Future-proofing almonds: Breeding success together

Cassandra Collins

Hort Innovation

THE UNIVERSITY of ADELAIDE

australian almonds

History

- Started in 1997
- Funding from HAL/HIA/ARC
- Six new cultivars released in 2016 and 2017, Maxima, Mira, Carina, Rhea, Vela and Capella

Funding and current team

Hort Innovation

australian almonds

THE UNIVERSITY of ADELAIDE

Cassandra Collins

Natalia Caliani

Annette James

Karin Andraschko-Schlosser

Virajinee Nayanathara Don Bulathsinhalage

Industry and breeding challenges

Industry challenges

- Profitability and market trends
- Water scarcity and consumption
- Climate change vulnerability
- Pest and disease pressure
- Pollination shortages
- Waste products

Breeding challenges

- Consistent yield and nut quality
- Tree health
- Grower adoption
- Processing efficiencies
- Consumer acceptance

Breeding targets

- Self-fertile
- High productivity
- High flower density
- Sweet kernel, large kernel, thin skin, light colour
- Soft - semihard shell
- High crack out and shelling
- Tight shell seal
- Tree habit
- Disease and drought tolerance

Breeding approach

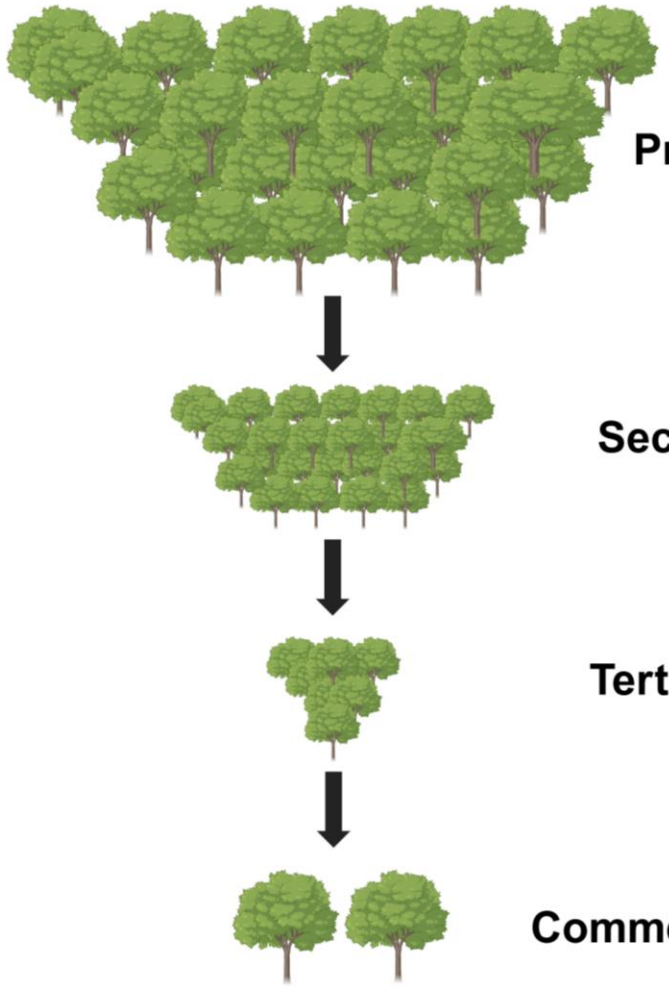
Objective: *to breed improved cultivars with superior kernel quality, self-fertility, disease resistance, high productivity.*

- Classical breeding using local and imported material
- Waite almond germplasm collection, Lindsay Point & ACE
- Primary evaluation on nut & kernel characteristics
- Secondary and tertiary evaluation on productivity, nut quality, growth habit, plant health and long-term yields

Progress to date

- 84 parent cultivars used
- 315 different crosses achieved
- 44,000 progeny produced in 16 years
- 37 cultivars imported since 1997
- 60+ superior selections to date
- Secondary and tertiary evaluations blocks established at ACE
- Commercial trials
- One new variety going through PBR process – **AuroraB**

Current breeding approach



Primary evaluation

~10,000

Secondary evaluation

~40

Tertiary evaluation

~20

PBR
Commercial varieties

1 - AuroraB

Photo credits – Karin Andraschko-Schlosser

Genetics for Next Generation Orchards

Hort Innovation Frontiers™

- **Almond flowering and dormancy traits – WSU -** *better understand flowering and dormancy traits to improve adaptability and ensure more consistent, higher yields.*
- **AI and Robotics – QUT -** *assess flowering and other key traits, improving data recording efficiency and selection accuracy.*
- **Multi-trait selection – AbacusBio and UQ –** *prioritise key traits and refine breeding focus to improve selection efficiency.*
- **Genomic prediction/pangenome – MU –** *implement genomic markers and insights to enhance prediction accuracy*

The University Of Queensland AUSTRALIA

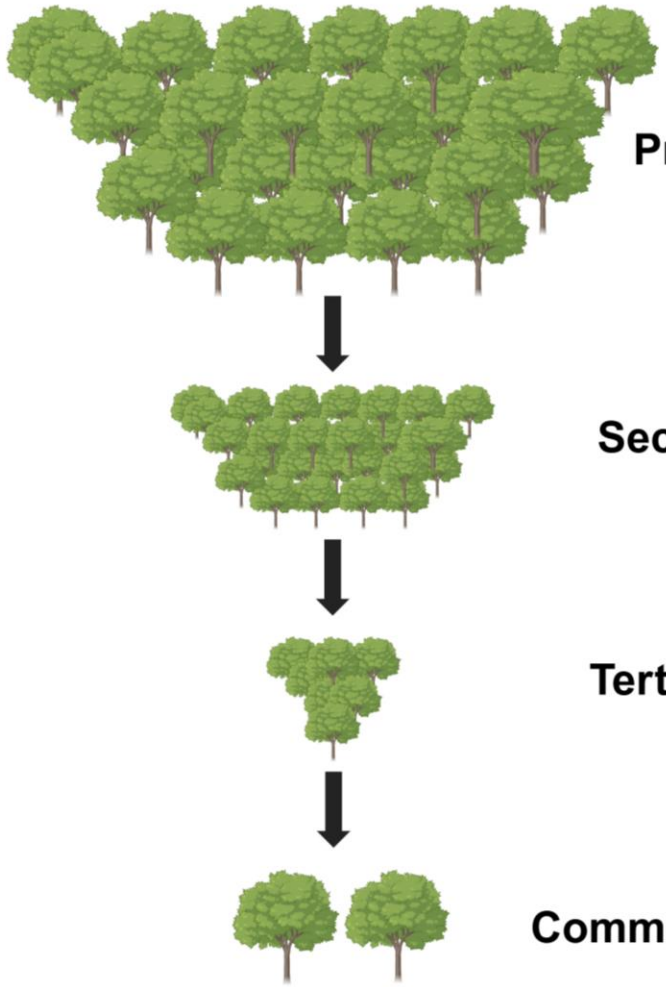
QUT Queensland University of Technology

AbacusBio

Western Sydney University

Murdoch University

Future breeding approach



Primary evaluation

~10,000

Secondary evaluation

~40

Commercial trials

- Growers
- Processors
- Marketers
- Nurseries

Tertiary evaluation

~20

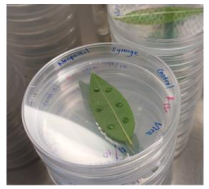
PBR
Commercial varieties

1 - AuroraB

Bacterial Spot in Almond

- Artificial inoculation methods for accurate phenotyping of this disease
- RGB image analysis for rapid phenotyping
- Reliable markers for disease identification and levels of copper resistance

Method 1
Needleless syringe method

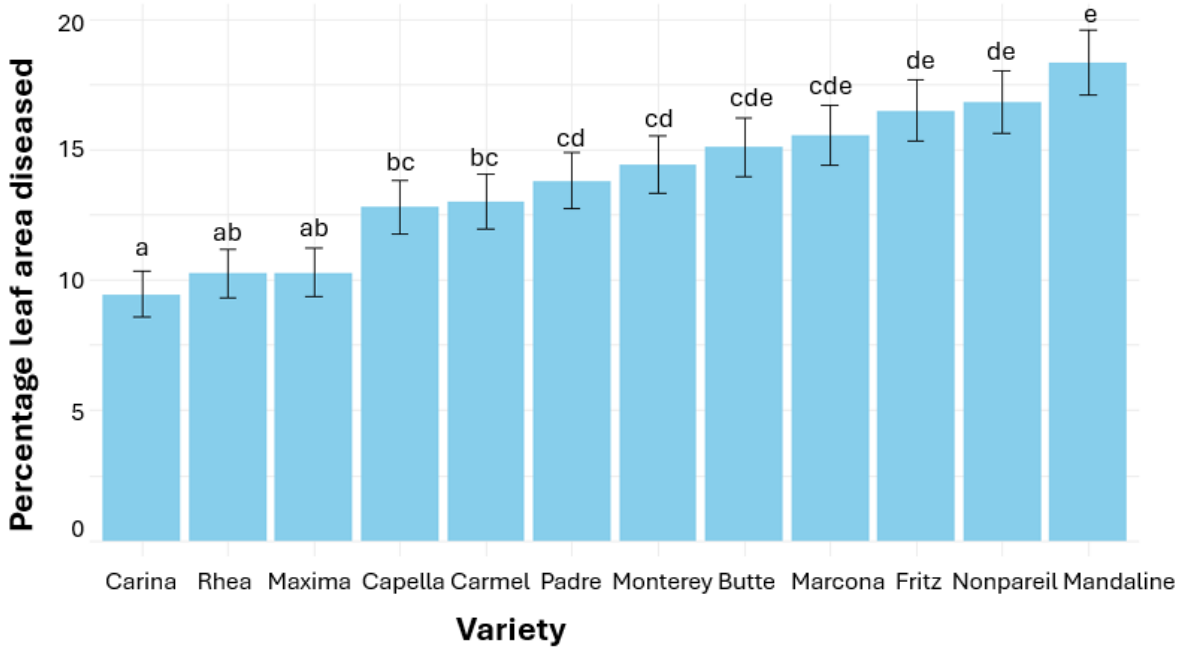


Method 2
Needle prick method

Method 3
Detached shoot method

Method 4
Attached shoot method

Method 5
Spray method



Bacterial Spot in Almond

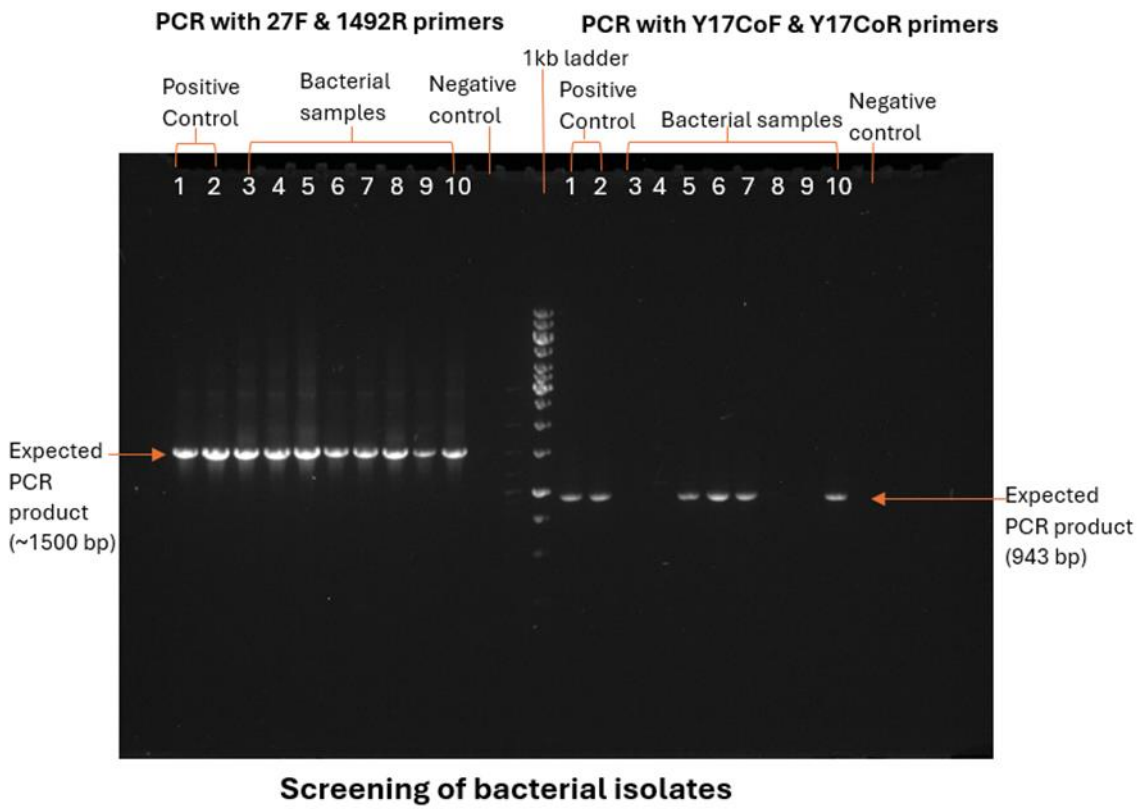
- Artificial inoculation methods for accurate phenotyping of this disease
- RGB image analysis for rapid phenotyping
- Reliable markers for disease identification and levels of copper resistance

Image Acquisition → Image Preprocessing → Image Segmentation → Feature Extraction and Analysis

Leaf Area	Lesion Number	Lesion %Area	Lesion Diameter	Lesion Intensity
10.336	6	6.294	0.428	47.026
8.404	4	3.844	0.398	47.264
12.639	6	5.081	0.446	38.614
14.438	5	1.608	0.283	51.339

AI-based automated RGB image analysis

Bacterial Spot in Almond

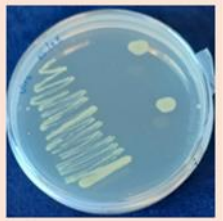
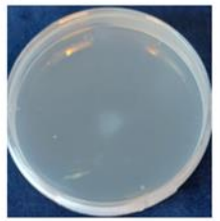
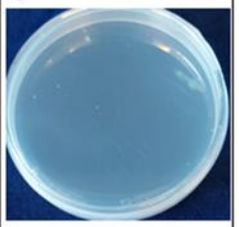


Screening of bacterial isolates

accurate phenotyping of this disease

notyping

tification and levels of copper resistance

Growth at different concentrations of copper			
Control	0.4 mM	0.8 mM	1.2 mM
+	+	0	0
			

Nutritional and flavour benefits

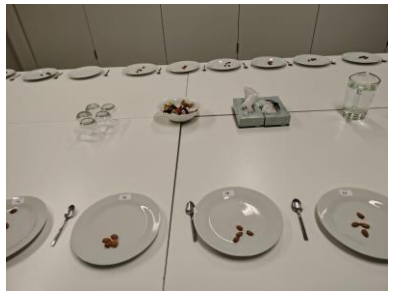
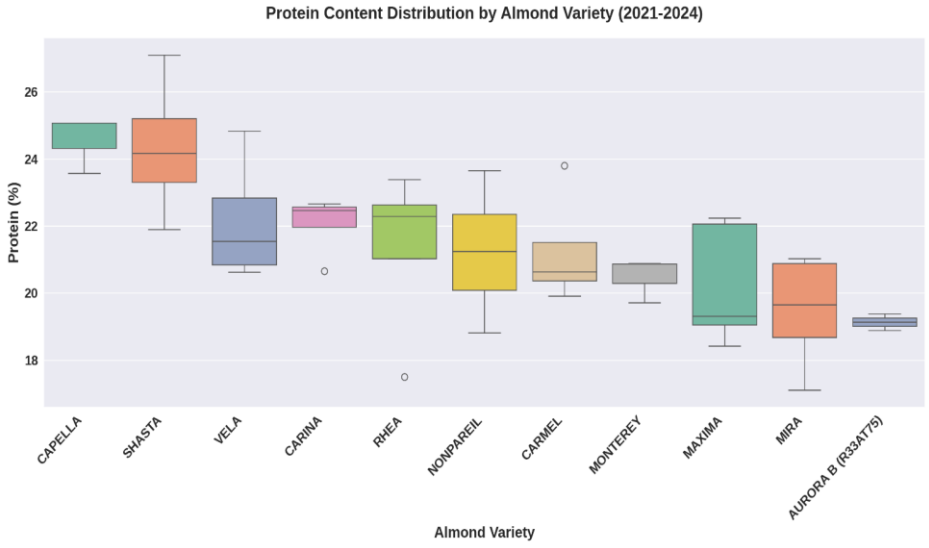
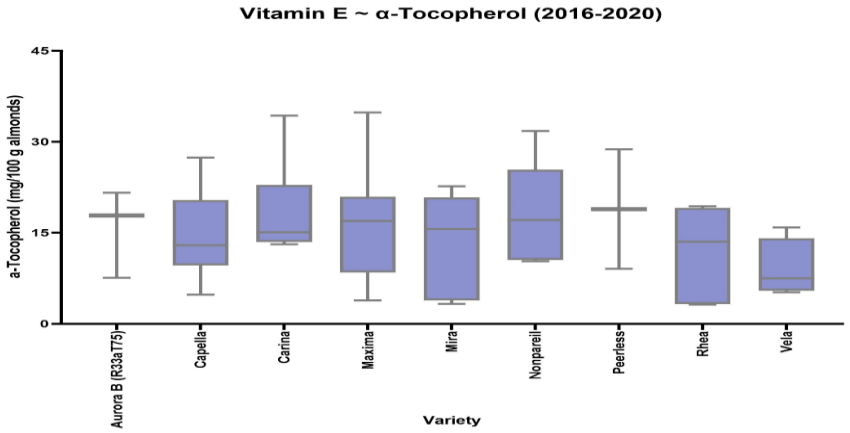
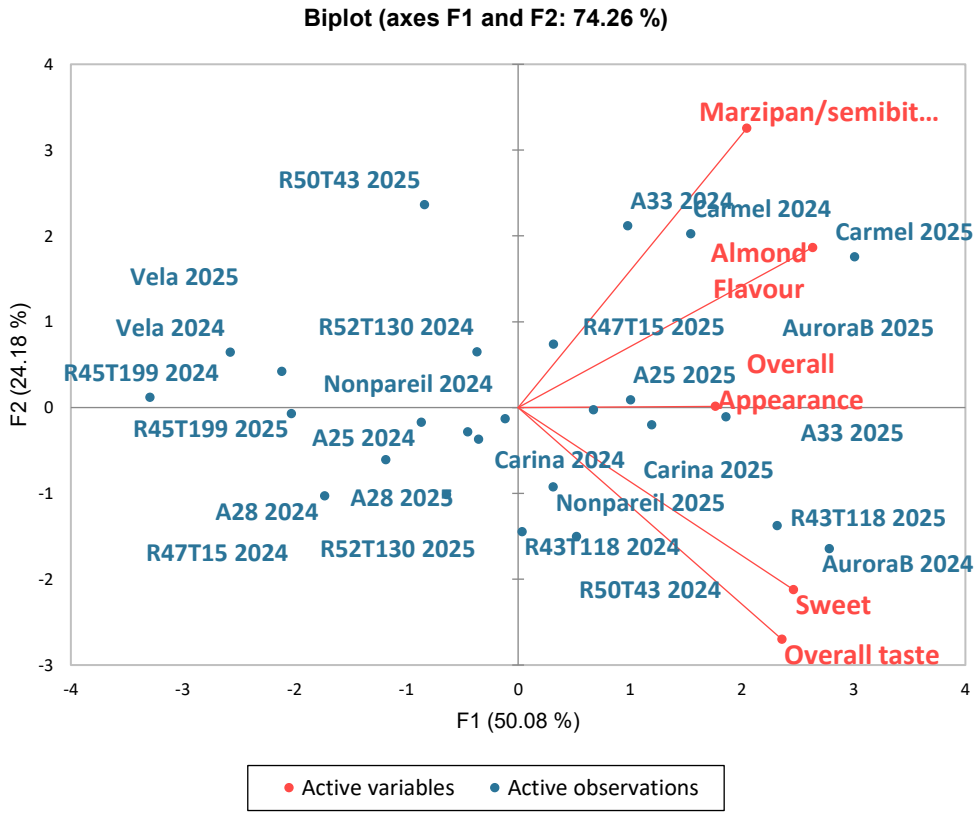


Photo credit Natalia Caliani

- Almonds are packed with healthy compounds, including unsaturated fats, fibre, protein, vitamins, minerals, and potent antioxidants.







Next Steps

- Compare and assess past selections to find ways to speed up breeding and improve efficiency.
- Develop new varieties that meet changing industry needs.
- Share results and work together — keeping all industry stakeholders informed, involved, and part of the process.

Acknowledgements

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- Plant Improvement Committee

Dr Tonya Wiechel, Agriculture Victoria

Tony Speirs & Andrew Lacey

Genetics for Next Generation Orchards Team

Growers participating in commercial trials