Final Report

Almond Centre of Excellence Experimental and Demonstration Orchard

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Almond Board of Australia

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AL19000

Project:

Almond Centre of Excellence Experimental and Demonstration Orchard (AL19000)

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Public summary

The purpose of AL19000 was to establish a stand-alone Experimental Orchard for Research and Development for the Australian almond industry. The project has involved developing a 60-hectare greenfield site on the outskirts of Loxton, South Australia into a state of the art research facility that focuses on cutting edge trials that are managed under commercial orchard growing conditions to ensure they can be replicated effectively. The ongoing philosophy behind the facility has been creating an orchard capable of hosting a myriad of research and development projects unencumbered by commercial considerations that so often hamper the continuity of such trials on private property.

The finished product is a showcase research site that has drawn widespread support from industry stakeholders and beyond. The ongoing funding model developed during the project is a shining example of high level collaboration between a peak industry body and Hort Innovation that will help underpin the long term viability of the facility. It has managed to strike a unique co-funded balance that does not create an extra impost on the grower members.

The need for the facility has come on the back of exponential growth of the Australian almond industry over the past 20 years and a recognition that the body of local research on growing almonds in Australia needed to be cultivated.

The Australian almond industry has grown since 2006 from producing 16,000 tonnes to have a current productive capacity of 153,500 tonnes in 2024. This is expected to grow to more than 180,000 tonnes by 2030. The industry's 2023-24 plantings data shows the orchard area was 64,180 hectares spread across four States but mainly concentrated on the Murray and Murrumbidgee rivers in the Riverland, Sunraysia and Riverina irrigation regions. It is expected additional plantings will add a further 6,000 hectares by 2030 as plantings of large orchards continue to be established.

The competitiveness of the Australian industry is based on being able to outperform other producing countries in terms of yield and input efficiency as our costs are considerably more than those borne by the Californian producers that dominate world production. The Spanish industry is also modernising with enhanced irrigation and new varieties. It is crucial the Australian industry develops technologies that improve input efficiency, particularly for water, bees and labour that are limited and increasingly in demand.

The areas of key focus that the ABA, working with Hort Innovation and the South Australian government, involved contracting of SARDI researchers to investigate: amendments to improve soil; improved rootstock / varietal / spacing combinations; and nutrition status assessment.. This project would enable the infrastructure required to be put in place to service not only ST16000 but also the breeding project for the University of Adelaide and the tree architecture project for Plant and Food Research. At the completion of AL19000, the orchard's value has been underlined many times and is now regarded as a showcase site for Australian horticultural research.

More than 20 research projects have already utilised the site. An event and visitor register that has been maintained since its completion has underlined the broad interest and relevance of the project. The extension of funded projects and the demonstration of new technologies and practices have also been enhanced by the facility. One of the special features is the range of plantings established for comparative purposes. It ranges from traditional varieties and tree densities right through to higher density new genotypes and tree architectures that are considered radical but offer the potential for shake and catch harvesting that would overcome the risk posed by summer rains that have historically been experienced two years in five, but are predicted to become even more common in future.

Shedding has been designed to be multipurpose to facilitate training and extension events as well as house filtration, fertigation, machinery, processing equipment for trials, and offices for staff and researchers as well as toilet facilities for visitors to forums and field day events.

The site has been fully fenced with secure access to ensure security of projects such as the breeding program that features trials covering crosses evaluations to commercial trials of selections and demonstration sites for new varieties. The ABA has experienced staff with experience as Technical Officers and Industry Development Officers to assist the highly competent Farm Manager to both monitor and assess performance but also to provide an extension program including field days, articles, video, presentation at industry forums and one to one advice. Industry Development Officers are now able to work full-time on site with the new offices established.

Keywords

- ACE
- Experimental Orchard
- Almond Centre of Excellence

Introduction

The Almond Centre of Excellence (ACE) was the brainchild of former ABA CEO Ross Skinner and former ABA chair Brendan Sidhu. Both spent countless hours winning industry and agency support and successfully lobbied the SA Government to purchase a 60 hectare greenfield site on the outskirts of Loxton and assist in the establishment of the irrigation infrastructure.
Hort Innovation's AL19000 followed not long after and ran from 1 November 2019 to 30 October 2024 and involved establishing the experimental orchard, sourcing all the equipment and developing infrastructure to meet the needs of a stand-alone industry specific research facility.
It has emerged as a showpiece example of industry collaboration and support to elevate the standard of research and development in a growing horticultural industry. It remains unique to Australian horticulture.
AL19000 also covered the operational costs of the orchard and as the project evolved so did the clarity around establishing a funding model that secured the long term viability of what was being created. Due to close collaboration between the Almond Board of Australia and Hort Innovation, a funding model was developed to manage the orchard in a professional manner and protect the myriad of trials that have been established on site. The funding model is the key plank in the development of AL23000 Almond Centre of Excellence Operation and Maintenance.
Many of the original trials that were introduced at ACE under ST16000 continue today under various iterations with the key research bodies, SARDI, Plant Food Research and Adelaide University.

A comprehensive summary of the ACE Orchard and the projects and findings has been established on the Almond Board of Australia website and acts as a key resource for grower members. You will find key links to projects past and present on the Hort Innovation website at the link below:

Almond Centre of Excellence - Australian Almonds

Methodology

The overall aim in establishing the Almond Centre of Excellence orchard was to deliver world's best practice by providing the infrastructure and equipment to facilitate the improved conduct of orchard-based trials and provide a demonstration site for the knowledge and technologies sourced from the Hort Innovation R&D program, overseas researchers, commercial suppliers and grower innovation. In doing so, the industry has been able to fast-track trials of production practices that may enable it to sustainably compete in the global market.

The methodology for the determination of the required infrastructure and equipment to deliver the experimental and demonstration orchard has been and continues to be a process wherein the Almond Centre of Excellence Management Committee (PRG) comprising of leading industry producers, provides guidance on the technical requirements of orchard technologies while researchers have guided both trial planting designs and required management practices with input from orchard staff.

Orchard equipment acquisition has been based on competitive quoting where possible however much of the equipment has been identified as best fit for purpose. Suppliers are limited however and the desire to be involved in the demonstration aspect of the orchard has generated strong support . In some instances, such as drip line product, this has been donated. The producers on the reference group are regularly involved in asset acquisition and have provided input on the quotes received. The Group has also identified possible purchases of preowned equipment when this is considered fit for purpose. The list of infrastructure and equipment required to establish the facility is listed in detail on the asset register.

The orchard design, infrastructure and machinery provide for:

- Orchard plantings based on conventional spacings to facilitate research into the adaptation of existing practices to improve yields, reduce production risks and enhance product quality. This field laboratory will enable an investment in the irrigation and nutrition infrastructure that will enable well resourced, long lived trial sites to be established to determine the efficient use of key inputs such as water and fertilizer and performance of new varieties and rootstock combinations. Other sectors of the conventional orchard will be used to investigate soil and tree management practices to improve pest and disease management and better manage severe weather events such as heatwaves, wind, frost and other risks including alternative pollination practices. The site has been designed with plantings and irrigation valves to accommodate current and future trials.
- Evaluation trials of new production systems that look to the future when replanting of existing orchards will be required and for new orchards as the industry continues to expand. The orchard has installed higher density production systems developed with a holistic approach to maximising yield and eliminating crop loss and food safety risks by striving to have product in a controlled environment in the least amount of time. Shake and catch systems lie at the heart of this concept but this will not be easily achieved and will require many hurdles to be overcome, not the least of which will be convincing growers of its merits. The trial sites at the Almond Centre continue to provide insights into the value of the higher density plantings. The guiding principles for the advanced production systems has been to achieve high crop yields, improved water and nutrient efficiency, better spray coverage on smaller trees, enhanced soil health by increasing organic matter in the light loams preferably by returning the fruit hull to the orchard, decrease energy consumption and equipment wear by eliminating or reducing machinery passes up and down rows during the growing and harvesting periods, fewer mummies left in lighter framed trees improving yields and leading to better orchard hygiene to aid insect and disease control. The analysis of these benefits versus yield generated is an ongoing goal.
- New variety and rootstock evaluation have been accelerated to provide quicker access to high yielding, self-fertile, closed shell, disease and nematode resistant trees producing good quality kernel and other almond products.
- Filtration and fertigation facility. With enhanced irrigation and nutrition management being a key objective of the orchard research program the capacity to manage fertigation to a high degree is crucial. The industry reference group of leading growers along with the former irrigation firm, Total Eden, developed the system. The shed is of a size and design to allow easy safe access for training purposes whilst maintaining efficient access to bulk fertiliser.
- Small scale processing facility to hull and shell almonds. The processing facility allows for more efficient assessment of varietal quality as part of the University of Adelaide's breeding project and other projects focused on product quality.
- Training facilities will be on site. Training is a key area supported by the industry and the Centre will enable an interactive learning experience with Australian and overseas researchers, extension staff, and agronomists presenting to industry growers and orchard staff. The machinery shed has been configured to accommodate presentations to large field day crowds. Visitor safety is becoming an increasing issue with field days on farms. The experimental and demonstration orchard will be developed with visitor safety as a priority.
- Offices for the farm staff and researchers will have capacity to cater for off-site researchers visiting their trials. Construction of the offices has been delayed due to protracted negotiations on purchasing the land from the SA Government. The new facility has been completed and features offices, a presentation room, kitchen and laboratory as well as worker amenities. The off-grid solar power solution and environmentally friendly materials, to maximise insulation capabilities, combine with a north easterly perspective and L shaped footprint that forms an outdoor courtyard protected from the prevailing winds and afternoon sun.

The construction of the amenities block was delayed due to ongoing issues with secure ownership of the orchard site, but has just been completed within the timeframe of the Project.

- Conventional and unique machinery required to perform orchard operations to meet researchers' needs has been purchased or developed. An example of the unique equipment needed is a weedicide unit to cope with varying width rows.
  - Security fencing and gates to control access to trial sites including the new variety crosses and selections.
  - Separately funded projects will be undertaken to develop and demonstrate equipment such as autonomous tractors, sprayers and harvesting equipment.
  - SARDI, Plant and Food Research, Adelaide University and the ABA have all undertaken Hort Innovation funded research at the orchard.
  - Commercial companies including irrigation, chemical and fertiliser businesses have also utilised the site to conduct product trials. The orchard continues to be a focus for funded and commercial trials that will benefit the industry and help contribute to the viability of the orchard.

It is envisaged that trial sites will be maintained into the future to obtain long term data which under the current R&D model does not occur. The five-year AL23000 Operational and Maintenance Project is the first example of this commitment. The experimental orchard has helped reduce the cost of projects. With past farm-based trials, most infrastructure is redundant at the end of projects whereas the experimental plots at the Almond Centre will be used repeatedly. The risk to projects going awry has also be lessened compared to farm-based trials as orchard staff will be managing sites to the researchers' requirements as their only priority. In the past, poor trial site management has impacted projects and resulted in poor outcomes for industry.

There are a number of reports listed on the Hort Innovation site outlining the outcomes of trials conducted at ACE Orchard. These include AL17005 Breeding, AL21001 Optimising Almond Production Systems, AS18000 National Tree Intensification, the aforementioned ST16000 and AS17002 Driverless Tractor.

Having completed the research amenities and offices, it is envisaged the facility will conduct undergraduate and postgraduate research and host international researchers to work in close proximity to researchers from local research providers and industry producers. The development of the research community supporting the almond industry is a key industry strategy and objective of this initiative. Inspections of the site by international researchers in recent months has sparked interest in pursuing such collaboration.

The Management Committee of the Almond Centre of Excellence experimental and demonstration orchard has included the following experienced and highly skilled industry participants who during their tenure have provided input into the orchard design and infrastructure:

- Brendan Sidhu - Century Orchards
- Domenic Cavallaro – SIAP chair
- Neale Bennett – Cowanna
- Grant Birrell – CEO NPA
- Damien Houlahan – ofi Global Almonds Manager
- Daryl Winter – Rural Funds Management
- Peter Cavallaro - Walker Flat Almonds
- Ross Skinner – former ABA CEO
- Robert Wheatley – Group General Manager Auston
- Deidre Jaensch – ABA Industry Development Manager
- Andrew Lacey - Lacton
- Michael Ward - Select Harvests
- Ben Wiblin – Almondco
- Tim Jackson – ABA CEO
- Adrian Hunt – Hort Innovation

SARDI researchers have also provided input into the orchard design from a biometric perspective. Total Eden provided valued input into the irrigation / fertigation system design, while Loxton Irrigation and Nutrien have assisted in more recent times with irrigation upgrades as required.

Results and discussion

The following outlines all the initial trials that were commissioned.

Total Orchard Plantings

The following table shows the trial areas planted to Almond Board of Australia, SARDI, University of Adelaide, Plant and Food Research projects and the total area now planted.

The following table shows the areas planted for each SARDI trial at the Loxton orchard as at 31 October 2024.

Aim of trials	Area at 31/10/2024
Conventional industry plantings (Horizon 1)	6.05
Closer plantings (Horizon 2)	5.60
H1 to H2 Optimised density	5.04
H2 High density to H3 super high density	1.60
Soil Amelioration	7.26
Scion/ Rootstock	1.68
New Rootstock Compatibility	1.50
Rootstock	0.91
Sprinkler	0.59
New Varieties	2.33
Tree Architecture	4.04
Single Variety Self Fertile Trial	2.7
Total	**39.30**

The following provides a summary of trials and their placement on the experimental orchard.

1. *SARDI Horizon 1 Resource Block*

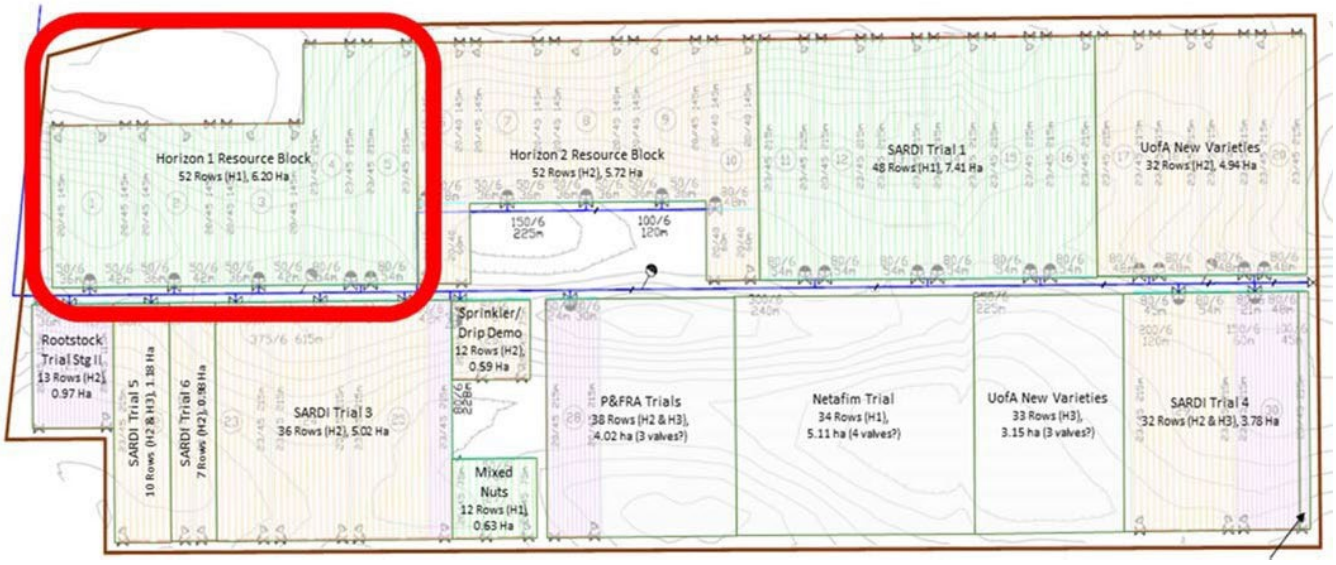
Rootstock	Scions	# Trees	Valves	Spacing	Area	Research Body
Nemaguard	Nonpareil Carmel Monterey	983 Nonpareil 493 Carmel 493 Monterey **1,969 Total**	1 – 5	7.0 x 4.5 m	6.20 Ha 52 rows	SARDI

Aim: General purpose H1 resource block suited to hosting future field experiments (e.g. kaolin clay, irrigation, nutrition trials etc.). Features the industry standard distribution of variety-rows to facilitate pollination and orchard operations and reflect current industry practice.

Key Researchers: Tim Pitt, Darren Graetz

Funding Source/Project Number: Hort Innovation ST16003

Site Management Requirements: Standard management, inputs to be applied consistently across the planting to avoid compromising future use for trials. Communication with SARDI prior to application of non-standard management inputs.



2. *Horizon 2 Resource Block*

Rootstock	Scions	# Trees	Valves	Spacing	Area	Research Body
Nemaguard	Nonpareil Carina Maxima Vela	733 Nonpareil 733 Carina 733 Maxima 733 Vela **2,932 Total**	6 – 10	6.5 x 3.0 m	5.72 Ha 52 rows	SARDI

Aim: General purpose H2 resource block suited to hosting future field experiments (e.g. kaolin clay, irrigation, nutrition trials etc.). Plantings laid out in a randomized distribution of variety-rows that not only facilitates pollination and orchard operations, but also ensures valid design and analysis of any trials that may be overlaid in the future.

Key Researchers: Tim Pitt, Darren Graetz

Funding Source/Project Number: Hort Innovation ST16003

Site Management Requirements: Standard management, inputs to be applied consistently across the planting to avoid compromising future use for trials. Communication with SARDI prior to application of non-standard management inputs.

3. *SARDI Soil Amelioration Trial*

Rootstock	Scions	# Trees	Valves	Spacing	Area	Research Body
Garnem	Nonpareil Carina Vela Carmel	576 Nonpareil 576 Carina 576 Vela 576 Carmel **2,304 Total**	11 – 16	7.0 x 4.5 m	7.41 Ha 48 rows	SARDI

Aim: To assess pre and post planting soil management strategies that show potential in improving the health of the soil system. Quantifying impacts on soil physical, chemical and biological condition as well as tree response and the economics of production.

Australian soils are generally recognized as shallow and poor compared to those of major production regions like California. Physical and chemical limitations to root growth are recognised factors in almond production.

Increasing the effective root volume of almond trees will allow access to more water and nutrients. Improving the moisture release characteristics of soil will allow more effective supply of water to tree roots under severe conditions, such as heatwaves. This will be investigated by soil treatments including pre and post planting organic amendments, subsoil ripping and combinations of both.

Key Researchers: Nigel Fleming, Vinod Phogat

Funding Source/Project Number: Hort Innovation ST16003

Site Management Requirements: Mixture of drip, sprinkler and dual system irrigation, manage irrigation to maintain both trees and cover crops where applicable. Other management, inputs to be applied consistently across the planting. Communication with SARDI prior to application of non-standard management inputs

4. *SARDI H1 to H2 Optimised Density*

Rootstock	Scions	# Trees	Valves	Spacings	Area	Research Body
Garnem	Nonpareil	540 Nonpareil	22 – 24	6.5 x 5.0 m	5.02 Ha	SARDI
	Carina	540 Carina		6.5 x 4.5 m	36 rows	
	Vela	540 Vela		6.5 x 4.0 m		
	Shasta	540 Shasta		6.5 x 3.5 m		
		2,160 Total		6.5 x 3.0 m		
				6.5 x 2.5 m		

Aim: To determine the optimum planting density transition from H1 to H2 for popular new varieties on the newly available full vigour Garnem rootstock. Quantifying the effects on production.

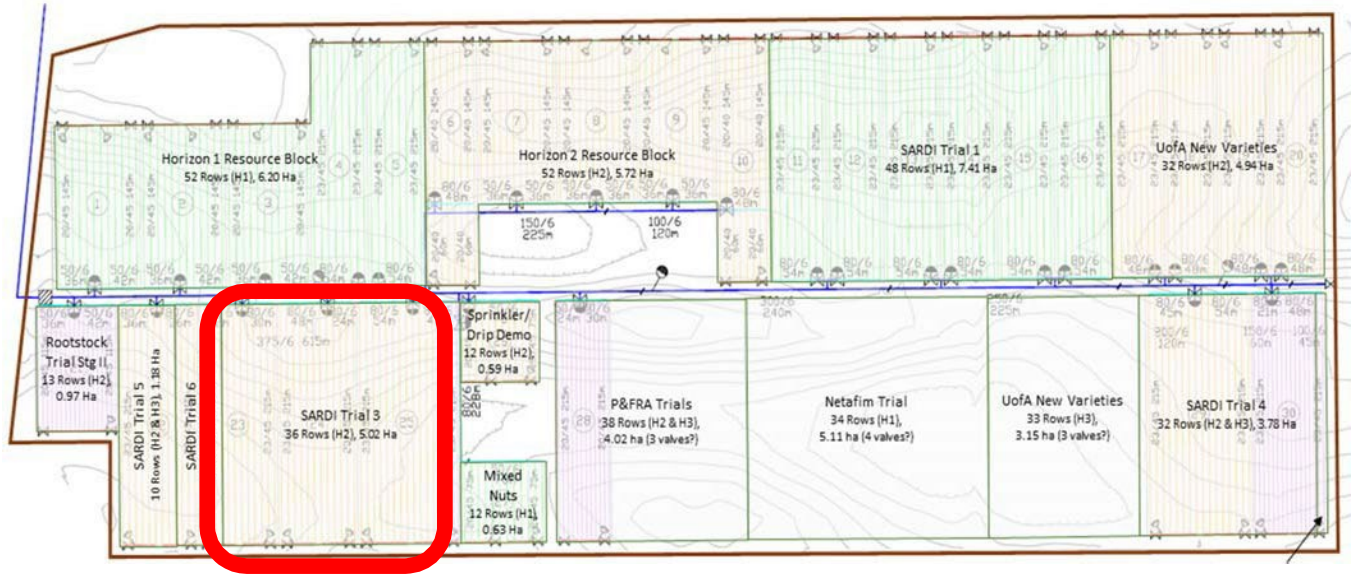
The vast majority of almond plantings to date in Australia are at a traditional spacing (H1), there have been minor plantings of higher density (H2) plantings. These H2 plantings may be an easier step for many towards higher density plantings as familiar genetic material, basic operating practices and the machinery of H1 plantings can still be used. However, the optimum planting density, and how this influences yield and sustainability, remains unknown. This fully replicated trial addresses these questions for a progressive new full vigour rootstock choice (Garnem) in an ordered 6 step progression up in density from 5 m to 2.5 m in between tree density at 6.5m row spacing's.

Critically, the layout allows the response of up to 3 new "main" varieties plus Nonpareil to be evaluated rather than traditionally just that of Nonpareil (with pollinators).

Key Researchers: Darren Graetz, Dane Thomas

Funding Source/Project Number: Hort Innovation ST16003

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with SARDI prior to application of non-standard management inputs.



5. *SARDI H2 to H3 Optimised Density and Management*

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Controller 7	Vela	880 Vela/C7	N/A	6.5 x 3.0 m	3.78 Ha	SARDI
Rootpac 40	Shasta	880 Vela/R40		6.5 x 1.5 m	32 rows	
		880 Shasta/C7		4.5 x 2.5 m		
		880 Shasta/R40		4.5 x 1.5 m		
		3,520 Total				

Aim: To build knowledge in the establishment and maintenance of high density almond growing systems using self-fertile almond cultivars and comparing newly available medium vigour rootstocks. Quantifying the effects on production.

To take the next steps from H2 (moderate density) plantings up to super high density (H3) plantings using new self-fertile scions and size controlling rootstocks to give the best chances of a successful outcome in a completely new system. This fully replicated trial uses two new self-fertile "Nonpareil quality nut" replacements, attempting to keep cropping as high and even as possible, combined with two moderately size controlling rootstocks, as best bet combinations to balance and manage overall vigour.

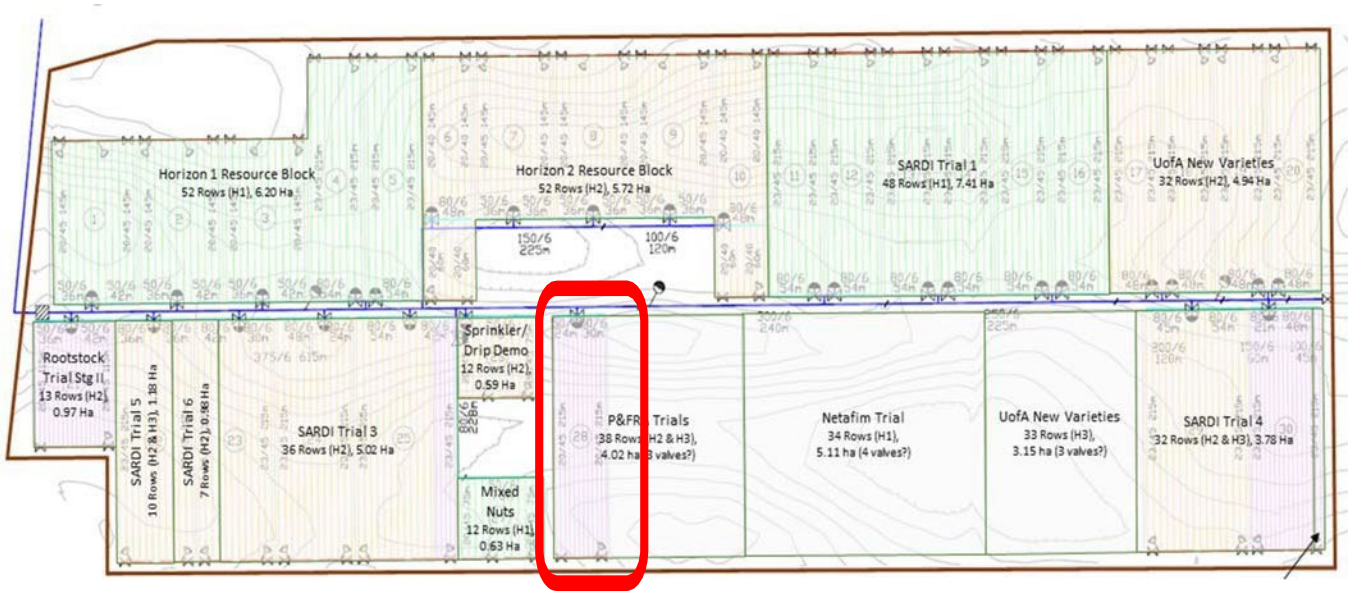
Four densities to be assessed that move between H2 and H3, and two simple training modifications will be investigated to facilitate this, Central leader and Palmette (Central leader with major row protruding limbs removed). Underlying reality is that no part of the system is well understood internationally, let alone under Australian conditions, as both the scions and rootstocks are new.

Develops knowledge in the establishment and maintenance of very high density (H3) Almond production systems under Australian conditions and attempts to manage some of the risk of extreme system change.

Key Researchers: Darren Graetz, Dane Thomas

Funding Source/Project Number: HIA/ ST16003

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with SARDI prior to application of non-standard management inputs.



6. SARDI Scion/Rootstock Compatibility

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Nemaguard Controller 6 Controller 7 Controller 9 Rootpac 20 Rootpac 40 Rootpac R Krymsk 86 Cornerstone Atlas Garnem Felinem Monegro Barrier 1	Nonpareil Vela Almond 21 Shasta Almond 12	169 Nonpareil 169 Vela 169 #21 169 Shasta 169 #12 **845 Total** **See detailed table below**	25	6.5 x 3.0 m 4.5 x 2.0 m	1.18 Ha 10 rows	SARDI

Variety by rootstock tree numbers	Nemaguard	Controller 6	Controller 7	Controller 9	Rootpac 20	Rootpac 40	Rootpac R	Krymsk 86	Cornerstone	Atlas	Garnem	Felinem	Monegro	Any rootstock[1]
Nonpareil	10	10	10	10	10	10	10	10	10	10	10	10	10	29
Vela	10	10	10	10	10	10	10	10	10	10	10	10	10	29
Almond 21	10	10	10	10	10	10	10	10	10	10	10	10	10	29
Shasta	10	10	10	10	10	10	10	10	10	10	10	10	10	29
Almond 12	10	10	10	10	10	10	10	10	10	10	10	10	10	29

[1] Additional barrier trees for ends of rows

Aim: To screen a likely range of new self-fertile "Nonpareil like" replacement varieties on a range of newly available rootstocks of differing vigour.

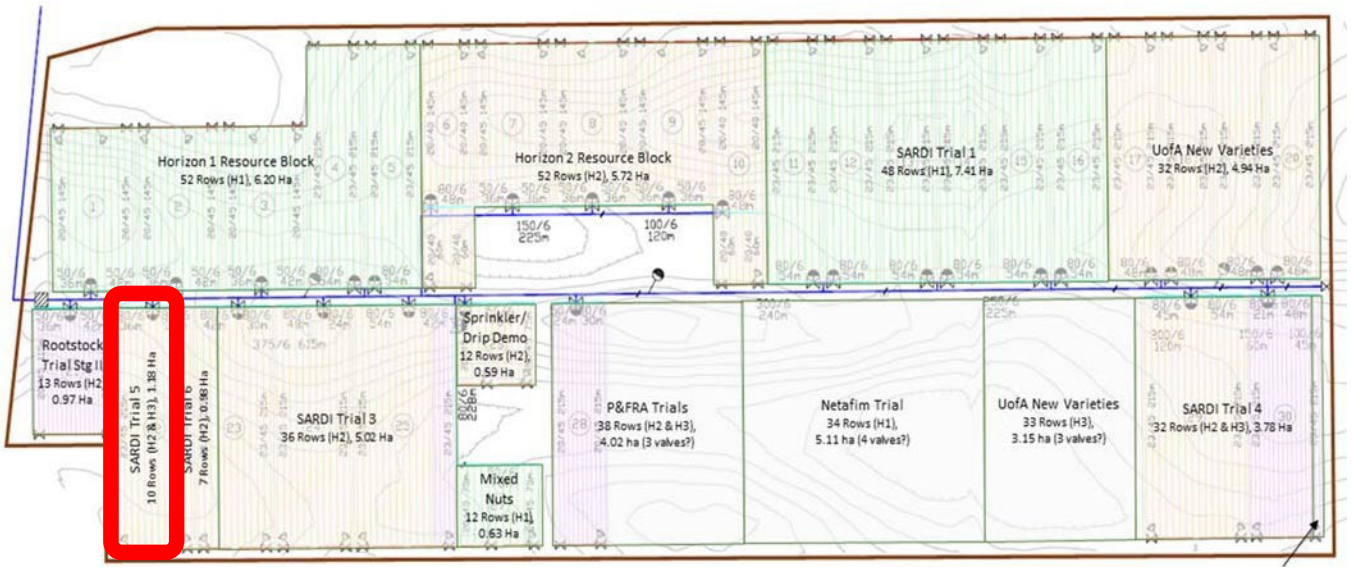
Scoping study to screen the compatibility of new self-fertile scion and rootstock combinations and gauge their suitability to higher density Almond production systems under Australian conditions. Two planting densities, H2 (3m x 6.5m) and H3 (2m x 4.5m). Demonstrating several promising rootstocks of differing source and vigour in association with a limited number of new self-fertile scions with the potential to become "Nonpareil nut quality" replacements.

This is a cost-effective screen, not a replicated trial, which aims to better inform decisions on likely combinations for next generation density trials. Five trees of each combination only allows for a general guide to tree health, vigour (size and density) and basic yield to be measured under low and moderate competition levels.

Key Researchers: Darren Graetz

Funding Source/Project Number: HIA/ ST16003 and AL21001.

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with SARDI prior to application of non-standard management inputs.



Frequent high wind speeds have required trial trees to be heavily staked.

7. New Scion/Rootstock Compatibility

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Nemaguard	Nonpareil	97 Nonpareil[1]	25	6.5 x 3.0 m	0.98 Ha	SARDI
Controller 6	Carina	20 Carina			7 rows	
Rootpac 40	Maxima	20 Maxima				
Garnem	Vela	20 Vela				
	R8BT58 (#18)	20 #18				
	R24AT90 (#28)	20 #28				
	30AT25 (#33)	20 #33				
	R28AT1 (#32)	20 #32				
	R3BT85 (#16)	20 #16				
	R30BT33 (#34)	20 #34				
	R19AT166 (#24)	20 #24				
	R32T162	20 T162				
	R36T212	20 T212				
	R38T208 R43T17	20 T208				
	R43T107	20 T17				
	R43T118	20 T107				
	R36T199	20 T118				
	R43T138	20 T199				
	R36T195	20 T138				
		20 T195				
		497 Total				

1 Includes additional barrier trees to complete rows

Detail of variety by rootstock tree numbers	Nonpareil	Carina	Maxima	Vela	R8BT58 (#18)	R24AT90 (#28)	30AT25 (#33)	R28AT1 (#32)	R3BT85 (#16)	R30BT33 (#34)	R19AT166 (#24)	R32T162	R36T212	R38T208	R43T17	R43T107	R43T118	R36T199	R43T138	R36T195
Nemaguard	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Controller 6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Rootpac 40	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Garnem	38[1]	27[1]	27[1]	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

[1] Includes additional barrier trees on for ends of rows

Aim: To screen a wide range of new scion genotypes, offering either high production or novel architecture, for graft compatibility, growth habit and production traits for inclusion in high density production systems

Scoping study to screen the compatibility of new scion and rootstock combinations and gauge their suitability to higher density almond production systems under Australian conditions. This scoping study focusses on promising scion genotypes from secondary evaluations. These genotypes may not be self-fertile but show potential as high yielding or having novel architecture that may make them suitable for high density growing systems.

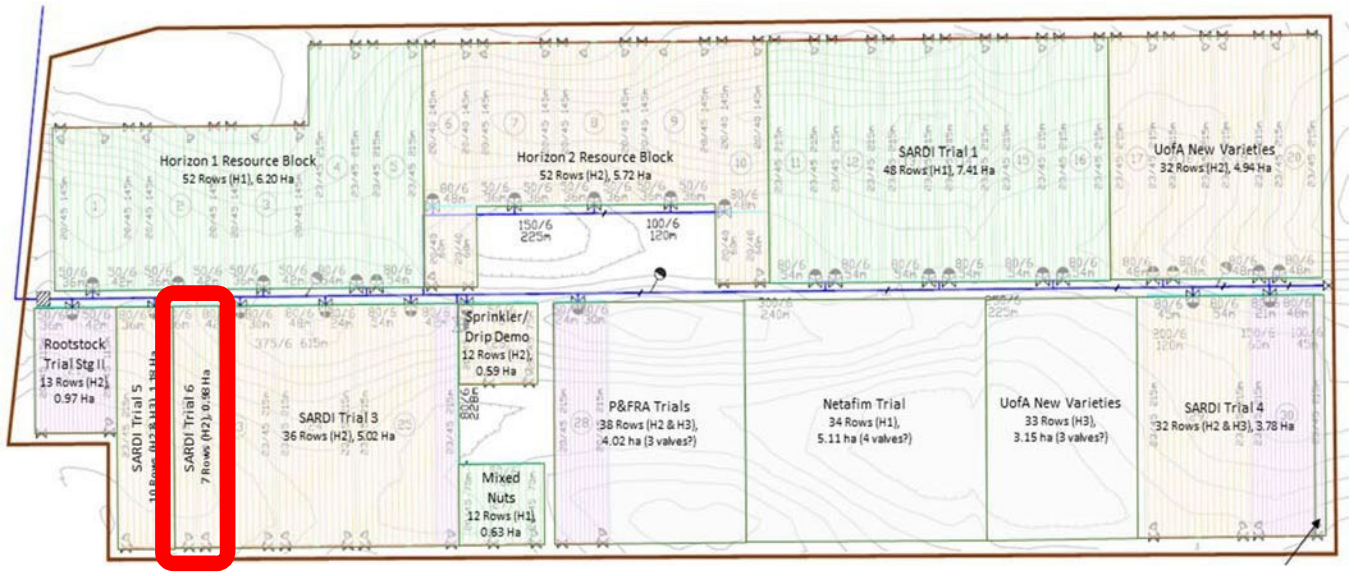
In recognition of the higher risk of adverse outcome, tree numbers are reduced by grafting to a smaller number of "more likely" rootstocks and having one density (3m x 6.5m). This enables a greater number of lines and wider scope of attributes to be investigated.

This is a cost-effective screen, not a replicated trial, which aims to better inform decisions on likely combinations for next generation density trials. Five trees of each combination only allows for a general guide to tree health, vigour (size and density) and basic yield to be measured under low competition levels.

Key Researcher: Darren Graetz

Funding Source/Project Number: Hort Innovation ST16003

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with SARDI prior to application of non-standard management inputs.



8. Tree Health and Development

Aim: Monitor tree growth and health status throughout the life of trees at the site, using traditional measurements as well as remote sensing technologies where appropriate.

This trial runs across all plantings at the Almond Centre of Excellence, with measurements commencing at planting and continuing for the life of plantings. Measurements will be analysed to assess the impact of treatments (variety, rootstock, spacing, management) within each of the trial plantings.

Traditional measurements being collected include tree butt diameter at 30 cm height, tree height and maximum width across the row, measured during dormancy.

Current and potential future measurements collected using remote sensing technologies include canopy size (ground cover and volume), tree architecture, abiotic stress, nutrient status and disease status.

Key Researcher: Mark Skewes

Funding Source/Project Number: Hort Innovation ST16003

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with SARDI prior to application of non-standard management inputs.

9. *University of Adelaide Breeding Evaluation Trial*

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Nemaguard	Various	**2336 Total**	17 – 20 29 – N/A	6.5 x 3.0 m	4.56 Ha 32 rows	UofA

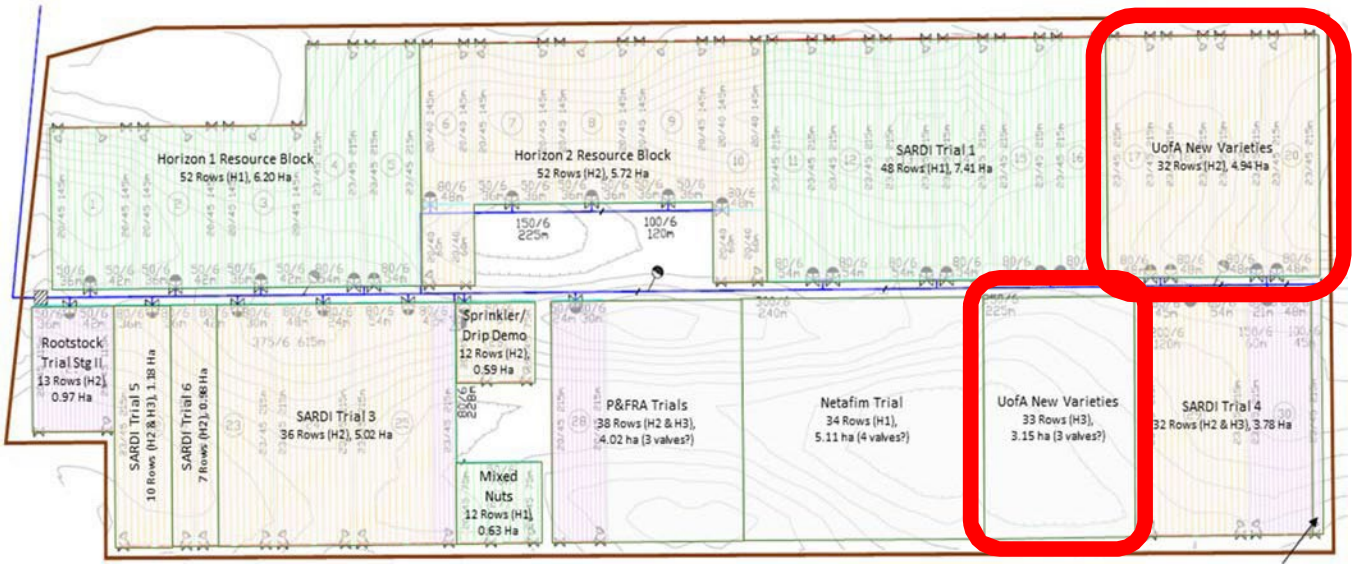
Aim: Assess tree growth, habit and productivity of crosses from University of Adelaide Almond breeding program.

Includes primary, secondary and tertiary evaluation blocks, tree numbers range from 5 to 73 per variety. Two trees of a small range of standard varieties are planted between new varieties to provide comparators to evaluate against.

Key Researchers: Michelle Wirthensohn

Funding Source/Project Number: originally AL17005, transferred to AL22009

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with University of Adelaide prior to application of non-standard management inputs.



10. Plant and Food Research Commercial High Density

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Nemaguard	Shasta Vela	1,352	N/A	6.5/4.5 m x 3.0-2.0 m	1.89 Ha	Plant and Food Research

Aim: To validate management systems for new almond orchards planted at high density. Four planting densities will be compared:

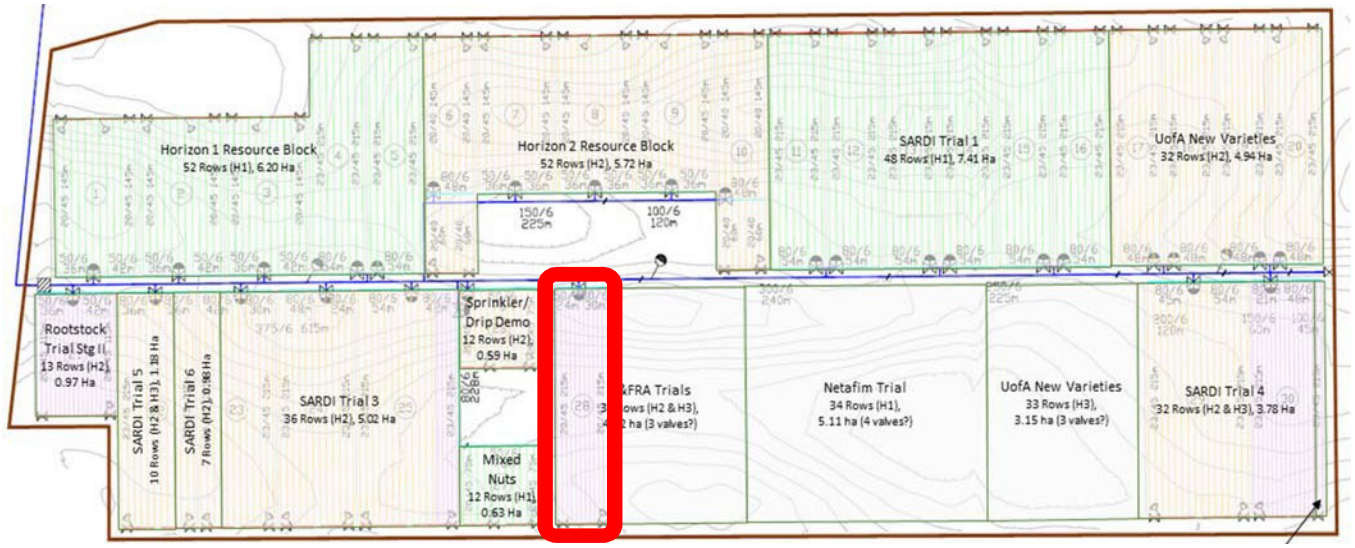
- 6.5m row width: 3.0m (513 trees/ha) & 2.0m (769 trees/ha)
- 4.5m row width: 3.0m (741 trees/ha) & 2.0m (1,111 trees/ha)

All trees planted as "unpruned" central leader trees taken direct from the nursery and grown with minimal pruning to produce full height trees up to 5 or 6 m tall depending on row widths. Trees planted 3.0 m apart along the rows will be trained as narrow "palmette" style trees by removing any large structural branches growing out into the centre of the rows. Trees planted 2.0 m apart will be pruned in both directions to produce a slender pyramid tree shape.

Key Researchers: Grant Thorp

Funding Source/Project Number: Hort Innovation AL14007

Site Management Requirements: Standard management, inputs to be applied consistently across the planting according to tree size. Communication with PFR prior to application of non-standard management inputs.



11. PFR Architectural Studies on Australian Almond Breeding Selections

Rootstocks	Scions	# trees	Valves	Spacings	Area	Research body
Garnem	Nonpareil Carina Capella Maxima Mira Rhea Vela plus 8 genotypes from UofA	**372 Total**	N/A	4.5 x 3.0 m	0.54 Ha	Plant and Food Research

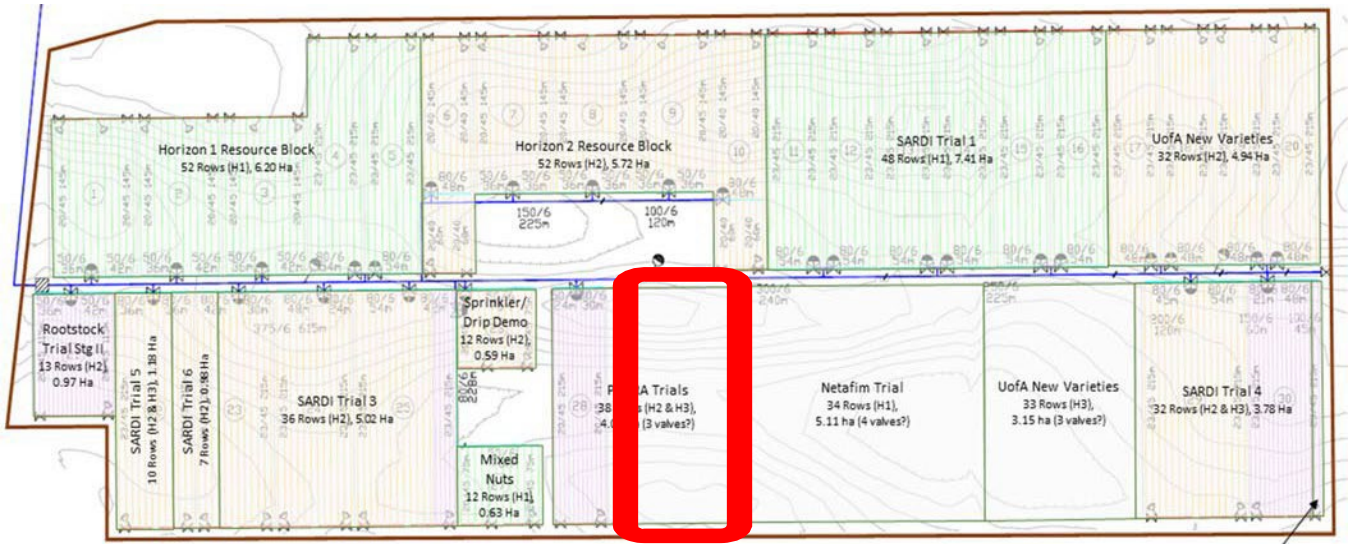
Aim: To accelerate identification, breeding and commercialization of almond cultivars suitable for high density orchards.

This short-term study will characterize desirable architectural traits in current and future almond cultivars starting with “unpruned” trees in their 1st leaf budded onto clonal rootstocks. All trees planted as “unpruned” central leader trees taken direct from the nursery and grown with minimal pruning. Branching, spur development and flowering to be quantified on these trees in their 2nd and 3rd-leaf. By not heading the trees at planting and not pruning or selecting limbs, the true natural growth habit of the varieties can be observed. These data will help develop future management guidelines for high density orchards.

Key Researcher: Grant Thorp

Funding Source/Project Number: Hort Innovation AL14007

Site Management Requirements: Standard management, inputs to be applied consistently across the planting according to tree size. Communication with PFR prior to application of non-standard management inputs.



12. PFR Pruning Responses – New Cultivars

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Garnem	Nonpareil Maxima Carina Vela Shasta	**Total 1,352**	N/A	4.5 x 3.0 m	1.89 Ha	Plant and Food Research

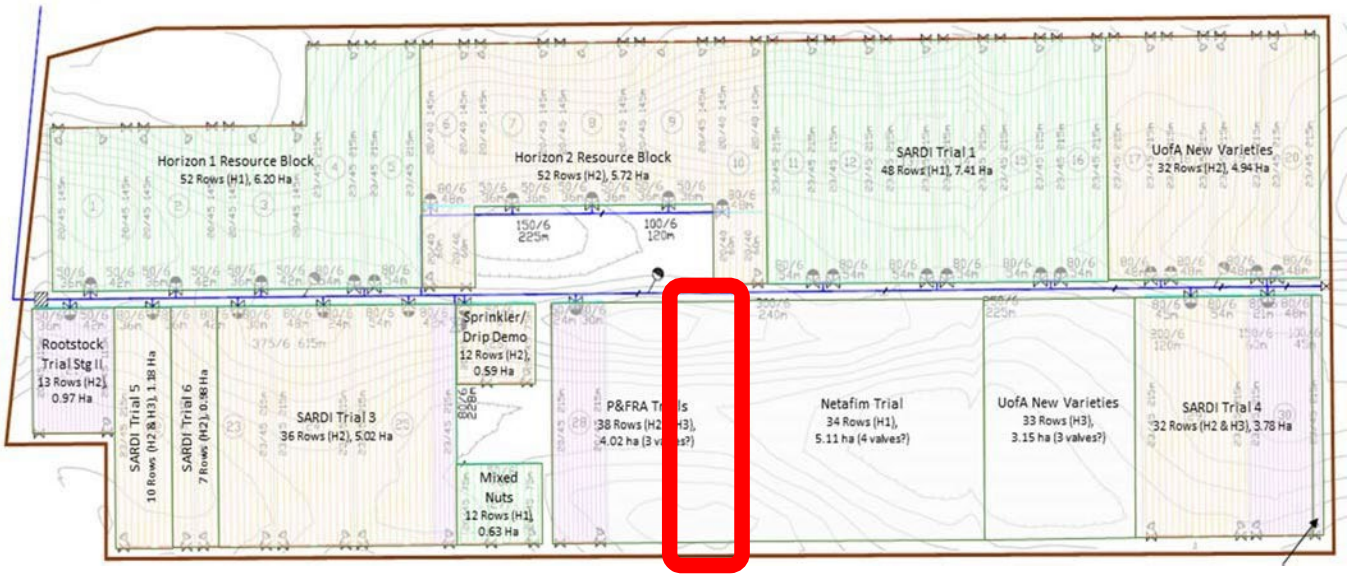
Aim: To optimise pruning systems for current and future almond cultivars planted at high density.

This medium-term study will evaluate a range of pruning and nursery management techniques to produce central leader trees suitable for high density plantings. Two sets of trees budded in early-December and mid-January and a third set "dormant budded" in late-March to produce a range of tree sizes (large, medium and small, respectively) for field- planting in winter. All trees grown as central leader trees with no or minimal pruning according to tree size at planting.

Key Researchers: Grant Thorp

Funding Source/Project Number: Hort Innovation AL14007

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with P&FRA prior to application of non-standard management inputs.



13. ABA Rootstock Evaluation on Light Soils

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Nemaguard Cadaman Atlas Nickels Rootpac R Barrier 1 (Empyrean) Penta Tetra	Carmel Nonpareil Peerless	**456 Total**	21	6.5 x 3 m	0.97 Ha 12 rows of 38 trees	Almond Board of Australia

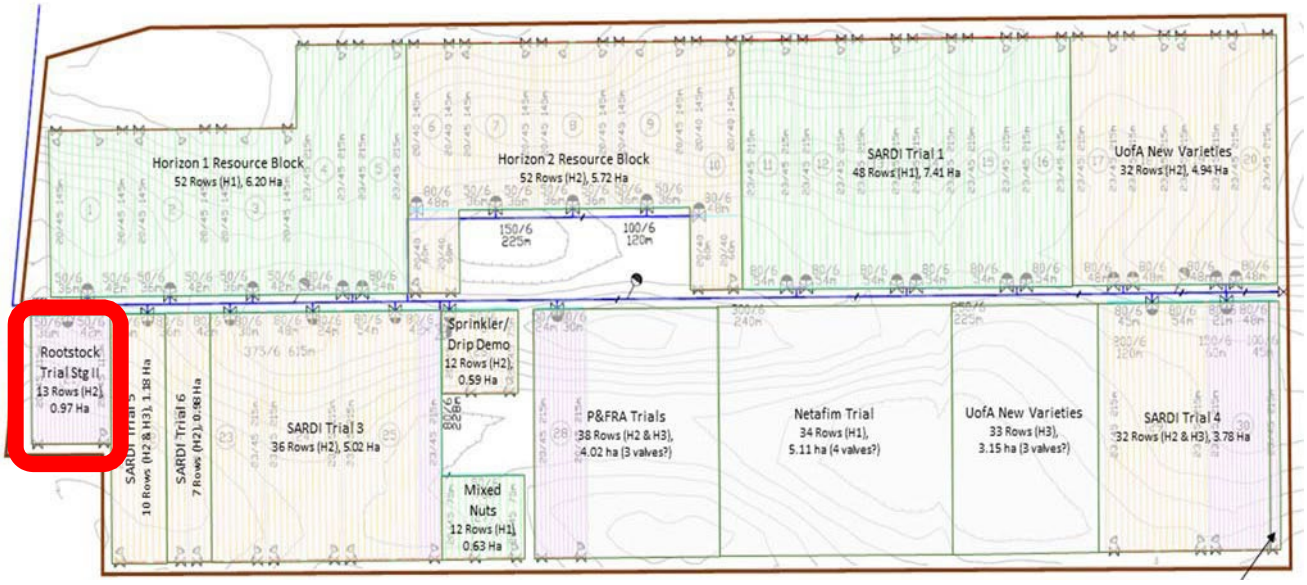
Aim: To develop performance data on rootstocks for traditional varieties on light soils.

This trial will add to the current rootstock trial site at Lindsay Point, it will be advantageous to develop another site to assess rootstocks that are more suited to a sandy loam soil type. A suitable site has been selected at the Almond Centre of Excellence. The site will be planted in a randomised, replicated trial plot design to maintain statistical accuracy. This proposed planting will provide the opportunity to gather data and test the performance of rootstocks that were proposed for the original planting but were excluded due to unavailability of material. The trial will complement the heavier soil trial located at the Loxton Research Centre

Key Researchers: Josh Fielke, Ben Wiblin

Funding Source/Project Number: Hort Innovation AL16006

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with ABA prior to application of non-standard management inputs.



14. ABA Sprinkler/Drip Irrigation Demonstration Site

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Nemaguard	Nonpareil Carina Vela Shasta	144 Nonpareil 144 Carina 144 Vela 144 Shasta **576 Total**	N/A	6.5 x 3.0 m	1.12 Ha 8 Rows	Almond Board of Australia

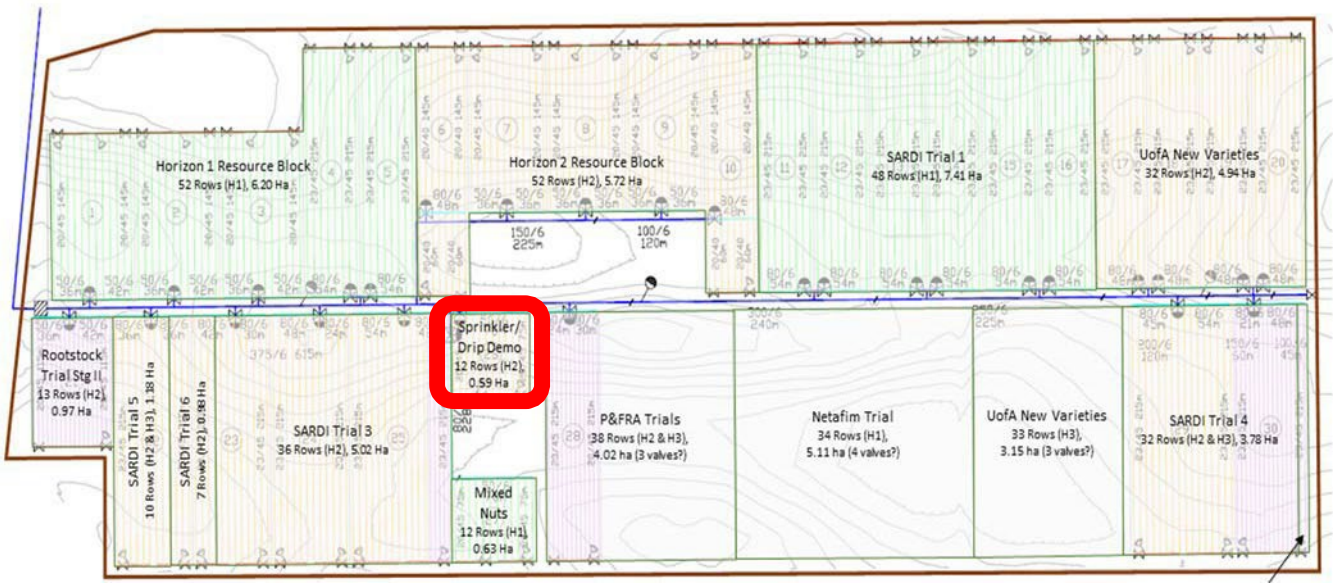
Aim: Demonstration block for a dual sprinkler/drip irrigation system. Sprinklers will be used as the primary source of irrigation during the growing season, with drippers used during harvest.

Tree growth and production within this patch will be compared with performance data from H2 Resource Block or Trial 3, depending on the mix of scions/rootstock planted in this block.

Key Researchers: Josh Fielke, Ben Wiblin

Funding Source/Project Number: Proposed Hort Innovation Project

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with ABA prior to application of non-standard management inputs.



15. ABA H3 Maxima

Rootstocks	Scions	# Trees	Valves	Spacings	Area	Research Body
Garnem	Maxima	172 **172 Total**	N/A	4.5 x 2.5 m	0.19 Ha 2 rows	Almond Board of Australia

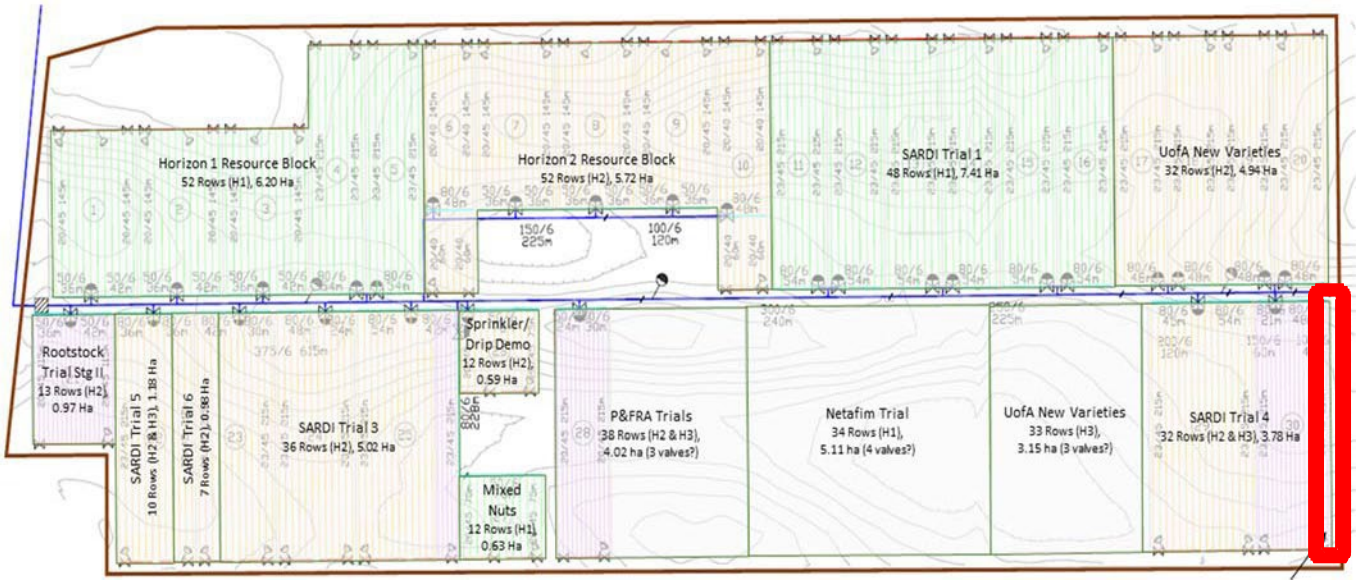
Aim: Monitor Maxima trees at high density for appearance/severity of black spot. The planting also provides the potential for trialing control options.

These rows will also provide barrier rows to Trial 4, improving the reliability of results from the outside rows of that trial.

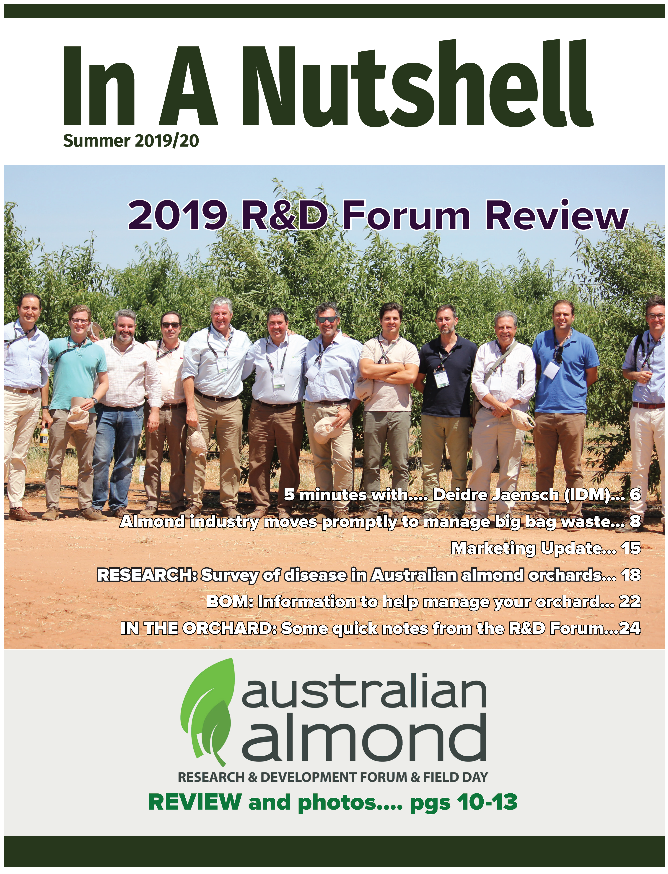
Key Researchers: Josh Fielke, Ben Wiblin

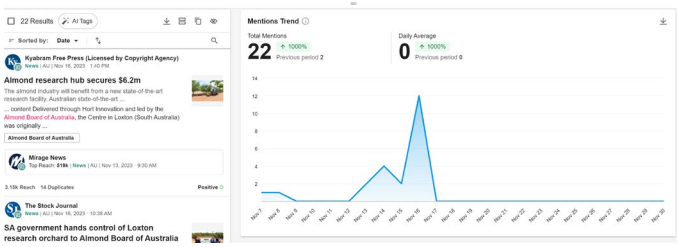
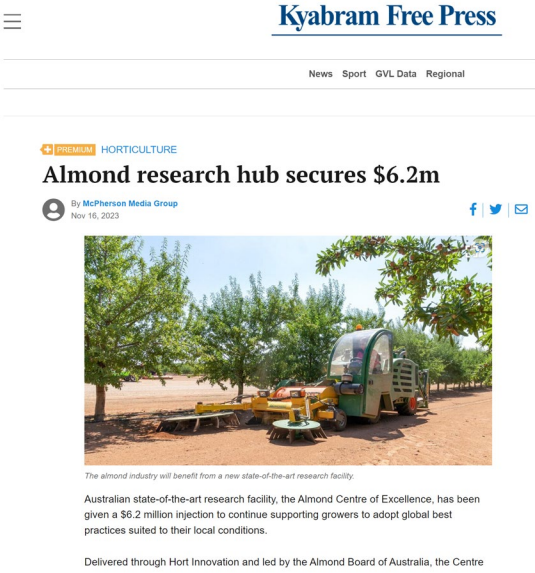
Funding Source/Project Number: Proposed Hort Innovation Project

Site Management Requirements: Standard management, inputs to be applied consistently across the planting. Communication with ABA prior to application of non-standard management inputs. ABA to manage black spot outbreaks if/when they occur, potential to trial alternative control options.



Outputs

Output	Listed in M&E Plan: • Yes • No	Description	Evidence and data
R&D Training and Extension activities	Yes	The list of activities on site ranges from one-on-one visits with the Orchard manager and staff to focus on specific aspects of the orchard to the Open Day that showcased the findings of a range of projects being stages at the facility	There have been six major events since the orchard reached sufficient maturity in 2022. There has also been over 600 separate delegations/visits to the site by different organisations. See Appendix 1 for list of events and visitor registration summary. Events include demonstration days, training opportunities and two key events – the 2019 R and D Forum which saw more than 260 industry stakeholders visit the facility for the first time.  Another key event was the official Opening of the site in November, 2023 which featured a range of presentations that highlighted the number of research trials being done on behalf of growers at the Experimental Orchard . The event attracted more than 200 industry stakeholders. As the industry looks for increased efficiencies on farm, there is significant interest, rootstocks, varieties, tree

			architecture, spacings and density which were key features of the Open Day orchard project presentations and updates. The event attracted considerable media coverage as highlighted below by our Media Monitoring portal and highlighted by two regional articles.   ing of the Almond Board of Australia's (ABA) Almond Centre of Excellence yesterday morning were PIRSA chief executive Professor Mehdi mer ABA chairman and current Riverland grower representative Brendan Sidhu, Hort Innovation head of industry services and delivery Corrine former ABA CEO Rosa Skinner. PHOTO: Stephanie Thompson  The almond industry will benefit from a new state-of-the-art research facility. Australian state-of-the-art research facility, the Almond Centre of Excellence, has been given a $6.2 million injection to continue supporting growers to adopt global best practices suited to their local conditions. Delivered through Hort Innovation and led by the Almond Board of Australia, the Centre

			
A project risk register	Yes	Establishing and reviewing a site specific matrix that identifies and reviews the level of all listed risks. This has been a joint role of Audit and Risk Committee and the ACE Orchard Management Committee.	See ABA Organisational Risk Register - Appendix 2
Establishing an industry specifically designed for best practice R and D	Yes	Installing, purchasing and maintaining the necessary infrastructure and equipment to run an almond orchard to commercial standards.	See comprehensive pictorial summary - Appendix 3 Irrigation System  Fencing Security Storage and workspace infrastructure  Internal Roads and Carpark

			  Farm equipment for Trial Management – The Italian-made Monchiero sweeper has been modified from macadamia orchard settings for the narrow high density rows at ACE.  Orchard preparation, Trees, Training, Training Aids and maintenance.
Enhanced outputs for research projects.	Yes	Conducted on R and D specific environment under guidance of researchers. A site for demonstration of loading technologies from commercial	Researchers from SARDI, Plant Food Research and the Adelaide University have all contributed positive evaluations of the ACE site and the collaboration with orchard staff in maintaining the site to a professional standard and assisting with trial work where necessary. Eg: “ *“It would be difficult to develop such valuable field research platforms without a dedicated experimental*

		sources.	*orchard. Almond researchers consider their journey with ACE has only just commenced. Many of the ACE experimental orchard plots are approaching full production and are generating information suited to both current and future orchard systems. These orchards are large enough to host a range of production focussed research questions that would be difficult to accommodate at commercial properties."* - SARDI researcher Tim Pitt Plot and technology trials at ACE have been conducted by the following commercial operations: • Stoller • EE Muirs • Omnia • Connected Farms • GoTrak • OMC • Laser bird deterrence • Bird decoy crop trial
A facility capable of attracting experienced global researchers	Yes	Facilitating visits to the orchard by international research specialists	The ABA has successfully hosted a range of researchers from Spain and California to the Experimental orchard. The facilitation has involved interacting with researchers operating at the site as well as presenting to growers at various industry events such as the ABA Conferences in 2022 and 2024 as well as Research and Development Forums in 2019 and 2023. The list includes:  • David Doll – Portugal (pictured right above) • Patrick Brown – California (pictured left above) • Jim Adaskaveg – UC Davis • Roger Duncan – UC Davis • Sebastian Saa - Almond Board of California

			• Javier Miarnau - Spain • Josette Lewis – Almond Board of California The recent completion of amenities is certain to enhance the chances of attracting long term visits to the site. See images Appendix 3.

Outcomes

Outcome as listed in M&E Plan	Progress to achieving outcome	Evidence and data	Progress: • On track • Off track
Provide Almond Industry purpose built experimental orchard	The development stage of the ACE Orchard is complete with the establishment of amenities tht feature offices, bathroom and kitchen facilities, a presentation room that sits 30 as well as a purpose built laboratory.	The completed project is showcased through a fly-over video found on our website. ACE Orchard Flyover 2022 - Australian Almonds  New amenities block:	On track
Improve input efficiencies and yield for growers due to adoption of research outcomes from ACE trials.	This is a long term goal that continues to be evaluated through a range of trials being conducted by research bodies as well as commercial trials.	The ABA maintains a running showcase of research results and links to Project reports on its industry website. A link to these resources is located in the Introduction section of this document.	On track
Enhance researchers professional development	Ongoing	The ongoing work of projects from a range of research organisations continues to demonstrate the value of the site	On track
An enhanced understanding of almond research program and industry development initiatives across industry and the broader research community	The attendance at industry events on site and subsequent participant surveys have underlined the interest, relevance and value of the trials to industry stakeholders.	A survey taken after the inaugurual ACE Open Day which showcased the research projects on site in November last year highlight the positive feedback for the site and the work being conducted at ACE in Appendices 4 Similar surveys taken at other events such as the more recent spray	On track

		efficiency workshop on-site reinforced this ongoing value.	
Provide facility that optimizes the opportunity for success through day-to-day management of project trials by experienced staff following direction from researchers	The orchard is managed by a staff with extensive almond orchard management experience. The manager comes with more than 25 years of experiences and liaises with all researchers regularly on site.	The feedback from researchers indicates that the standard of orchard management not only maintains the site in a professional state, but also provides the type of support required while on site working. The recent completion of the new amenities and laboratory will enhance the facilities available to researchers. "*The ACE orchard has provided us with a purpose-built site and resources to develop an extensive breeding program with more than 9500 separate varieties planted for evaluation. The various stages of evaluation within the breeding trials at ACE allows us to progress the breeding program with continuity and the long term goal of creating new varieties that will deliver the attributes the industry is seeking*," **Associate Professor Cassandra Collins, Adelaide University, Almond Breeding Project Lead, October 25, 2024.** *"The ACE Orchard has allowed us to conduct industry specific trials on tree architecture and planting density. The body of research has been preserved to the highest integrity by the ACE Orchard staff and continues to provides us with the best opportunity to advance trials that are aimed to improve almond productivity in Australia."* **Senior Scientist Roberta De Bei, Plant Food Research, October 30, 2024** See Appendix 1 – More researcher feedback	On track
Foster Collaboration and maximise extension across the Hort Innovation Almond R and D program	The new funding model and Collective Industry Fund established specifically to underpin the viability of the orchard as a stand-alone operation could not have been achieved without collaboration across multiple levels of the ABA and Hort Innovation.	The development and approval of the 5-year budget and the funding streams contained within highlights the unified approach and willingness to recognise the dynamic challenges around operating an orchard whilst also recognising the transparency required to ensure the long term viability of the facility is preserved.	On track

Monitoring and evaluation

Key evaluation questions of the project:

1. To what extent has the project achieved its expected outcomes?

   The project has been completed on time and within budget and is already delivering the type of stakeholder engagement and research that was set out in the plan. Ongoing evaluations surveys are conducted to measure progress.

2. How relevant was the project to the needs of intended beneficiaries?

   Industry feedback through surveys at events held on site underline the relevance of the trials and activities conducted on site for almond growers.

3. How well have intended beneficiaries been engaged in the project?

   The visitor and event register underline the acceptance and take up of the site as a research hub for almond growers. The feedback from subsequent events held on site as well as ongoing evaluation from researchers has very supportive. The Advisory Committees evaluating new research ideas now have greater scope to expand trial concepts confident that the ACE orchard can deliver high integrity environment for the proposed trials. The new for analysis of various self fertile varieties side by side has emerged as the latest new trial to be established at ACE.

4. To what extent were engagement processes appropriate to the target audience/s of the project?

   It has become clear from feedback, attendance numbers and ongoing visitation rates that the orchard provides an environment that delivers a tangible experience. The ability for grower members to see, watch and evaluate something live has enhanced the delivery value for a wide range of extension activities (eg: spray day) as well as demonstrations of new technologies as well as assess the suitability of various orchard structures in a commercial environment. The experience of our orchard staff along with the researchers allows grower members to get direct face to face feedback on a range of issues from the day to day management to the long term high level goals of projects.

5. What efforts did the project make to improve efficiency?

   The efficiency of having a fit-for-purpose research facility has provided an environment where the sole focus of orchard management has been preserving the trials and the integrity of data collected. This can been difficult on private land when mixed with the day-to-day operations of a commercial orchard.
   One orchard management team has been able to oversee the care and maintenance of multiple projects minimising the need for extra labour in different locations.
   The installation of the scour value on the pump line emphasised the importance of such features.
   Assessing the value of various commercial products or technology has also helped improve efficiency whilst also serve as an evaluation for broader industry use. ACE has used several soil moisture technologies since the project begun as part of their day-to-day management.

Stated project M&E audience and information needs		
Audience	Information needed	Achieved
Primary		
ABA Project team	Project plan and deliverables	Achieved
	Expenditure against budget	Achieved
	Requirements to manage research trials	Achieved
	Requirements to manager commercial trials	Achieved
	Input data; yield and economic data	Ongoing

Hort Innovation R&D Manager	Project progress against deliverables; timelines and budget	Achieved
	New and emerging issues/opportunities	Ongoing
ABA ACE Committee (project steering committee)	Project progress on implementation of infrastructure / equipment acquisition program	Ongoing
	New and emerging issues/opportunities	Ongoing
	Annual program including list of on-site trials, research and commercial projects	Achieved
	Report on demonstration/ extension activities of research projects and commercial technologies	Achieved
	Report on economic analysis of trialed production systems	Ongoing
	Meeting minutes	Achieved
	Quarterly reports to the ABA Board of directors - project status	Ongoing
Secondary		
Growers	Economic comparison for new technologies and production systems	Ongoing
	Pros and Cons for each production system and new technologies	Ongoing
Hort Innovation funded researchers	Project plan and outputs	Achieved
Commercial partners	ABA trial agreement/MOU	Achieved
Overseas researchers	Opportunities for sabbaticals to work on the ACE farm with local researchers and growers	Ongoing
Industry stakeholders	the almond research program and industry development initiatives	Ongoing
General community	the almond research program and industry development initiatives	Ongoing

Recommendations

Ongoing collaboration between Hort Innovation and the Almond Board will be essential in overcoming the challenges inherent uncertainties in operating an almond orchard.

Refereed scientific publications

NA

Intellectual property

NA

Acknowledgements

The completion of this project and the ongoing viability of ACE would not have been possible without the support and foresight of the Hort Innovation senior executive and board as well as the Almond Board of Australia directors. Both have recognised the value of the project while also acknowledging the need for a strong working partnership to ensure its long term viability. The vision and work of former ABA CEO Ross Skinner also should be acknowledged as without his passion and acumen this project would not have been realized. The support provided by a range of ABA directors, but especially

Brendan Sidhu and his staff at Century Orchards have also played a pivotal role in overcoming day to day resourcing issues.

Appendices

Appendix 1.

ACE Experimental Orchard Extension events – 2022-24

Event Name	Event Type	Total Attendees	Grower enterprises	Grower attendees	Grower Hectares	% of industry
Soil Science Australia: Riverland Soil Knowledge Day (2/6/2022)	External Field Day	24	Not recorded – External event			
Insight trac/ go-track / Fish screens- ACE (13/07/2022)	Field Day	40	10	20	17,367	28
AV Drip irrigation training - Riverland (26/07/2022)	Workshop	19	9	14	15,937	26
ACE Orchard - Open Day (13/10/2022)	Field Day	51	24	35	39,054	63
Almond Centre of Excellence Open day 2023 (14/11/2023)	Field Day	206	36	67	26,316	42
ABA 'Almond Skills' Irrigation Workshop – Riverland (17/6/2024)	Workshop	21	8	19	20,960	34
ABA Spray Day (18/9/2024)	Field Day	73	19	39	20,403	33

Visitor log (2/11/22 to 18/10/24)

	Grower	Researcher	Industry suppliers	Government	Funding Body	Media	Stakeholder	Education	Cross industry
Sign in's	84	219	181	9	12	13	20	40	26

Appendix 2.

ALMOND BOARD OF AUSTRALIA ORGANISATIONAL RISK REGISTER

DATE	RISK IDENTIFIER	RISK DESCRIPTION	IMPACT DESCRIPTION	IMPACT LEVEL	PROBABILITY LEVEL	PRIORITY LEVEL	MITIGATION ACTION	CONTINGENCY ACTION	COMMITTEE	OWNER	PROGRESS	STATUS
Date Raised	Short one/two word identifier of risk	Brief summary of the risk.	What will happen if the risk is not mitigated or eliminated?	Rate 1 (LOW) to 5 (HIGH)	Rate 1 (LOW) to 5 (HIGH)	(IMPACT X PROBABILITY) Address the highest first.	What can be done to lower or eliminate the impact or probability?	Action to be taken if risk occurs	Relevant Committee affected or responsible for oversight	Staff member responsible for oversight	Current detailed progress to date	Status to date
17/02/2021	Legal Liability	Legal liability risk to Directors and Officers	Directors and Officers legal liability exposure	3	1	**3**	Ensure insurance such as Directors & Officers insurance is up to date and sufficient	Enact relevant insurance policies	Audit & Risk	Shannon Harkins	No Change. Current active policies to date include: Associations Liability Insurance (includes Directors & Officers Insurance); Business Travel Insurance; Commercial Insurance (includes comprehensive vehicle cover, property damaage, legal liability etc); Rural Insurance (ACE Orchard coverage); Products Liability & Marine Insurance (legla liability and transport insurance for budwood)	Ongoing
17/02/2021	Cyber Security	Risks associated with ABA server and data penetration/infiltration	Sensitive & confidential information could fall into the wrong hands externally	5	2	**10**	Source cyber security insurance; Updated cyber security system implemented. Undertake periodic review. Ensure policies & protocols exist for correct treatment and storage of ABA data	Enact relevant insurance policy; Review internal policies & protocols; Review current data storage and retention methods	Audit & Risk	Shannon Harkins	No Change. Cybersecurity service contract signed. Process underway to migrate cloud storage away from Dropbox to MS One Drive & Sharepoint and MS365 operations and protocols to be updated and integrated. Information sourced on cyber security insurance;	Ongoing
4/01/2022	Health & Safety	Risks associated with the Health and Safety of ABA staff and ABA sites	Directors and Officers legal liability exposure	4	2	**8**	Staff (farm)have recieved ongoing WHS training. The departure of Meshu Shah rquires a handover to new admin employee. Establish ongoing schedule for regular WHS meetings with key stakeholders (Orchard Farm Mgr, Asst. Farm Mgr etc)	ACE committee chair Brendan Sidhu and ABA staff to meet on site each quarter to review WHS issues and protocols.	Audit & Risk	Tim Jackson	More rigour placed on signing in when attending ACE. Some contractors not signing out. Harvest SOPS integrated into SafeAg app with the view of copmpleting outstanding protocols and up-skilling whole staff on WHS awareness and responsibilities. High vis and induction required of all visitors to ACE Orchard.	Ongoing
4/01/2022	Food Safety	Risks associated with agreed food safety standards within the ABA	Directors and Officers legal liability exposure	1	1	**1**	Materials used for ABA promotions to be sourced from certified suppliers.	Change suppliers	Audit & Risk	Tim Jackson	No change	Ongoing
4/01/2022	Employee Issues	Any issue associated with employees (Staff levels, behaviours, situation, resourcing)	Organisation liability	2	2	**4**	Implementation of code of conduct for staff. Ongoing performance reviews with staff and establishing two-way communicaiton with staff members. Updating Position Descriptions as required.	Engaged HR consultant for advice. Used code of conduct and organisaiton policies as farmework for any discussions around behaivours.	Audit & Risk	Tim Jackson	No change	Ongoing
4/01/2022	Compliance and Governance	Any material breaches of laws, Board approved policies and procedures	Directors and Officers legal liability exposure	4	1	**4**	Ensuring correct policies and procedures are in place and staff are appropriately trained.	Reviewing training and address potential breaches directly with staff and implementing required level of response.	Audit & Risk	Tim Jackson	No change	Ongoing
4/01/2022	Insurance Risk	Any matters that could impact on insurance or generate a claim against the ABA	Organisation cost and liability	2	1	**2**	Review/assess available insurances on the market against ABA risk profile and operations	Take-up insurances or increase limits as required to mitigate ABA risk liability	Audit & Risk	Shannon Harkins	No Change. Cyber security insurance to be taken-up following completion of organisational cyber security over-haul. Organisational insurance 'health check' to be undertaken	In Progress
4/01/2022	Industry Sabotage	Any sabotage of ABA infra-structure - Budwood Site or ACE Orchard	Impact on orchard condition	3	1	**3**	Fencing of properties and lockable shedding where possible. Video surveillance and on-line euqipment monitoring.	Engagement with law enforcement	Audit & Risk	Anthony Wachtel	No change	Ongoing
24/04/2024	ACE orchard crop underperforms resulting in below budget returns	A poor crop year at ACE would undermine the current funding model that it underpins the self-funding model co-funded through CIF-2	Will be relying on carry-over reserves and potentially ABA reserves to carry through to new season.	4	1	**4**	Carry sufficient reserves to cover such an outcome as well as build a sufficient buffer within ACE accumulated funds to help cover such developments.					
27/04/2024	Crop failure	Trees at orchard fails to yield a commercial sized crop due to disease or weather event (eg: frost)	The fundamental revenue source that under[ins the funding of the operation will be lost or severely reduced.	5	2	**10**	Reserve funds established and retained from crop receipts to help offset any revenue losses.	Immediate review of finance model and a long term restructure of financing projections.	Audit & Risk	Tim Jackson	Funding model has an inbuilt buffer and provision for retaining funds. First couple of years will be challenge while funds are built.	Ongoing
7/02/2024	Input cost mitigation for ACE and Budwood sites	Managing increases in costs of input costs.	Impact self-funding budget and potentially viability for both operations.	3	2	**6**	Lock in long term deals on water and elecitricity to provide security around costs. Review P and L quarterly.	Maintain a close watch on outgoings and expenditure in conjunction with ACE and Budwood managers.	Almond Centre	Tim Jackson	Budgets in place and quarterly review due for ACE and Hort Innovation in March. An extra year at a lower rate has been secured for power taking us out to 2026, while a five year lease on 300ML has been secured for ACE. All water for 2024 secured.	Ongoing
7/02/2024	Travel	Ensuring the safe arrival and travel of employees.	Drivers involved in breakdown or accident in blackspots have no support.	3	2	**6**	Purchasing two vehicle trackers that do not require connectivity to phone network to stay in contact with headquarters. Travel policy to be developed.	Travel policy to be implement and toolboxed for staff.	Audit & Risk	Tim Jackson	Waiting on arrival of new vehicle trackers. Policy in draft form and will be followed up with toolbox meeting to discuss.	In Progress
4/01/2022	Litigation	Any current or potential legal action against the ABA	Directors and Officers legal liability exposure	3	1	**3**	Ensure all appropriate and relevant insurances are in place. Ensure all staff understand legal responsibilities associated with their respective positions.	Take-up insurances or increase limits as required to mitigate ABA risk liability. Ensure staff are adequately trained and appraised. Engage legal counsel if required.	Audit & Risk	Tim Jackson	No current legal proceedings against the ABA	Ongoing
30/04/2024	Insect or disease	The health of the orchard being significantly impaired by the onset of harmful pests or disease.	The onset of disease could lead to tree removal and jeopasrdise project continuity.	5	2	**10**	Ongoing vigilance and maintain high level of orchard management competence.	Liaise with best minds in industry to combat isues.	Almond Centre	Anthony Wachtel	Ongoing surveillance of tree health a KPI of orchard mnagement team.	Ongoing
30/04/2024	Water cost/deliverability	In times of drought the cost of water and availability of water will best tested.	Trees maybe mothballed if insufficient water can be accessed.	5	2	**10**	Conduct six monthly reviews of water purchasing strategy.	Keep Hort Innovation informed of developments and risks in this area and investigate alternative sources for water.	Almond Centre	Tim Jackson	A five year lease has been secured at a fixed price for a portion of the water required. However, this lease is contingent on that water being available.	Ongoing

PROBABILITY

Appendix 3.

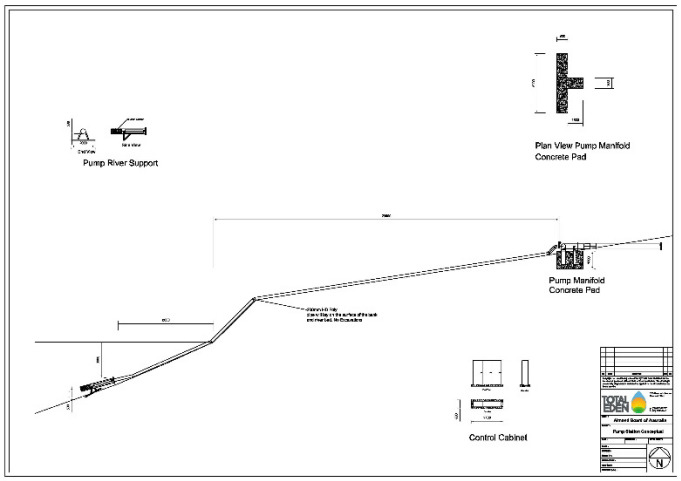
Irrigation System

Main Line

Main Line

Submains

Submains



Single Valve Manifold and Laterals

Twin Valve Manifold and Laterals

Valve Unit

Purge Valve Outlet

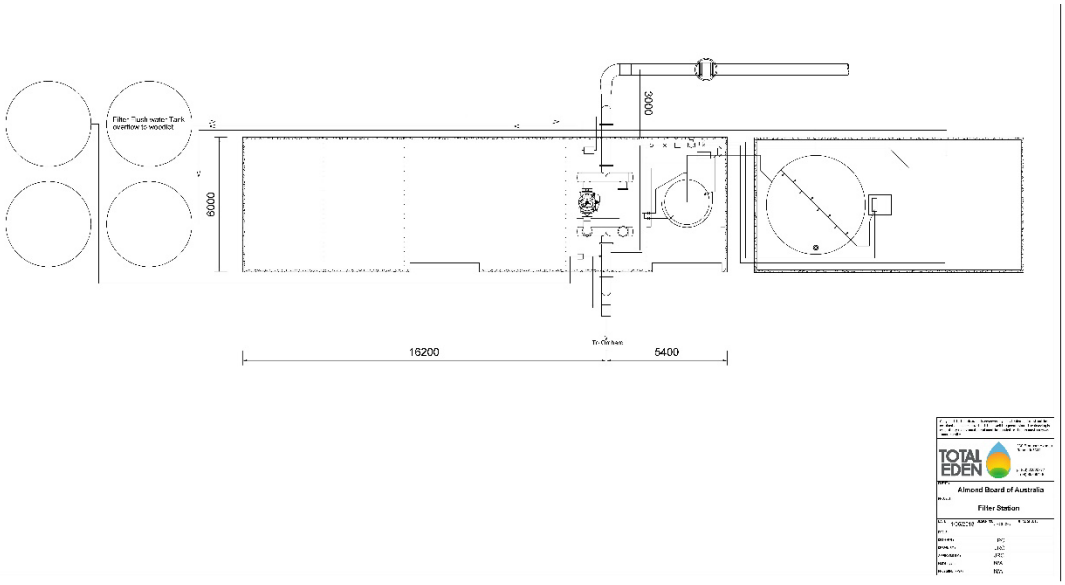
Collection Manifold

Collection Manifold 2

Dream 2 Control System and Expand by Total Eden
Irrigation controller

Amiad Filter

Fertigation System



Fencing Security

⇦ **2 x Gates – 4M x 1800**
Entrance gates on sliding rail with security screening and visitor log.

⇦ **Boundary Fence – 3.5km & associated materials**
Rabbit proof wire bottom, ring lock upper, and steel posts.

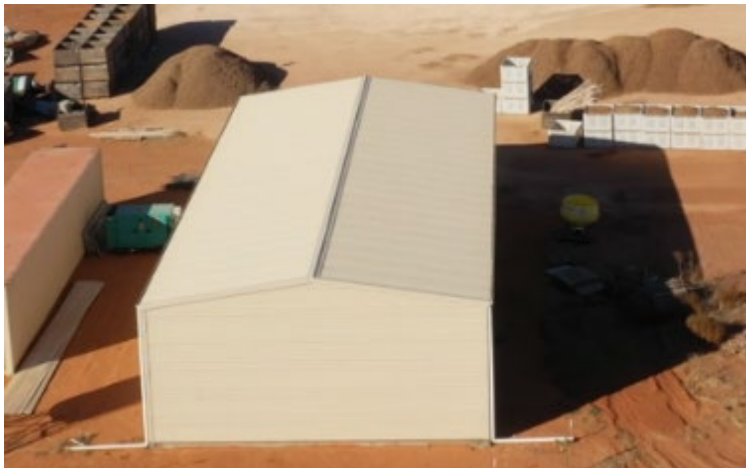
Storage and Workspace Infrastructure

⇦ **Filtration/Fertigation Shed, electrical connection, water tanks, with fibre optics and hard pad to enable bulk fertiliser movement.**

⇦ **Machinery Shed with spray bay, workshop bay, 3 x machinery storage bays (also venue for field days presentations), wash down area, off grid solar power and hard pad surrounding.**

⇦ ⇩ **Solar/Battery System**

Off Grid Solar, Battery and Generator System



⇦ **Processing Shed and Hard Pad**

⇦ **Storage Shed to protect trial nuts from poor weather.**

⇦ **Shipping Container for secure storage of high value product during development.**

⇦ **Donated site office relocation, repair and tie down.**

NEW ACE OFFICE FACILITY
Office building for staff, researchers, with toilet and kitchen facilities for field days, workshops, and meetings.

Office building – kitchen facilities

Office building – kitchen facilities

Office building – toilet facilities

Office building – disabled facilities

Office building – workspace for staff

Office building – workshops/meeting room

Internal Roads and Carpark

⇦ **1 kilometre of orchards roads and carpark of adequate size for field days.**

Farm Equipment for Trial Management

⇦ Utility vehicle for farm manager.

⇦ Kubota Tractor/Front Loader M8540DCN Cab 4WD
Purchased new. Modified for almond orchards with front end loader for general orchard management.

⇦ 2018 Kubota RTV-X900G, Diesel 22hp Utility Vehicle

Purchased new. All-terrain vehicle for checking irrigation and general staff movement.

	**⇦ Toyota Forklift 42-7FG25** Purchased used. Forklift for fertiliser movement from storage to mixing tank.
	**⇦ X-Plane 3.6M** Purchased new. X-plane for annual smoothing of orchard floor before harvest.
	**⇦ Mini Plane 3.0M 'V' Float** Purchased new. Mini plane for high density plantings.
	**⇦ Prunings rake for tractor for clearing tree offcuts – tree architecture trial.**

	**⇦ Herbicide unit 2019 Air-O-Fan Herb-500 gallon and (FMEB) Eliminator Spray Boom 18'-24'** Herbicide unit purchased new with modification to allow use in narrow rows for high density trials.
	**⇦ Hardi ATV 60L Induction Hopper with Valves and Pump Diaphram** Purchased new.
	**⇦ Tipping trailer 10x5 Hydraulic Lift** Purchased new. With detachable sides for rock/prunings removal, dripline/tree runout.
	**⇦ Slasher 14' – Orchard Floor Maintenance** Purchased used with folding wings to allow slashing of narrower rows.

	**⇦ Husqvarna M-ZT 61 Zero Turn Mower w/mulching kit** Purchased new.
	**⇦ OMC Tree Shaker** Purchased used. For harvesting trials on Horizon 1 & 2 plantings.
	**⇦ Kubota XVL95 2S Skid Steer Loader w/4in1 Bucket,** **Beacon & UHF**
	**⇦ Modified curved Rear Boom Shaker** For high density plantings (hired whilst trees size allowed).

	**⇦ 2014 Sweeper (Flory 7033 AC)** Purchased used. To mound shaken nuts.
	**⇦ Flory 7600 SP Pick-up Harvester** Purchased used.
	**⇦ Monchiero pick-up harvester for narrow row trials modified for assessing hields per tree.**
	**⇦ 2014 OMC After Shock AR-400 Shuttle** Purchased used to remove crop from the orchard.

	**⇦ Jack Rabbit Reservoir Cart with Desticker** Purchased used. Prepper cart to clean rubbish from mounded nuts and condition nuts in rain affected harvests.
	**⇦ Elevator to form stockpiles.**
	**⇦ Impact huller (University of SA)** For processing small volume new varietal trials.
	**⇦ WIA Weldmatic 250l Package w/Draw Troller & 355mm Cut Off Machine** Tools for routine and urgent maintenance.

	**⇦ Spitwater 10-120H 240V Hot/Cold Water High Pressure Cleaner w/Hose** Tools for routine and urgent maintenance.
	**⇦ Air Compressor** Tools for routine and urgent maintenance.
	**⇦ Kubota Fossil Generator 23.00 kVA** Tools for routine and urgent maintenance.

Orchard Preparation, Trees, Training, Training Aids and Maintenance

	**⇦ Orchard Ripping**

	⇦ **Soil Ameliorants**
	⇦ **Trees for Trials**
	⇦ **Row markers, wooden stakes, bamboo and ties.**
	⇦ **Water requirement of 1986.3 megalitres for life of project.**