

Integrating data for tree crop modeling under climate change

Alessandro Ossola, PhD



Is climate (change) affecting your productions?

AGRICULTURE

Heatwave hits California lemons sending prices soaring

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KEY POINTS

- A heatwave in Southern California's major lemon growing region this month caused a loss of lemons and squeeze in supplies.
- The decline in supplies has driven up wholesale prices about 40 percent or more in some markets.
- Some are predicting the supply crunch could continue into September and October.



EUROFRUIT

Heat wave slashes Spanish citrus crop

By Maura Maxwell | 22 September 2015

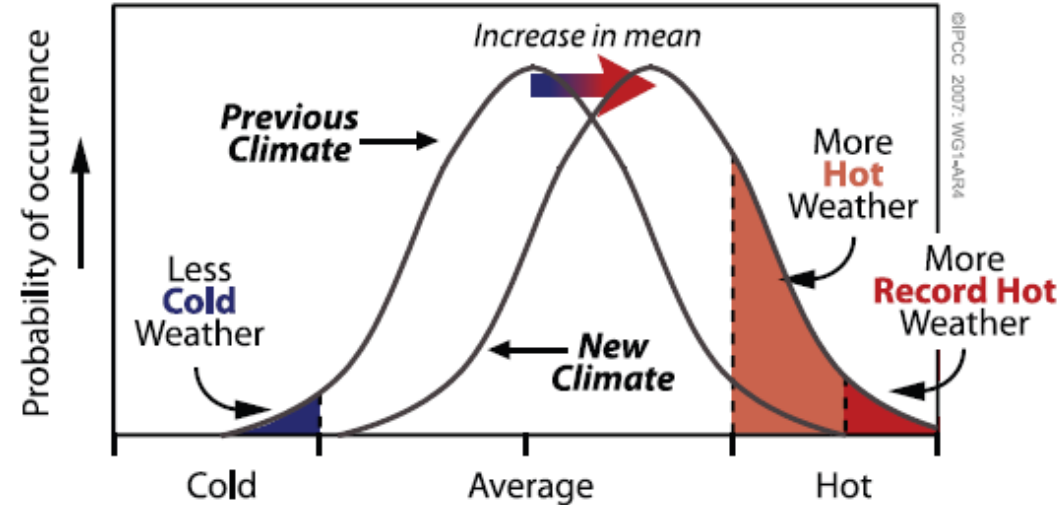
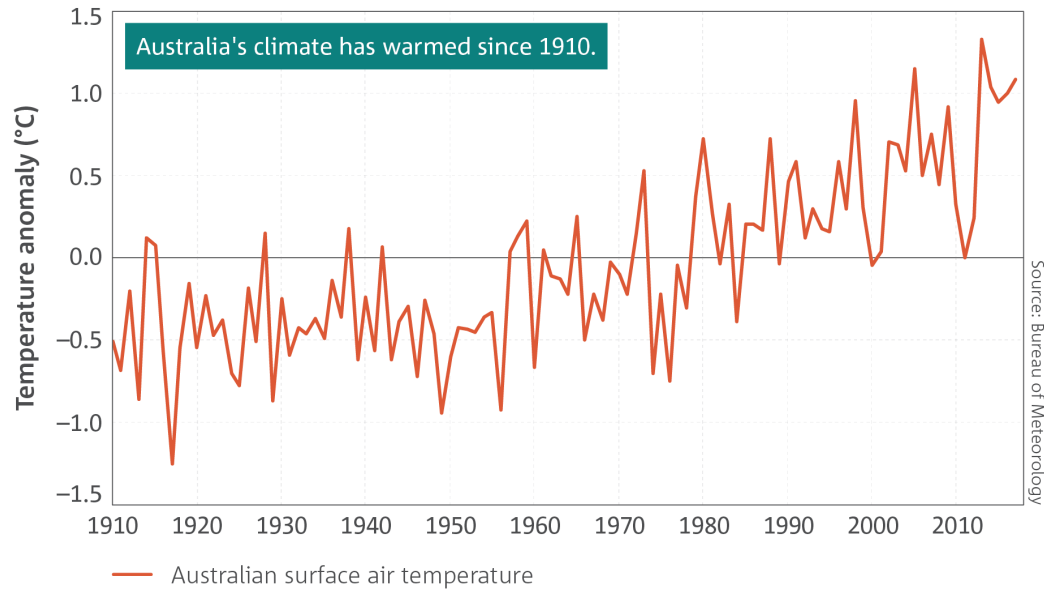


A sharp fall in citrus production in the coming season is being hailed by the Spanish government as welcome news for the national industry and the European market as a whole. The drop is due to the prolonged heat wave that engulfed much of the country during the spring and early summer, bringing record temperatures and leaving several dead.

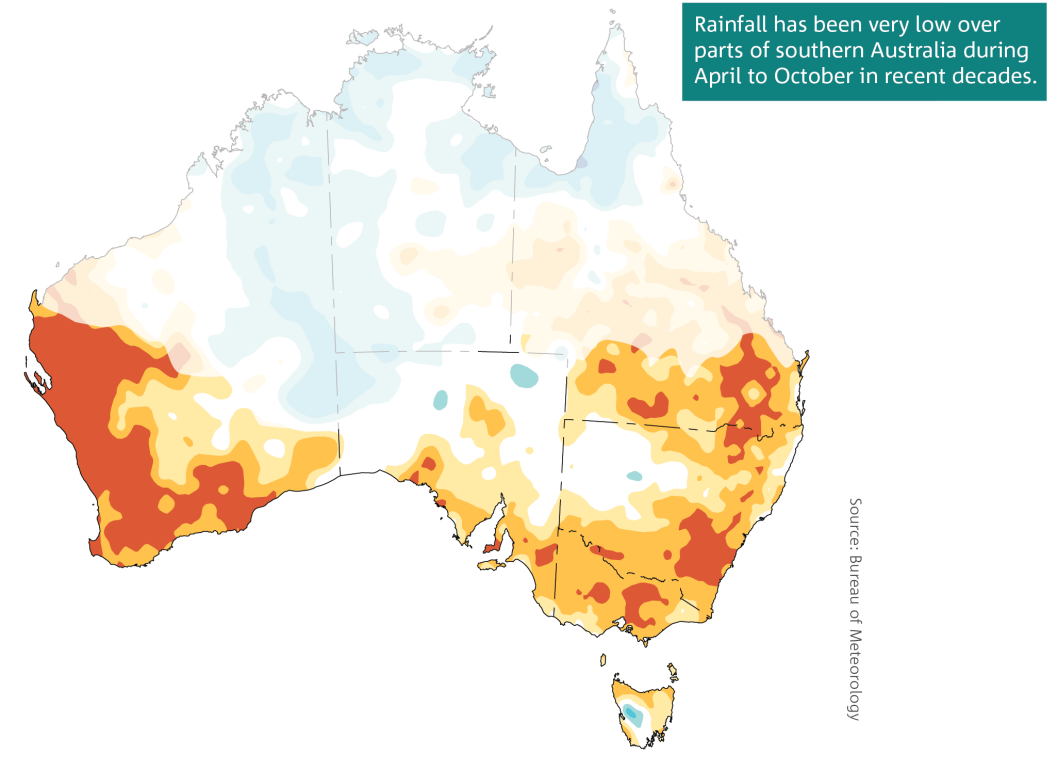
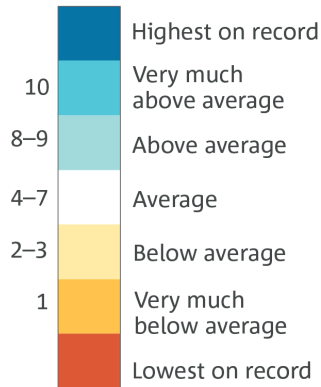


At a meeting held last week at the Ministry of Agriculture to analyse the start of the new campaign, representatives from the main producer groups presented the latest crop forecasts showing that early season mandarin varieties including Satsuma, Okitsu and Nules are down by as much as 25 per cent compared to last year. Volumes of early oranges – principally the Navelina variety – are projected to fall by 7-10 per cent.

This is what is going on in Australia...



Rainfall decile ranges



.. I will tell you a story ..

Impacts on the ornamental horticulture industry are severe



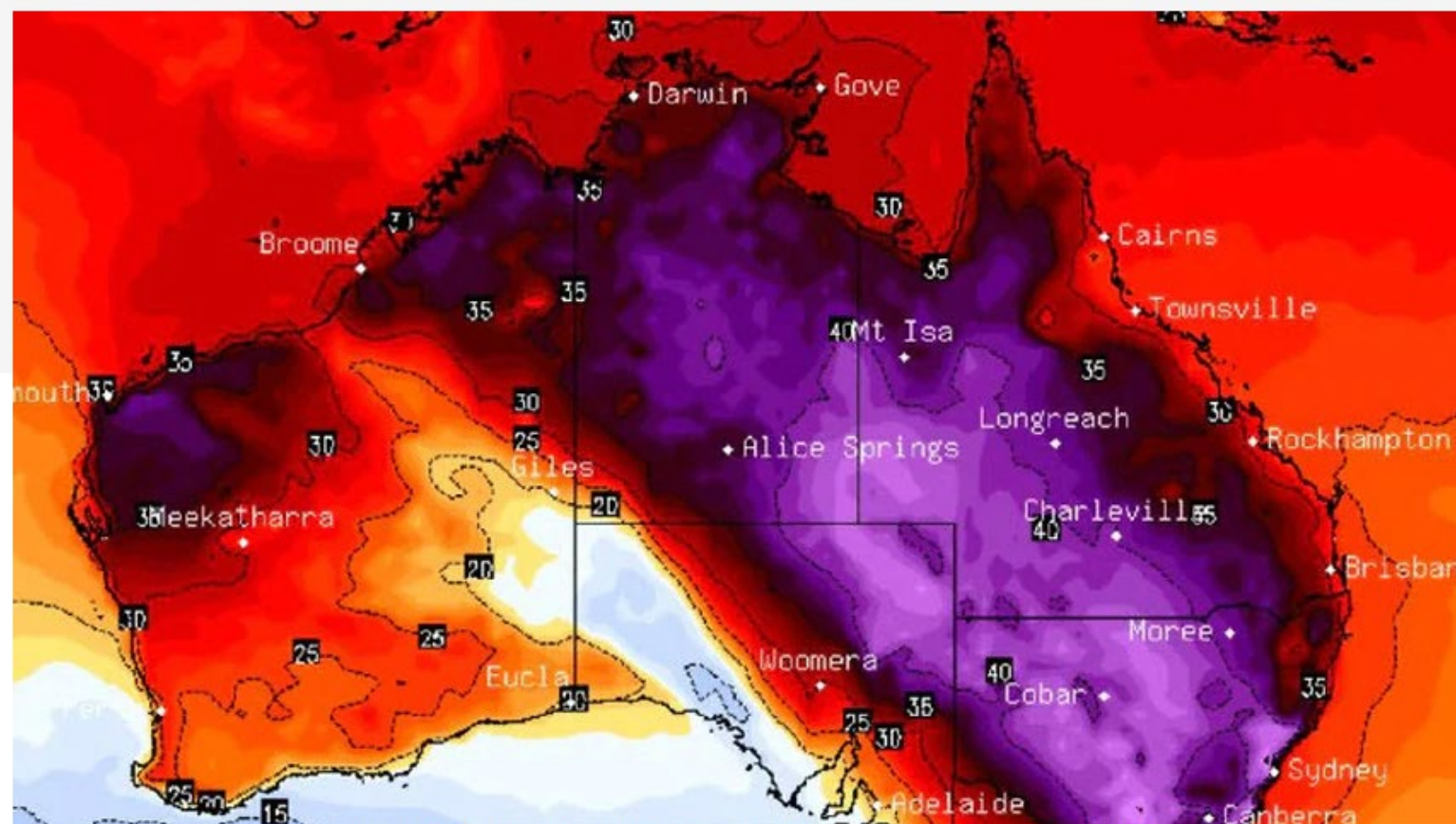
Platanus acerifolia
London planetree,
Richmond 9th Jan. 2018



Banksia serrata
Old Man Banksia, Sydney
10th Mar. 2019

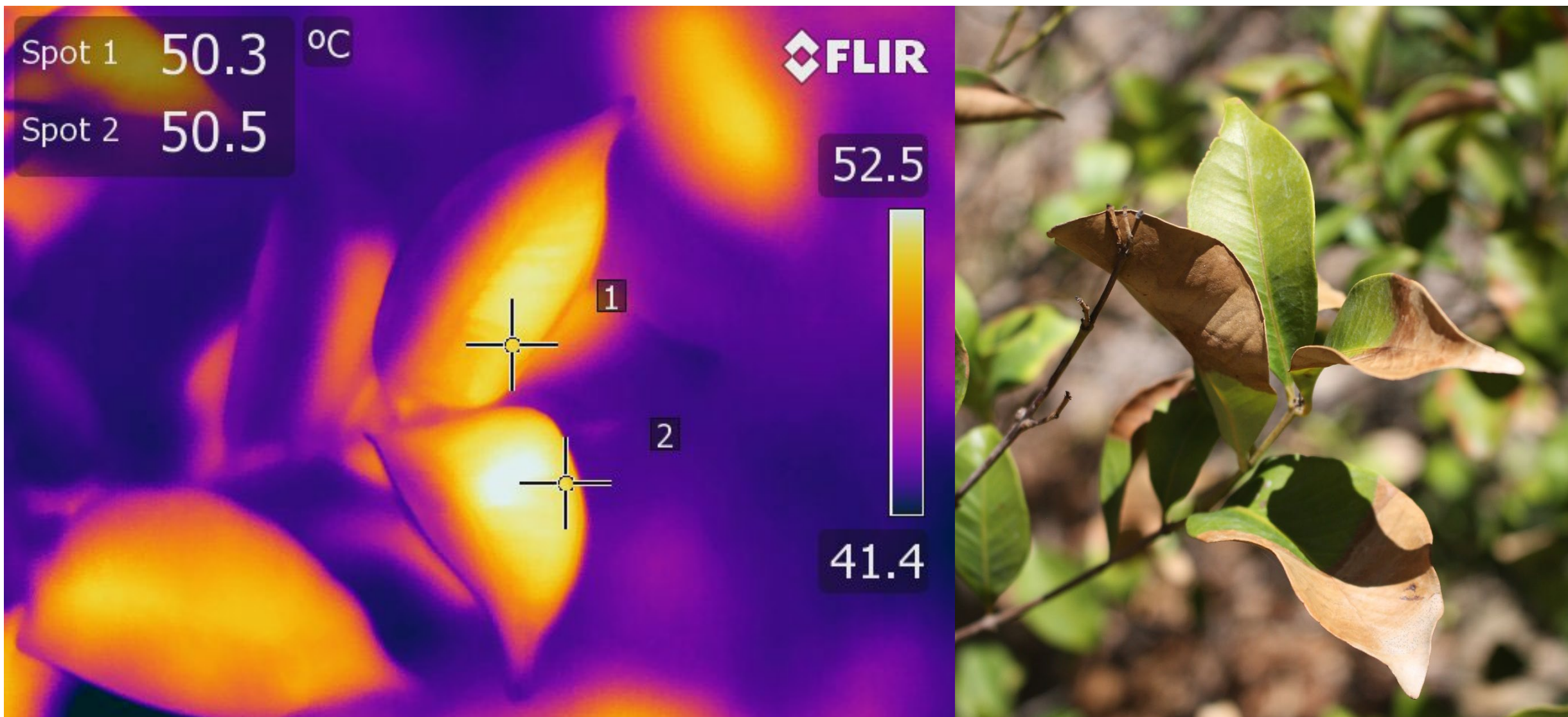


Sydney's Penrith the hottest place on Earth amid devastating bushfires



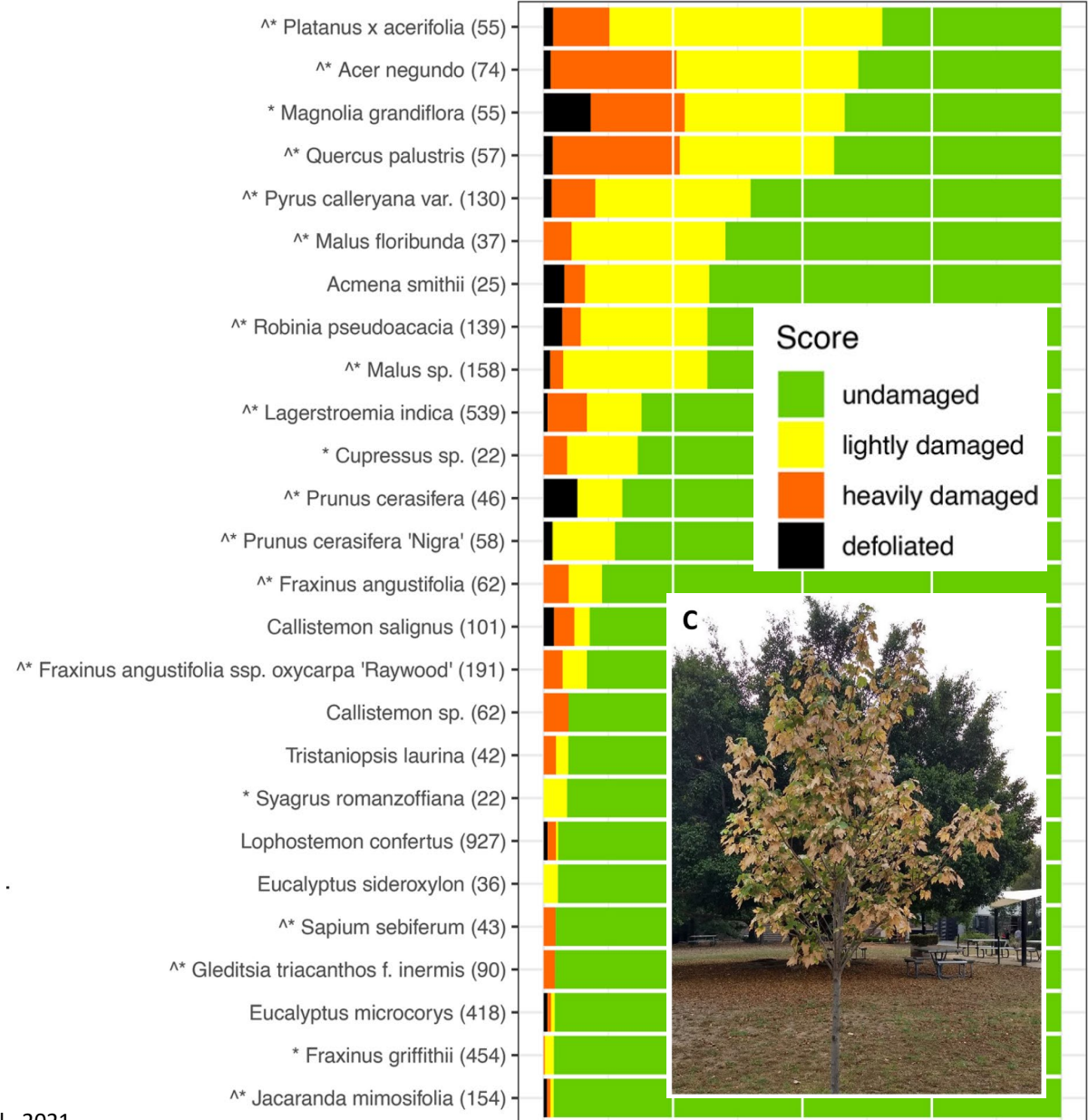
48.9 °C
(120°F)

Penrith was the hottest place on Earth on Saturday, reaching a high of 48.9C. Source: BSCH



Measured in W. Sydney on 10th Feb. 2017, 14:00 AEDT, Air T = 40.7 °C, 32% RH

Multi-million \$ damage to tree assets



Almost 10% of street trees experienced canopy damage

Helping Australia's horticultural industry adapt to climate change



KEY ISSUES

1. Inability to forecast climate change impacts
2. Need for long-term planning, market diversification
3. Increase resilience and opportunities for growers

**Hort
Innovation**



**GREEN CITIES
FUND**

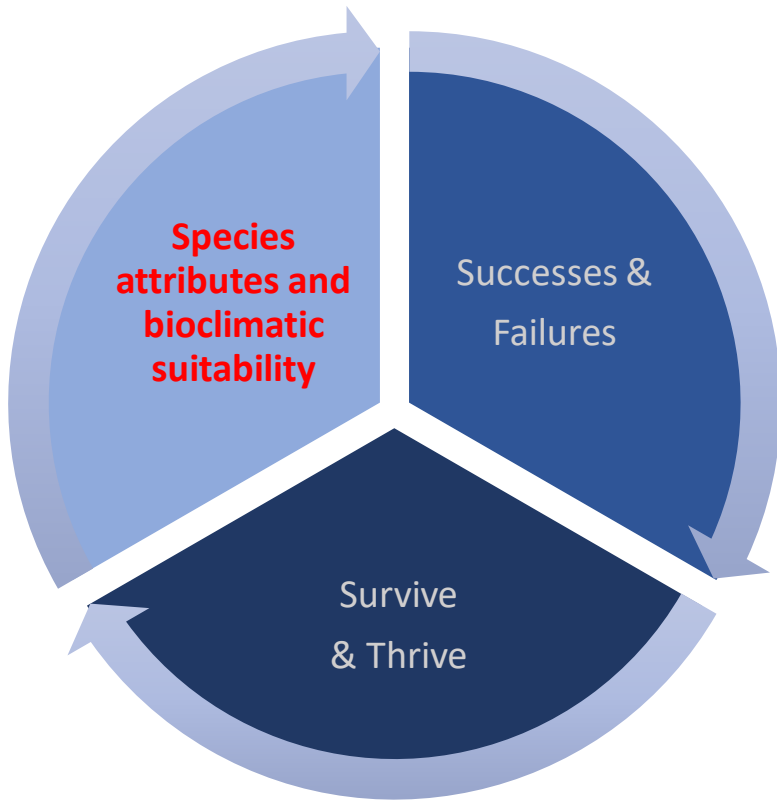


Do you love diversity?



Which one is '*climate ready*'?

We built an evidence base from multiple data streams



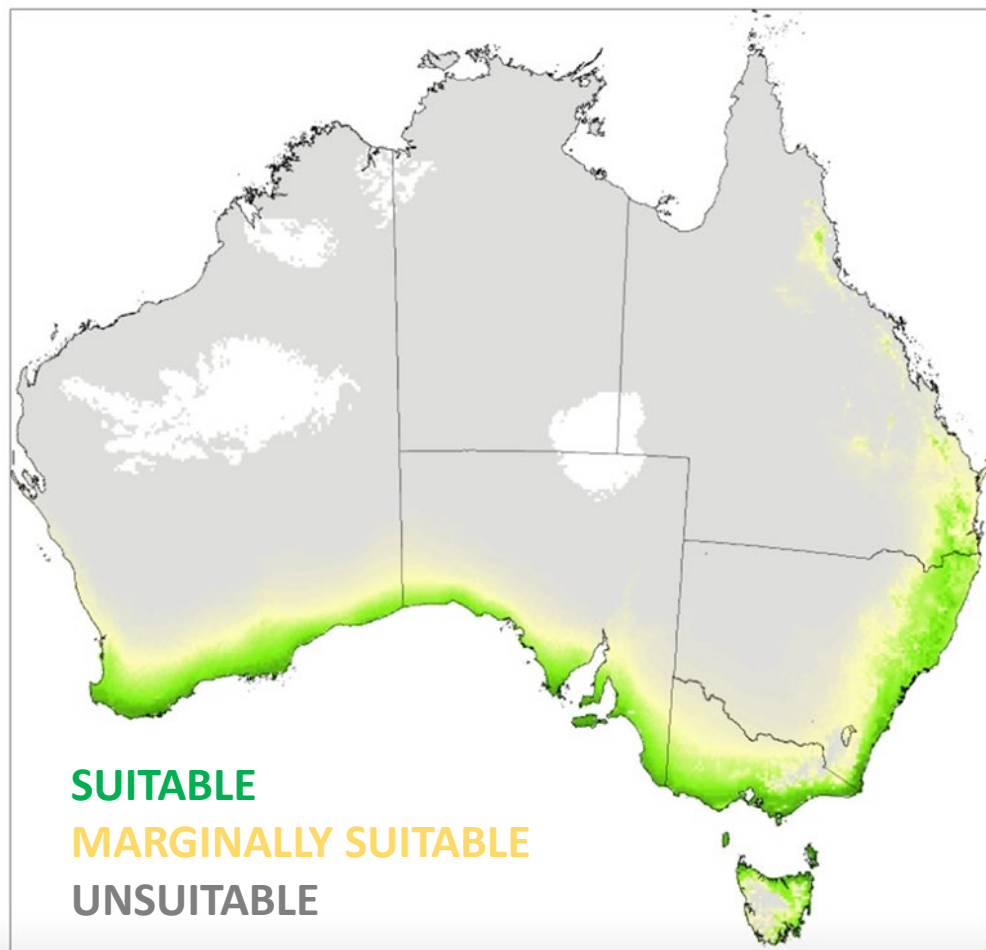
Bioclimatic models to estimate areas of climatic suitability for each species under a changing climate in 2030, 2050 and 2070.

Trait database that includes information for >2500 species & cultivars on species' attributes (biology, tolerances, site context, hazards)

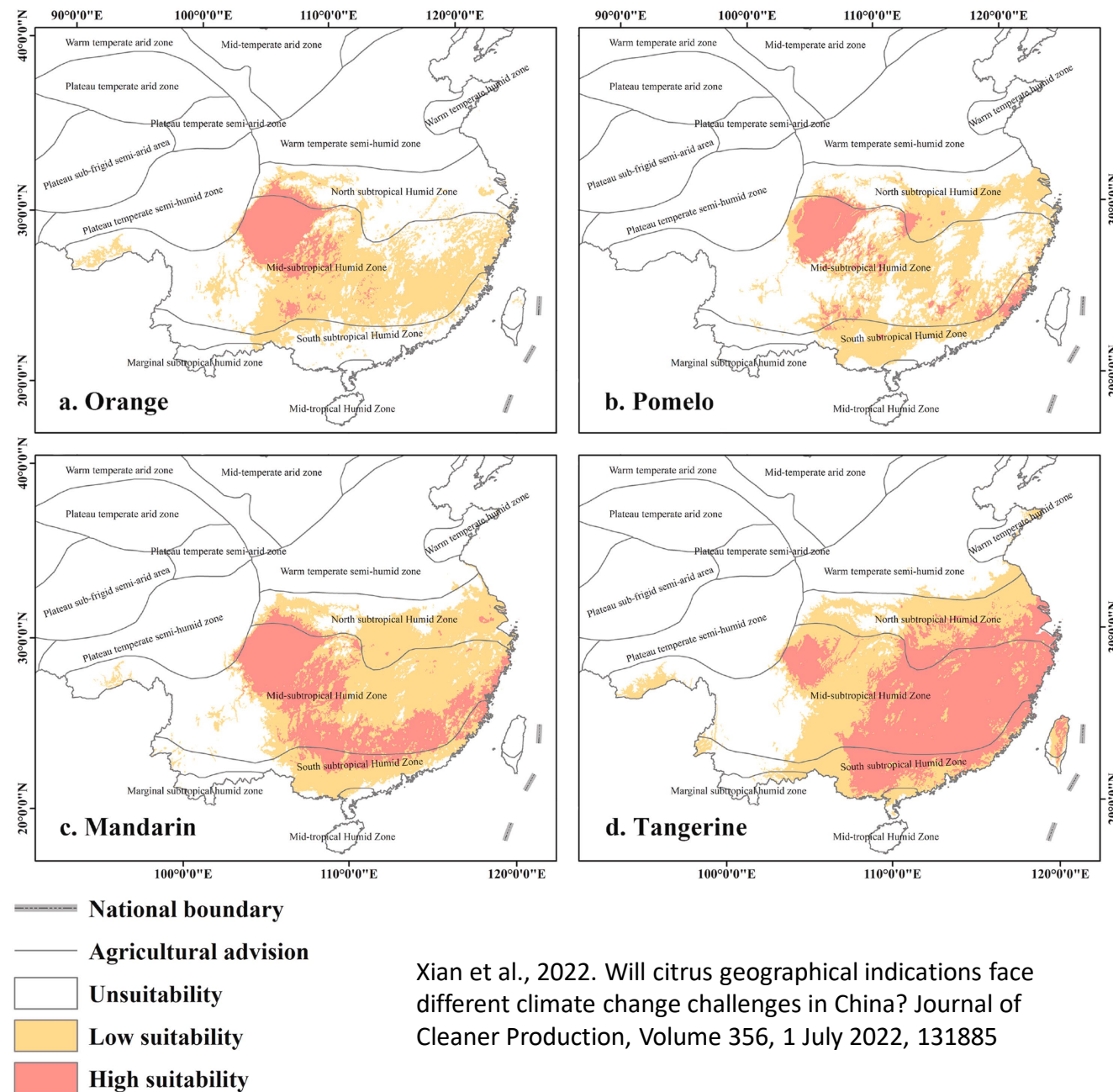


Which
Plant
Where

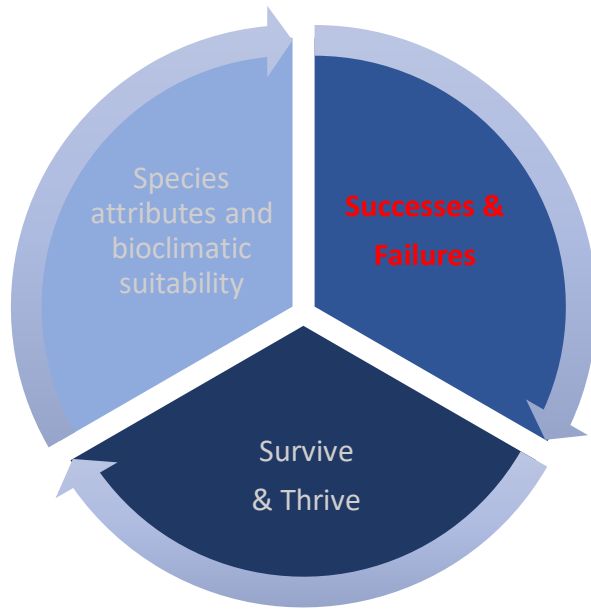
Hort
Innovation



Bioclimatic models = estimated areas of climatic suitability for each species under a changing climate in 2030, 2050 and 2070.



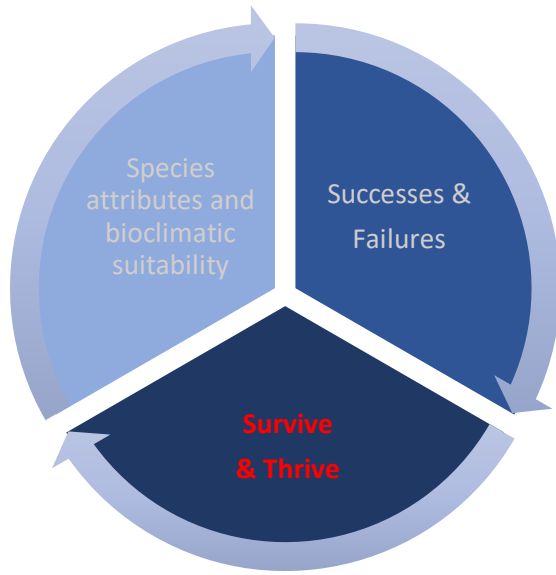
Xian et al., 2022. Will citrus geographical indications face different climate change challenges in China? Journal of Cleaner Production, Volume 356, 1 July 2022, 131885



This module accessed success and failures of urban tree plantings in relation to local conditions as well as variables such as planting and management techniques.

12 'Living Labs' were established across Australia





This module subjected a sample of 113 species to controlled heatwave and drought conditions in glasshouses to assess the abilities of different species to withstand:

- Drought tolerance
- Heat tolerance
- Plant stress indicators



We built simulated drought and heatwave effects



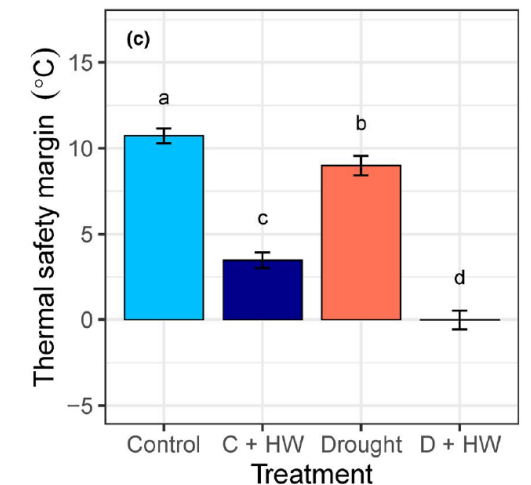
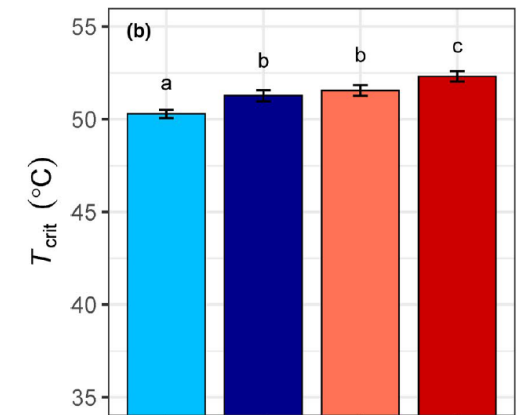
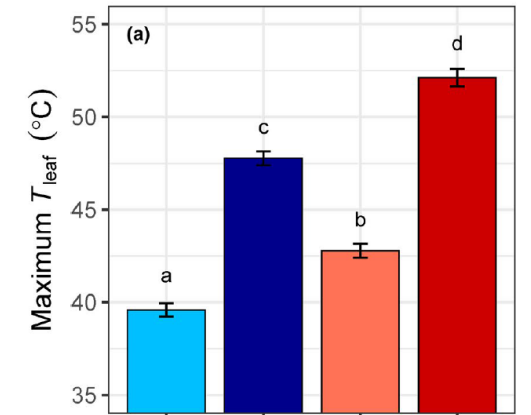
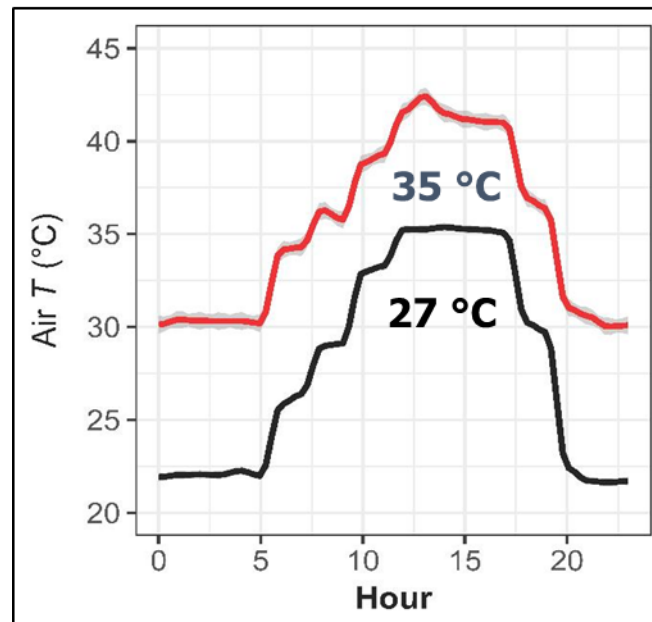
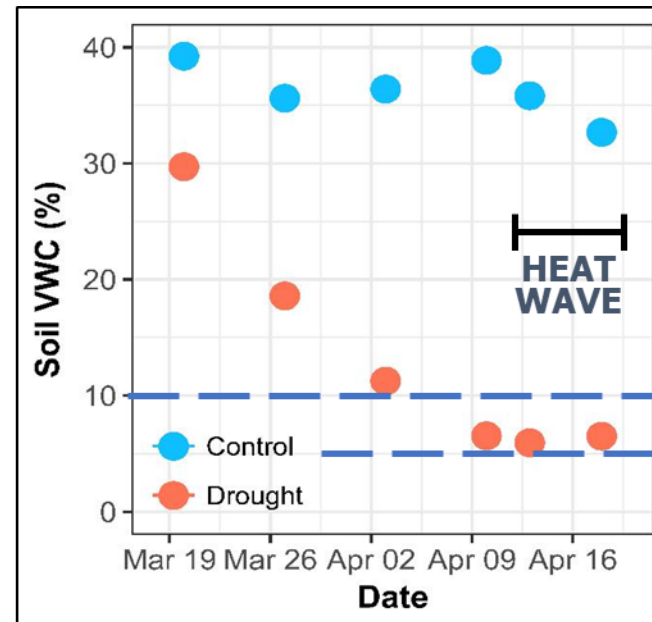
ORIGINAL RESEARCH
published: 21 January 2020
doi: 10.3389/fpls.2019.01715



A Simple Method for Simulating Drought Effects on Plants

Renée M. Marchin^{1*}, Alessandro Ossola², Michelle R. Leishman² and David S. Ellsworth¹

¹ Hawkesbury Institute for the Environment, Western Sydney University, Penrith, NSW, Australia, ² Department of Biological Sciences, Macquarie University, North Ryde, NSW, Australia



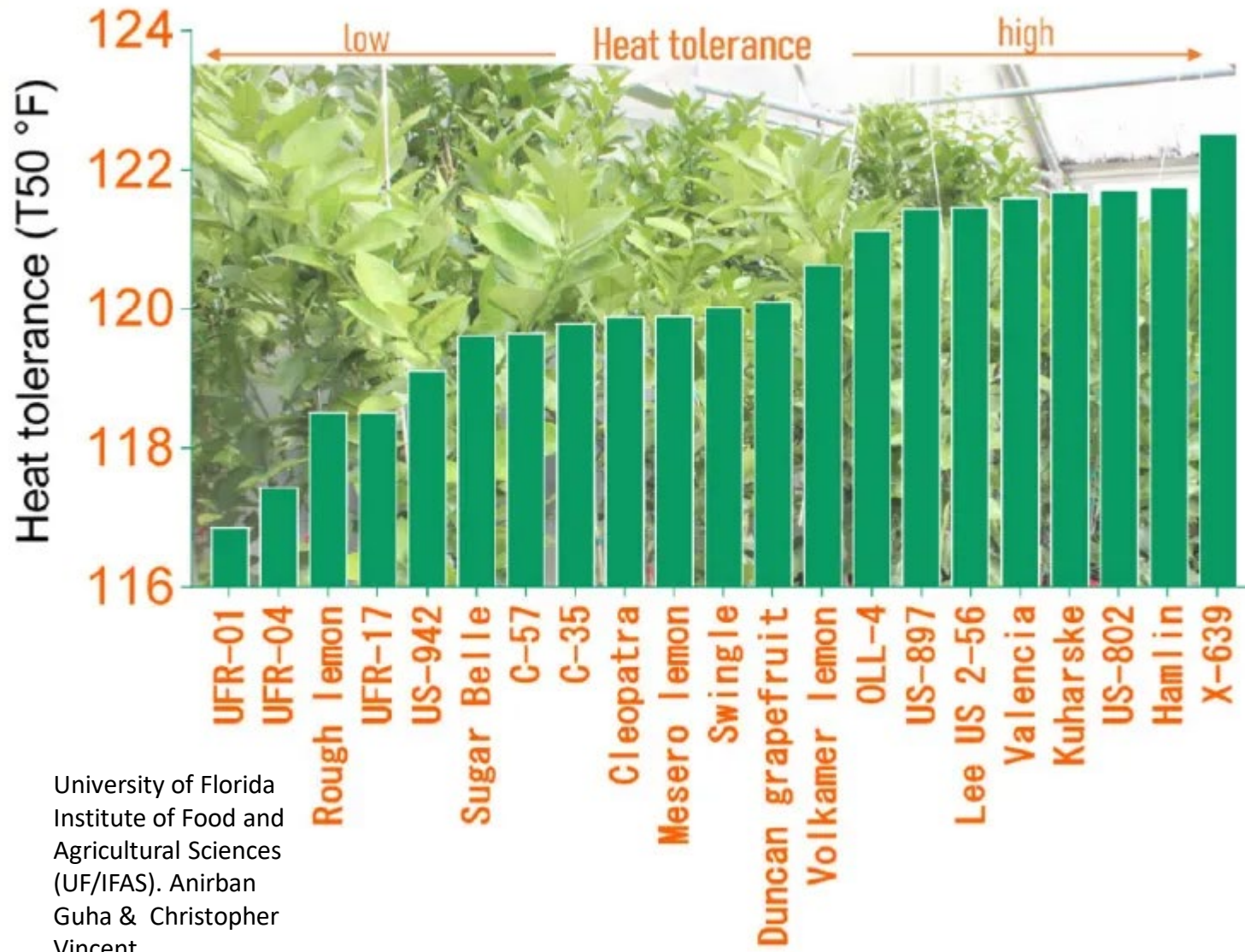


Spurflower (*Plectranthus argentatus*)
Drought sensitive



Lilly pilly (*Syzygium wilsonii*)
Heat sensitive






+ heat interactions with
huanglongbing (HLB) disease and
altered transpiration and leaf cooling

University of Florida
Institute of Food and
Agricultural Sciences
(UF/IFAS). Anirban
Guha & Christopher
Vincent

We built a climate-ready species selection tool



<https://whichplantwhere.com.au>

Search by location Search by species The Science How it works Resources Log in Sign up

Future proof urban landscape projects with climate-ready species


Search location

Search species

Location

Search for location or postcode

Q Urban Space Type: ☐ Garden ☐ Park ☐ Street ☐ WSUD



Underpinned by the latest scientific research

Which Plant Where is a culmination of 5 years of research investigating which horticultural species will survive in Australian urban landscapes, not only now but under future climates. This plant selection tool is underpinned by the latest scientific evidence, providing growers, nurseries, landscape architects and urban greening professionals with integrated tools and resources to develop resilient and sustainable urban green spaces for the future.

[See the science](#)

The Which Plant Where project acknowledges the Traditional Owners of Country throughout Australia and their continuing connection to lands, waters and communities. We pay our respect to Aboriginal and Torres Strait Islander cultures and to Elders past, present and emerging.

Resources

Community Engagement



The Great Australian (GREEN) Dream

Resilient Urban Landscapes



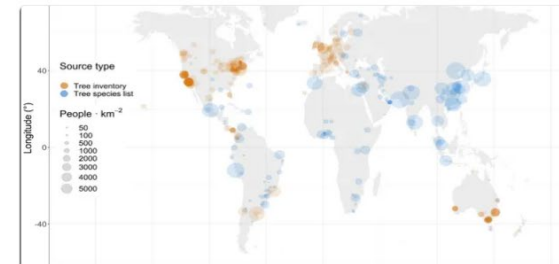
What Makes a Plant Drought or Heat Tolerant?

Climate Change



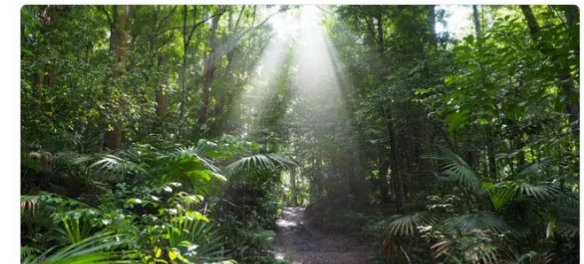
How can we determine if a species is 'climate-ready' for a location?

Monitoring and Maintenance



The many uses of urban tree inventories

Planning



What can we learn from natural ecosystems?

Which Plant Where

Search by location Search by species The Science Pricing Resources Log in Sign up

Clear Filters (3)

2126 x

Climatic Suitability 2030 2050 2070

Results: 38 Results are sorted alphabetically by climatic suitability

Growth form

☒ Tree ☐ Shrub ☐ Grass-like ☐ Herbaceous ☐ Palm ☐ Climber ☐ Fern ☐ Succulent ☐ Cycad

Urban space type

☐ Garden ☐ Park ☐ Street ☐ WSUD

Height in cultivation

☐ 0 – 1 m ☐ 1 – 3 m ☐ 3 – 6 m ☐ 6 – 10 m ☒ 10 – 15 m ☐ 15+ m

Spread in cultivation

☐ 0 – 0.5 m ☐ 0.5 – 1 m ☐ 1 – 2 m ☐ 2 – 4 m ☐ 4 – 8 m ☐ 8+ m

Shade tolerance

☐ Full sun ☐ Part shade ☐ Full shade

Leaf loss

☐ Evergreen ☐ Deciduous ☐ Semi-deciduous

Origin

☒ Native ☐ Exotic

Acacia harpophylla
Brigalow
Tree
Climatic Suitability 2030 2050 2070

Acacia implexa
Hickory Wattle
Tree
Climatic Suitability 2030 2050 2070

Acacia maidenii
Maidens Wattle
Tree
Climatic Suitability 2030 2050 2070

Acacia parramattensis
Parramatta Green Wattle
Tree
Climatic Suitability 2030 2050 2070

Acacia prominens
Golden Rain Wattle
Tree
Climatic Suitability 2030 2050 2070

Acronychia oblongifolia
Common Acronychia
Shrub
Tree
Climatic Suitability 2030 2050 2070

- >2500 species, cultivars and varieties
- Climate suitability in relation to postcode
- Information on environmental tolerances, appearance, uses
- Calculates canopy area and planting diversity of your chosen species palette
- Calculates shade, carbon and biodiversity value of your chosen species palette



Lophostemon confertus

Brisbane Box



Tree

Climatic Suitability

2030

2050

2070



Angophora floribunda

Rough Barked Apple



Tree

Climatic Suitability

2030

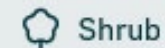
2050

2070



Agonis flexuosa

Burgundy Western Australian
Weeping Peppermint



Shrub



Tree

Climatic Suitability

2030

2050

2070

What did we learn?

- Single data streams (climate models, ecophysiology, field experiments) are not enough, if not integrated.
- Refine bioclimatic models to include considerations about yield, etc. -
> more and better data collection
- Include interactions with climatic conditions for main pests and pathogens



Thanks to Aaron Dillon &
Deborah Pagliaccia for inviting

and our partners ...

**Hort
Innovation**

hort frontiers
Strategic partnership initiative

GREEN CITIES
FUND



Planning,
Industry &
Environment



Urban
Science
Lab



MACQUARIE
University



WESTERN SYDNEY
UNIVERSITY

Questions?



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