasible to plant out large-scale experiments, so the minimum number of replicates (i.e. individual plants of each species per treatment) you should aim for in your trial is 8-10.

4.4 - Randomisation
To minimise the effects of environmental factors on your trial, individuals from different treatments must be randomly allocated positions within your trial site. For example, if 20 trees in total are being planted, 10 with a watering well (treatment) and 10 with a soil berm (control), don't plant the 10 with wells next to each other, followed by the 10 with berms. This is because environmental factors such as soil type may vary across the trial site. An easy way to randomise your plants is to have, for example, a red marble that represents the watering well and a blue marble that represents the berm. Put the marbles in your pocket and then take one out one marble to determine which of the two treatments will be planted first. Repeat this until all the plants have been allocated positions. If there are three treatments, use three different coloured marbles, and so on. This will ensure individuals from different treatments will be interspersed with one another.

4.5 - Consistency of planting is key
The best trials will be those that are the most consistent in how they source, install and monitor their plants. This will enable you to conclude with more confidence that any differences between treatments were a result of the treatment alone. There are several ways to achieve a high level of consistency.

Firstly, plants used in the trial should be of the same quality (e.g. size and structure) at the time of planting. A consistent pot size across your trial is essential unless you are using more than one pot size as a treatment type. Although plants can be of similar quality, no two plants are the same. If your trial species stock varies in size then consider randomising the size distributions as a treatment. To do this, first record the pot size, then simply measure the height (soil surface to highest growing point on main stem) and/or stem diameter (from a consistent height from the soil surface) of each plant, which will enable you to rank the plants based on their size. Depending on the number of treatments you have in your trial, these ranked plants can be designated to a treatment randomly using the marble method described above (see step 4.3).

Secondly, the preparation of the planting site shouldn't vary across your site (s) through space. As an example, when you are digging the holes in which to place the plants, make sure they have the same shape and dimensions. The accepted technique used in urban areas is that the hole should be three times as wide and as deep as the root mass of the plant, in a wok shape.

The purpose of the two points discussed above is to ensure the highest possible level of site and planting consistency is achieved. However, adhering to these practices will be invalidated if consistency is not maintained for the duration of the experiment. This means that maintenance regimes, such as water and fertiliser addition, need to be the same for all plants within your trial unless you have planned to compare an alternative maintenance regime as a treatment. Remember, it should only be the treatment you're testing that should vary between plants in your trial.

STEP 5. MONITORING

5.1 - Recording success and failure

The success of your trial species will be determined by its ability to survive and thrive beyond the establishment phase, ideally while receiving little or no maintenance. Assessing survival is self-explanatory but at times can be difficult to gauge accurately. This is because a plant may appear to be dead but is in fact just sitting dormant until more favourable conditions present themselves, at which time the plant can re-sprout and recover. Therefore, you must continue to survey plants that have previously been recorded as dead for the duration of your monitoring effort.

The survival of your trial species at the planting site is only part of determining whether the species is a suitable candidate to plant in your urban area. To complete the picture, you will also need to assess whether the species is growing and healthy. Two common non-destructive measures of plant growth are height and stem diameter at breast height (1.3 m above the surface of the soil). As discussed in the 'consistency is key' section (see step 4.4) above, you will have already measured these two growth parameters at the time of planting. Using these initial measurements, you will be able to track the growth of your trial plantings over time.

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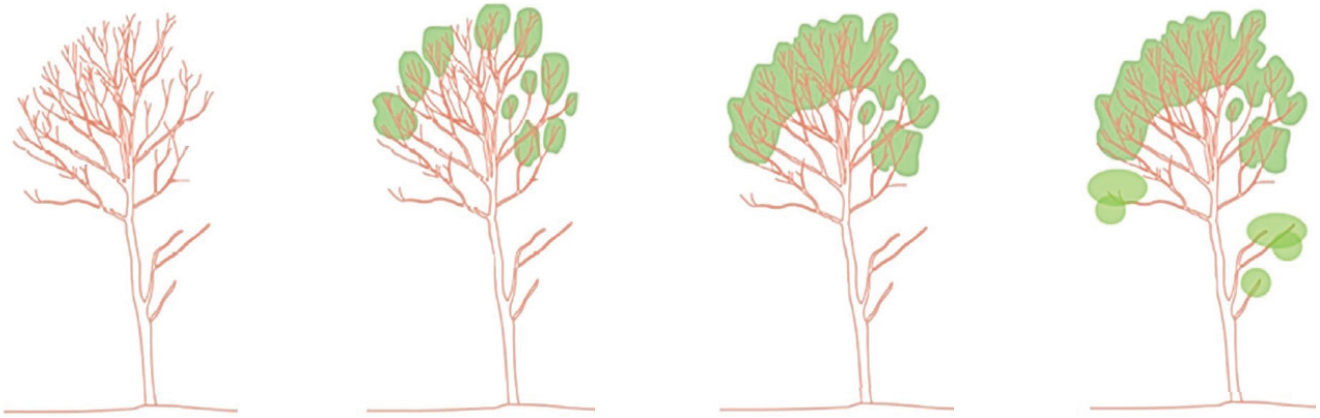
A good indicator of plant health is canopy density. The below easy-to-understand plant health scale based on canopy density can be used to guide you. A quick visual assessment using this scale will suffice, but for a more accurate measure of canopy density, a spherical densiometer (an instrument used to measure tree canopy density) can be used.



Dead:
No crown

Unhealthy:
1-70% crown

Relatively healthy:
71-90% crown

Healthy:
91-100% crown

5.2 - Time your monitoring

Monitoring is vital because it's when you get the return on your investment. However, it can be costly and time consuming if not done efficiently, so it's beneficial to do your monitoring at the most relevant and convenient times. For example, plantings are most vulnerable to mortality or declines in health during winter and summer when climatic conditions are at their most extreme. Therefore, monitoring at these times, or at the end of harsh times is more appropriate than monitoring in autumn and spring when conditions are milder. If you are trialling a deciduous species, monitoring should be carried out during the "leaf-on" stage of their annual growth cycle because visually assessing the health of a plant with no leaves is near impossible. Finally, to reduce the cost of monitoring your trial, try to schedule it at the same time as the routine maintenance is being carried out.

5.3 - Frequency of your monitoring

Plantings are most vulnerable to mortality or health declines during their initial establishment period, which is typically the first two years after planting. This means monitoring should be more frequent during this time (e.g. quarterly) but then can be progressively scaled back (e.g. yearly) through time. Before committing to planting a trial, note that it will likely involve at least a five-year monitoring effort.

5.4 – Document your trial using photos

There is no better way to remind yourself of how your trial has progressed over the long term than with photos. Think of them as your insurance policy. Photos should be taken at every stage of the trial from site preparation through to monitoring. It is important that your plants are photographed from the same position through time and that each photo has a date stamp, so that plant progress is easy to track.

04.
DATA SHARING & ADDITIONAL RESOURCES

STEP 6.
DATA SHARING

6.1 - Sharing is caring

To help inform the selection of appropriate species for future trials, it is important that you share the findings of your trial. This can be done at by either sharing it with the Which Plant Where team or you can register your trial in the TreeNET case study portal, which will give users the basic information about your trial as well as your contact information, so they can make enquiries.

By feeding information back into this knowledge base, you are enabling it to grow, which will mean the next people to trial a species will have a greater amount of information on which to base their species selection. This will ensure future street tree trials do not reinvent work already done but rather value add to it.

ADDITIONAL RESOURCES

TREENET Street Tree Species Trials Research: Street Tree Species Trials

Which Plant Where Online plant selector tool (Release date OCT 2021): Which Plant Where

Nursery Tree Stock Quality: Insights into Standards for Nursery-Grown Tree Stock

Don't Buy It – Don't Plant It! Applying AS 2303 Tree Stock for Landscape Use

What is Tree Resilience and How is that Reinforced in the Production Nursery?

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