High density orchards

A new era for almond farming?

Insights from the National Tree Crop Intensification in Horticulture program AS18000

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This is a project of the *National Tree Crop Intensification in Horticulture Program (AS18000)* funded through Hort Innovation Frontiers with co-investment from Plant & Food Research, South Australian Research and Development Institute, Hort Innovation using the Almond research and development levy, and contributions from the Australian Government.

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What is High Density?

- High Density (HD) is an orchard system where trees and rows are planted much closer together than in traditional orchards
- High Density is a system that seeks to maximise YIELD per unit of LAND through improved input efficiencies, and facilitated mechanization
- HD = above 500 trees/ha
- Super HD (SHD) = above 2000 trees/ha

High Density

Potential Advantages	Possible challenges
Higher yields early	Higher initial investment
Improved yield efficiency	Unknown longevity
High potential yields per hectare	Increased management complexity
Improved light interception and distribution	Overcrowding with unsuitable genetics
Improved uniformity of maturity	Possible increased disease and pest pressure
Efficient use of resources	Return on investment uncertainties
Higher water use efficiency	New narrower machinery required

National tree crop intensification in horticulture - Almonds AS18000

Aims:

To improve our understanding of the physiological and genetic factors determining orchard light environment, precocity, vigour management and tree architecture.

To develop systems to manage these components in a high-density setting.

To provide Australian almond growers with a better understanding of the performance of intensive almond production systems in Australia.

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Orchard Trials

20 cultivars, 9 rootstocks, densities between 350 and 1481 trees/ha in 3 regions

Pruning Responses: to test young tree training/pruning systems suitable for high-density orchards

Architectural Studies: to phenotype architectural traits for high productivity in high-density orchards

High-Density Trial: system based on narrow, central leader trees with a range of densities, established and maintained with minimal pruning

Regional field trials: to test new varieties, rootstocks and growing systems in NSW, VIC and SA

High density + 2D canopies: to assess the feasibility of growing almonds on 2D narrow orchard systems

Nursery tree form: traditional headed tree vs central axis trees

Cultivar architecture

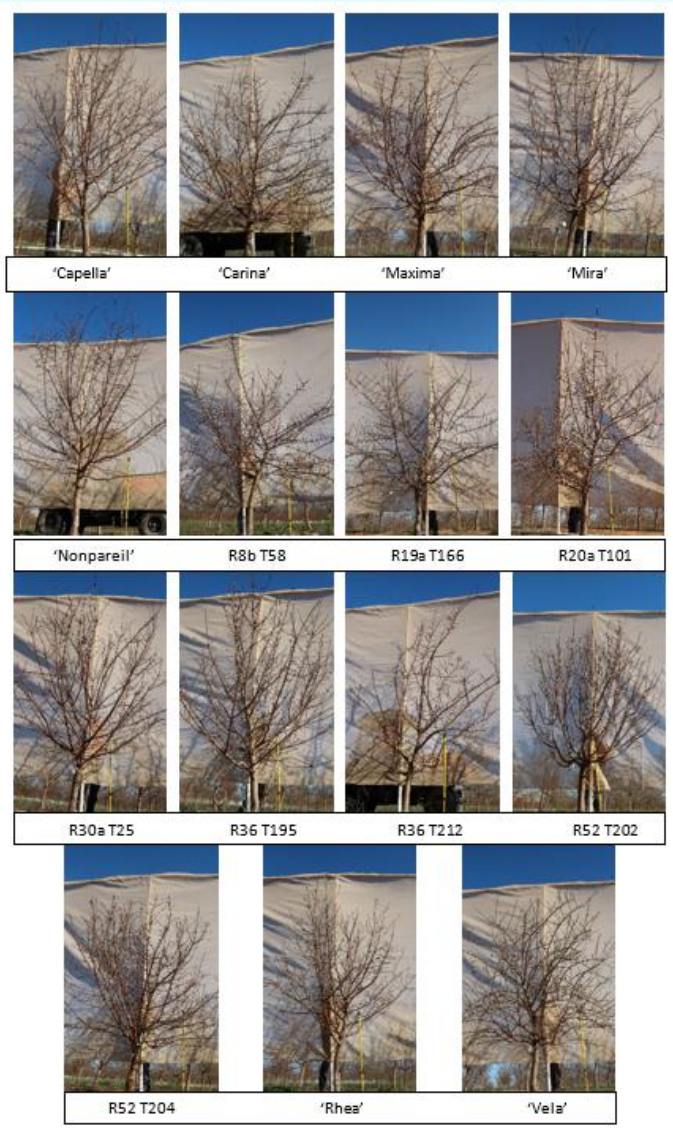


Figure 1. Genotypes used in the architecture studies at the Almond Centre of Excellence (ACE) orchard in Loxton. Images taken in July 2020. Trees planted July 2018.

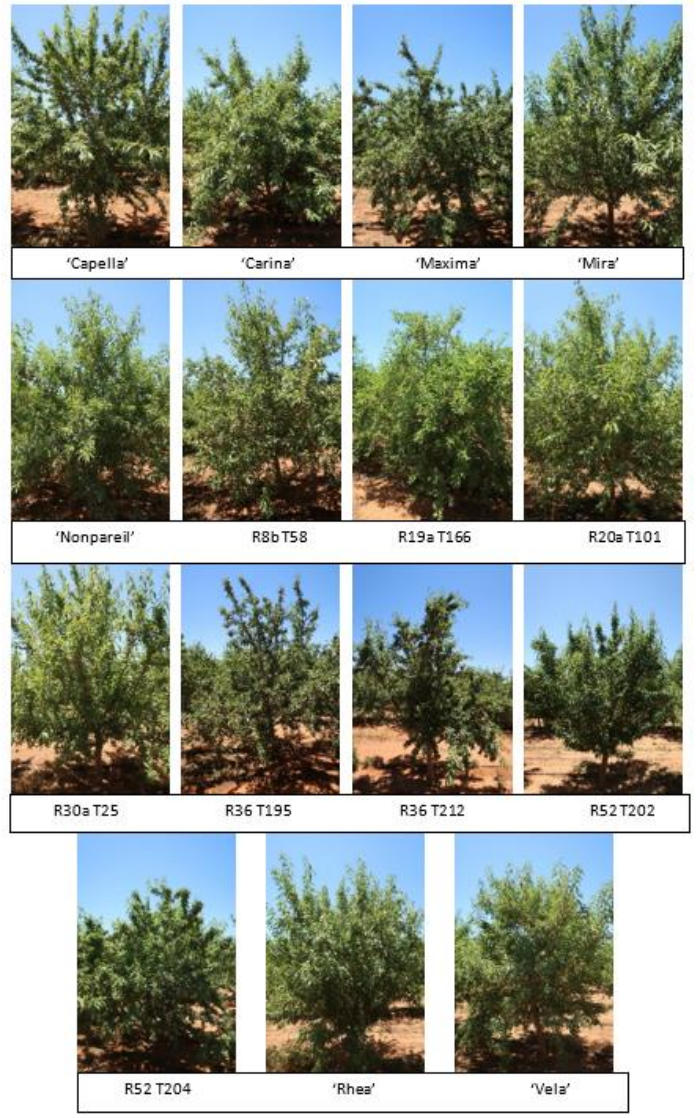
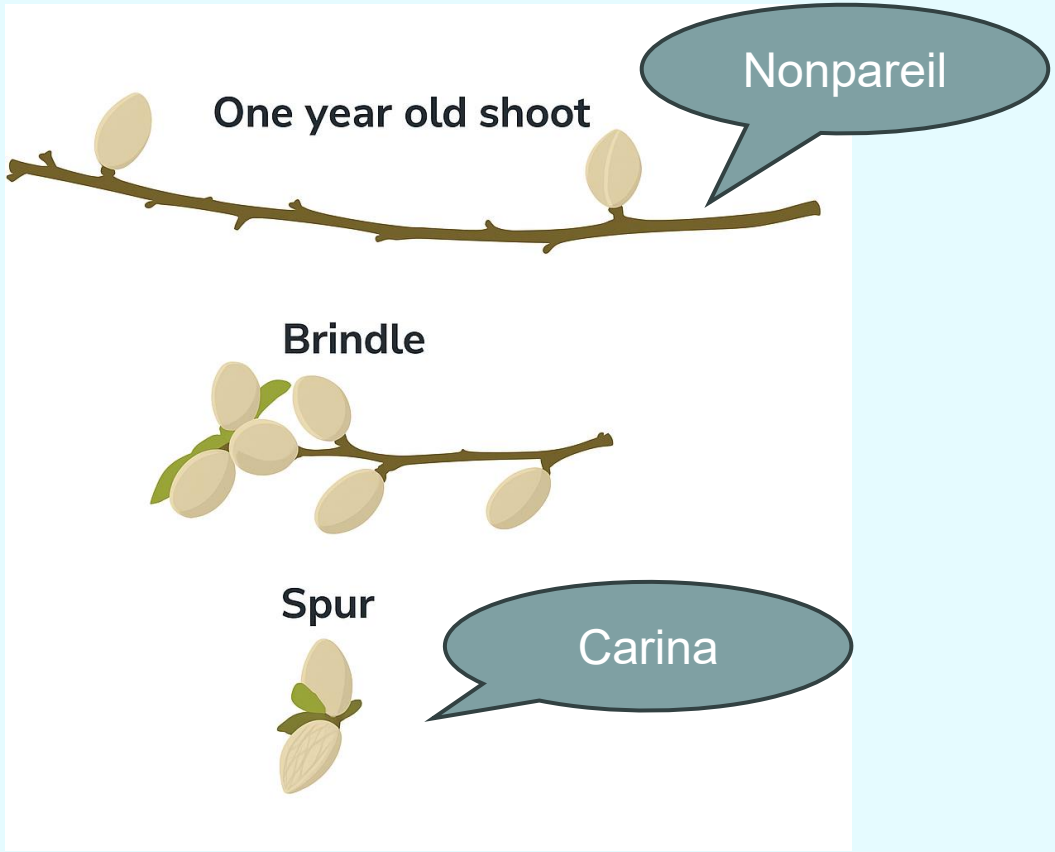


Figure 2. Genotypes used in the architecture studies at the Almond Centre of Excellence (ACE) orchard in Loxton. Images taken in November 2020. Trees planted July 2018.

Canopies with compact, porous and spur habit/short branches



Dwarfing rootstocks

Shasta® on Controller™ 6 rootstock planted in 2018 at Carina Farm - Victoria

Shasta ® and ‘Vela’ on ‘Nemaguard’ planted in 2018 at ACE – Loxton

Inputs management

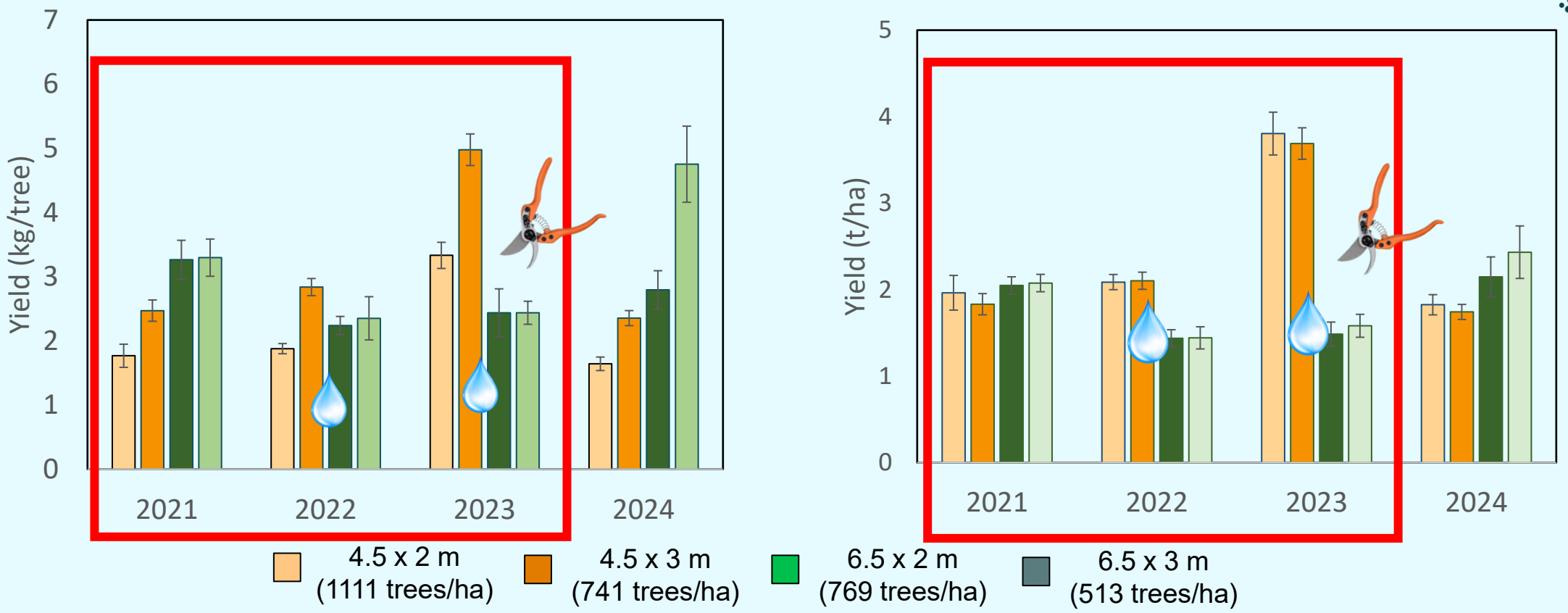
Cultivars: Shasta® and ‘Vela’ budded on ‘Nemaguard’

Planting density:

- ✓ 4.5 m x 2 m (1111 trees/ha) and x 3 m (741 trees/ha)
- ✓ 6.5 x 2 m (769 trees/ha) and x 3 m (513 trees/ha)

Orchard age	Target irrigation (ML/ha)
1st leaf	4.5
2nd leaf	8.5
3rd leaf	9.7
4th leaf	12
5th leaf	14

Kernel yield – Shasta®



Inputs requirements/ha in the establishment phase might be higher than in traditional orchards:

- To ensure each tree receives the same amount of water
- To further increase yields in the first years

Pruning and hedging are non-negotiable to maintain healthy canopies and machinery access

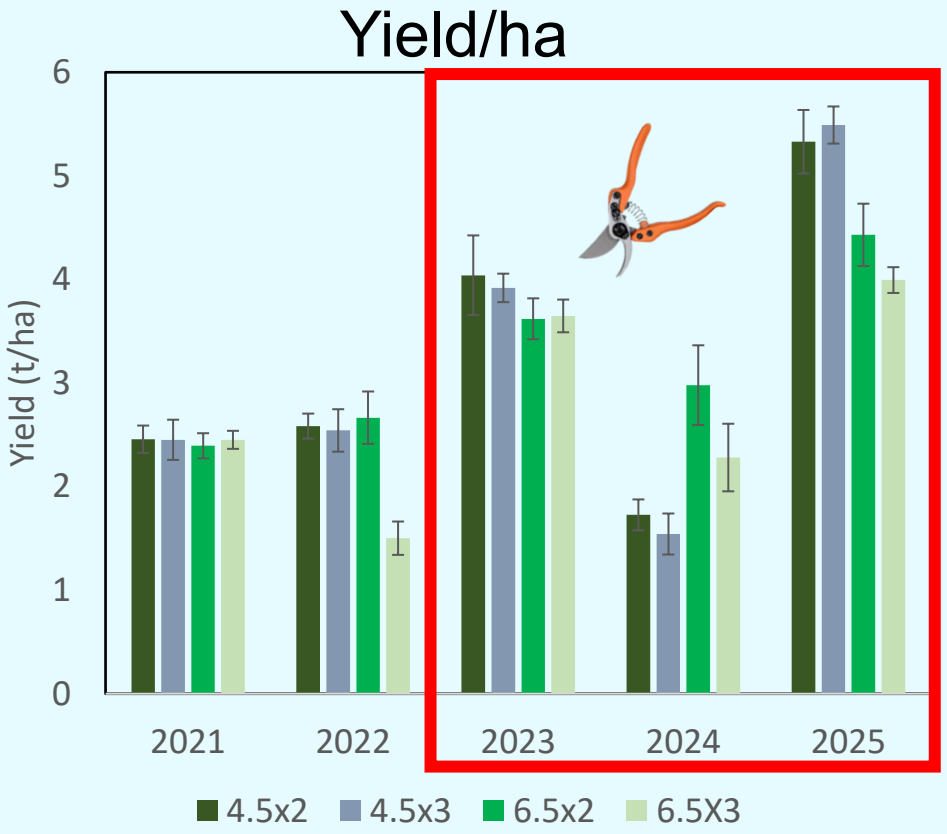
Shasta® and ‘Vela’ on 4.5-m rows

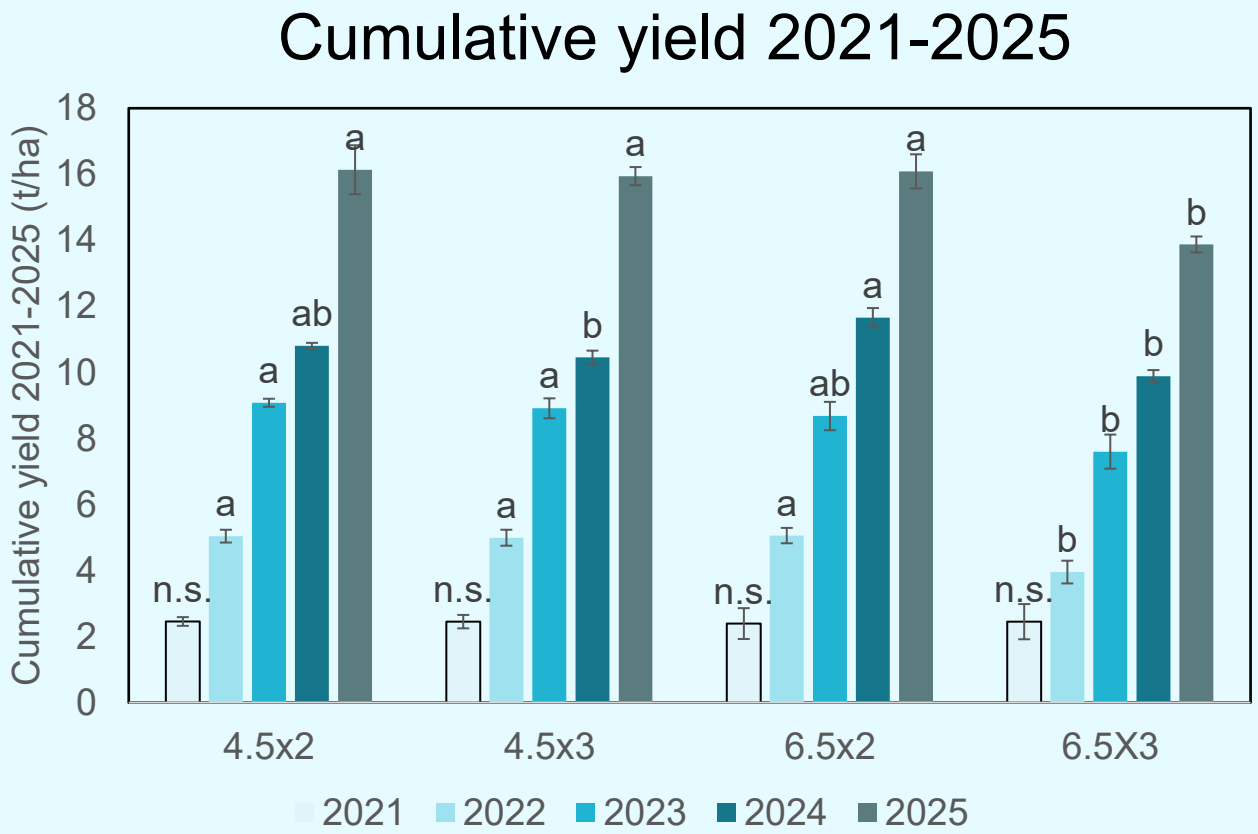
Images taken during in February 2023.

‘Vela’ and Shasta® on 4.5-m rows

Images were taken in Aug 2023.

Kernel yield ‘Vela’ following pruning





What's next?

Opportunities for future work

- Understanding tree architecture for specific systems and genetics new to Australia
- Long term evaluation of cultivars and rootstocks in different regions and soil types
- Irrigation and nutrition + disentangling the effects of irrigation and nutrition
- Pruning and training
- Integrate experimental results into economic models

Hort Innovation Request for Proposal:

AS25002 - Competitive Orchard Production Network

Acknowledgements

NATIONAL TREE CROP

Intensification In Horticulture Program

(AS18000)

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Select Harvests

CMV Farms

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The almond Board of California

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Thank you

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