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SuniTAFE SMART Farm Campus
Crop Trial Fact Sheet

Super High-Density (SHD) Almond Trial

SuniTAFE SMART Farm Campus – Cardross, Victoria



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Trial Overview

The Super High-Density (SHD) Almond Trial at the SuniTAFE SMART Farm Campus, Cardross (Victoria) was established in 2016 through a five-year partnership with Spanish nursery company Agromillora, the global pioneer of SHD orchard systems.

The trial was designed to evaluate the performance of dwarfing rootstocks, hedgerow orchard designs, mechanised production systems, and intensive water and nutrient management under Sunraysia growing conditions.

This 2.8 hectare orchard represents one of Australia's earliest demonstrations of the SHD almond production model developed in Spain and adapted for local conditions.



Trial Specifications

Location

SuniTAFE SMART Farm Campus

161 Dairtnunk Avenue, Cardross VIC 3496

Planting Year

2016

Orchard System

Super High-Density (SHD) Hedgerow Almond System

Rootstock

Rootpac® 20 (Nanopac)

A patented dwarfing rootstock developed by Agromillora that:

- Reduces tree vigour by approximately 40–50%
- Produces compact upright growth
- Enables high-density planting and mechanised harvesting
- Encourages early bearing and high yield efficiency
- Performs well in heavier, alkaline and calcareous soils

Almond Varieties

- Non Pareil – 4,425 Trees
- Carmel – 2,214 Trees
- Price – 1,650 Trees
- Wood Colony – 203 Trees
- Mixed Varieties – 329 Trees

Orchard Design

Parameter	Trial Design
Tree Spacing	1.0 m
Row Spacing	3.0–3.5 m
Trees per Hectare	2,000–2,400
Irrigation	Double-line drip
Dripline	16 mm UniRAM
Emitter Rate	2.3 L/hour

Comparison with Traditional Almond Orchards

System	Trees/ha
Conventional Almond Orchard	300–400
SHD Almond Orchard	2,000–2,400

The increased planting density allows for rapid canopy closure and significantly greater light interception during the early years of orchard establishment.



Trial Performance

Highest Kernel Yield

2,175 kg kernel/ha

Industry Benchmark

2,500–3,000 kg kernel/ha

While yields have been slightly below the industry's best-performing SHD systems, the trial has provided valuable insights into orchard spacing, mechanisation and management practices applicable to Australian conditions.

Water Use Efficiency

Average Annual Water Use

8.06 ML/ha

Typical SHD almond orchards on Rootpac® 20 require:

8.0–11.5 ML/ha annually

This represents approximately 20–30% less water than many conventional almond production systems.

Why SHD Systems Use Less Water

- Smaller tree canopies
- Reduced vegetative growth
- Compact root systems
- Precise irrigation targeting
- Earlier canopy interception of sunlight

Soil Characteristics

The trial site contains:

Topsoil Depth

55 cm – 100 cm

Soil Types

- Loamy Sand
- Sandy Loam
- Light Sandy Clay Loam

These soil conditions are generally well suited to Rootpac® 20 due to:

- ✓ Good drainage
- ✓ Suitable rooting depth
- ✓ Adequate aeration
- ✓ Moderate water-holding capacity



What is Super High-Density Almond Production?

The SHD almond system was developed in Spain during the early 2000s and adapted from successful super-intensive olive production systems.

The concept relies on:

Dwarfing Rootstocks

Rootpac® 20 controls tree size sufficiently to allow thousands of trees to be planted per hectare.

Hedgerow Architecture

Trees form a continuous fruiting wall rather than individual open-centre trees.

Mechanised Operations

The narrow orchard profile enables:

- Mechanical harvesting
- Mechanical hedging and pruning
- Reduced labour requirements

Precision Irrigation & Fertigation

Water and nutrients are delivered frequently and accurately to the shallow root zone.

Rootpac® 20 Profile

Parentage

Prunus besseyi × Prunus cerasifera
(Cherry Plum × Sand Cherry Hybrid)

Key Advantages

- ✓ 40–60% vigour reduction
- ✓ Early bearing
- ✓ Improved yield efficiency
- ✓ Adaptability to alkaline soils
- ✓ Good tolerance to wet or heavier soils
- ✓ Moderate nematode resistance
- ✓ Tolerance to White Root Rot
- ✓ Considerations
 - Sensitive to Crown Gall
 - Produces root suckers
 - Requires intensive irrigation management

Nutrition Management in SHD Almonds

Because SHD orchards contain more trees in a smaller root volume, nutrient management must be highly precise.

Recommended Annual Nutrient Targets

Nutrient	Recommendation
Nitrogen (N)	200–250 kg/ha
Potassium (K)	85–95 kg per tonne of kernels
Calcium (Ca)	Structural and shell development
Zinc (Zn)	Early shoot growth
Boron (B)	Pollination and fruit set

Seasonal Fertigation Program

Spring

(Bud Break to Leaf Development)

Apply:

- 30% annual nitrogen
- Zinc
- Boron

Early Summer

(Fruit Set to Kernel Fill)

Apply:

- 40% annual nitrogen
- Peak potassium requirement

Late Summer

(Post-Harvest)

Apply:

- Remaining 30% nitrogen
- Rebuild carbohydrate reserves
- Support next season's bud development

Irrigation Management

Recommended Root Zone

1.2 m wide × 0.4 m deep

Irrigation Strategy

SHD systems perform best with:

- ✓ Double-line drip irrigation
- ✓ Frequent irrigations
- ✓ Pulse irrigation scheduling
- ✓ Minimal deep drainage
- ✓ Precise moisture management

Avoid:

- ✓ Flood irrigation
- ✓ Long irrigation intervals
- ✓ Excessive soil saturation



Recommended Row Direction

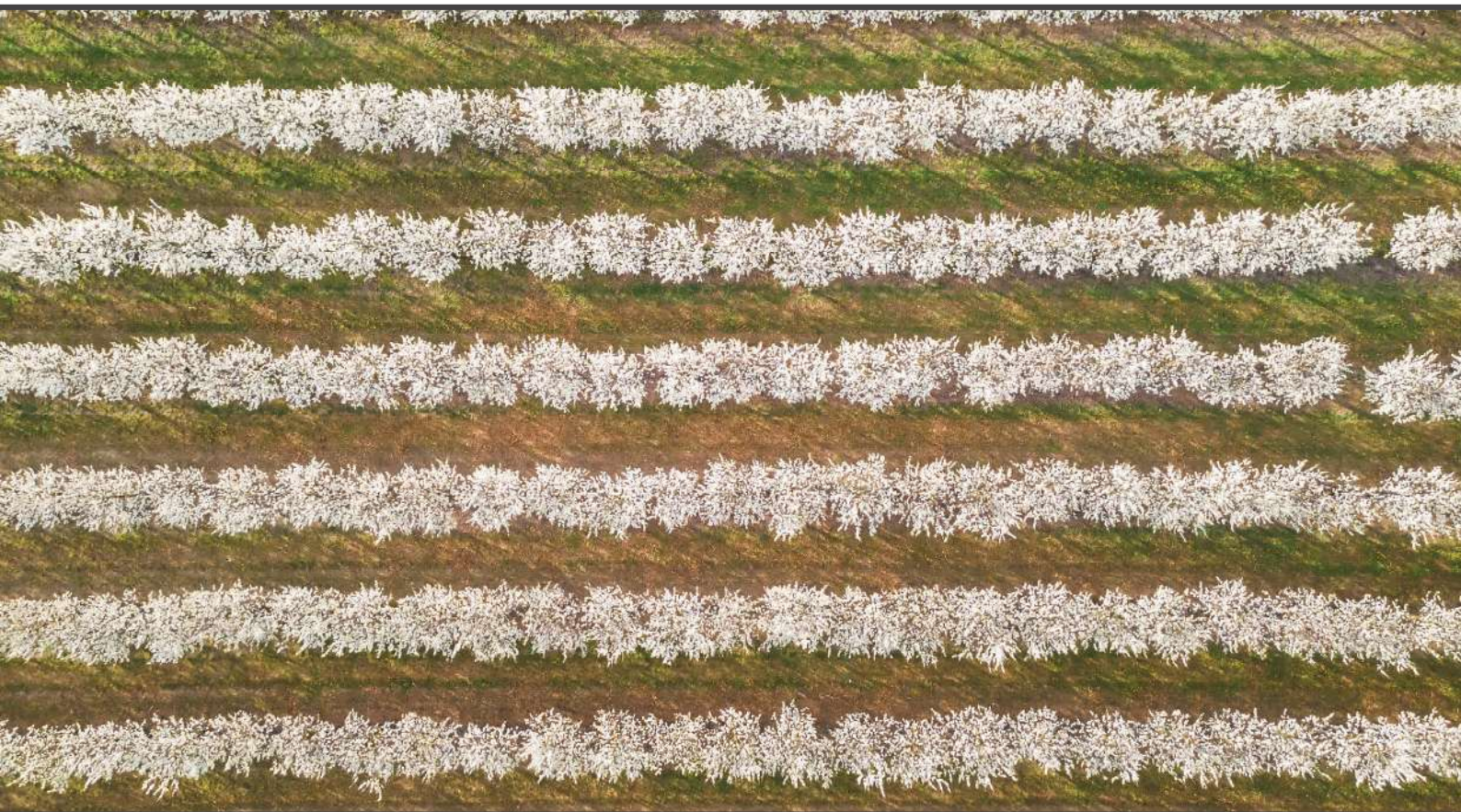
The recommended row direction for super high density (SHD) almond orchards is **north-to-south (N-S)**. This orientation maximises uniform sunlight and light distribution across both sides of the canopy.

Benefits of North-to-South Orientation

- Better light
- Higher bud potential
- Narrower rows

Alternative Considerations

- **East-West (E-W) impact:** E-W row directions cause heavy shading on the northern side of the rows, which can lower canopy growth efficiency and can increase yield variability.
- **Site specifics:** Local terrain slopes, prevailing strong winds for pollination, and property boundaries occasionally require slight adjustments to the ideal N-S alignment.



Pruning Recommendations

When utilising **Rootpac-20 dwarfing rootstock**, the pruning strategy shifts because its **60% reduction in vigor** naturally limits vegetative growth and balances the hedge profile after the third leaf. Managing the canopy requires fewer corrective cuts and relies on highly scheduled, fully mechanised hedging designed for compact dimensions.

Formation and Training Pruning (Years 1–3)

- **Natural branch stimulation:** Rootpac-20 naturally promotes axillary shoot production and lateral branching. Capitalise on this by minimising aggressive manual cuts, focusing instead on light summer pinches to shape the continuous vertical wall.
- **Trunk clearance:** Maintain a strict trunk clearance of 50 cm to 60 cm. Using pre-developed bare-root trees on Rootpac-20 allows you to skip early manual lower pruning, as the first scaffold branches arrive pre-established at this height.
- **Central leader dominance:** Avoid topping the main leader too severely in year one. Let the low-vigor plum hybrid genetics naturally form a narrow, upright, and highly branched canopy structure.

Production and Maintenance Pruning (Post-Year 3)

- **Tightened canopy dimensions:** Restrict the maximum tree height to **2.2 to 2.5 meters (7.2 to 8.2 feet)**. Maintain a strict canopy width of **70 cm (27.5 inches)**—meaning the vegetative hedge should never extend more than 35 cm on either side of the tree's central axis.
- **Post-harvest mechanical hedging:** Shift the main hedging pass to late autumn right after harvest, coinciding with leaf fall. Because Rootpac-20 limits aggressive wood regrowth, this single annual clean-up keeps the interior canopy photosynthetically active without causing a flush of water sprouts.
- **Light penetration window:** Keep the upper portion of the hedge slightly narrower than the bottom (creating a minor trapezoid profile). This ensures uniform light penetration, which is vital for Rootpac-20 to maintain high fruit density per cubic meter of hedge.

Operational Adjustments

- **Reduced pruning frequency:** After the juvenile phase (3rd leaf), Rootpac-20's growth balances out due to high fruit load. You can reduce summer mechanical trimming to a single light maintenance pass to clear the tractor alleys.
- **Compatibility:** Ensure your scion matches this rootstock's growth habits. Varieties like Lauranne (Avijor) or Guara adapt perfectly to this system, requiring minimal structural intervention. Avoid combinations like Diamar, which respond poorly to structural shaping on this specific rootstock.

Lessons Learnt from the SMART Farm Campus Trial

Challenge 1 – Tree Crowding

At 1 metre spacing, some trees have become increasingly crowded, reducing light penetration and productive fruiting wood.

Challenge 2 – Harvester Access

The 3 metre row spacing is extremely narrow for conventional almond harvesting machinery.

This has resulted in:

- Aggressive annual pruning
- Removal of productive fruiting timber
- Increased management costs
- Potential yield limitations

Challenge 3 – Bird Damage

Significant bird pressure occurs due to the orchard's proximity to residential areas.

Traditional bird deterrents such as gas guns are not practical.

Potential future solutions may include:

- Autonomous drone deterrent systems
- Alternative visual and acoustic technologies



Potential Future Improvements

Based on trial observations, a revised SHD design may improve long-term performance.

Proposed Orchard Design

Parameter	Proposed Design
Tree Spacing	2 m
Row Spacing	4 m
Trees per Hectare	Approx. 1,250

Potential benefits include:

- ✓ Better light penetration
- ✓ Reduced tree competition
- ✓ Larger canopy development
- ✓ Improved yield potential
- ✓ Reduced pruning intensity
- ✓ Greater machinery compatibility
- ✓ Ability to utilise harvesters such as the Pellenc over-the-row system

Existing Orchard Option

Remove every second tree and every second row while retaining the Non Pareil variety to create a wider and more productive orchard structure.

Key Takeaways

- The SMART Farm Campus SHD Almond Trial demonstrates the feasibility of hedgerow almond production under Sunraysia conditions.
- Rootpac® 20 successfully controls tree vigour while supporting early production and efficient water use.
- Average water use of **8.06 ML/ha** aligns with international SHD benchmarks.
- Yields of up to **2,175 kg kernel/ha** indicate the system is commercially viable but may be constrained by tree density and machinery access.
- Future SHD orchard designs are likely to benefit from wider spacings approximately **4m × 2m**, balancing mechanisation, canopy development, and productivity.

SMART Farm Insight: SHD almond systems are not simply conventional orchards planted closer together. They require integrated management of genetics, irrigation, fertigation, mechanisation, and canopy architecture to maximise productivity and profitability.





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