Government of South Australia
Department of Primary Industries and Regions

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

ACE FACT SHEET

# SARDI Density Optimisation

## Low (H1) to Medium (H2) density

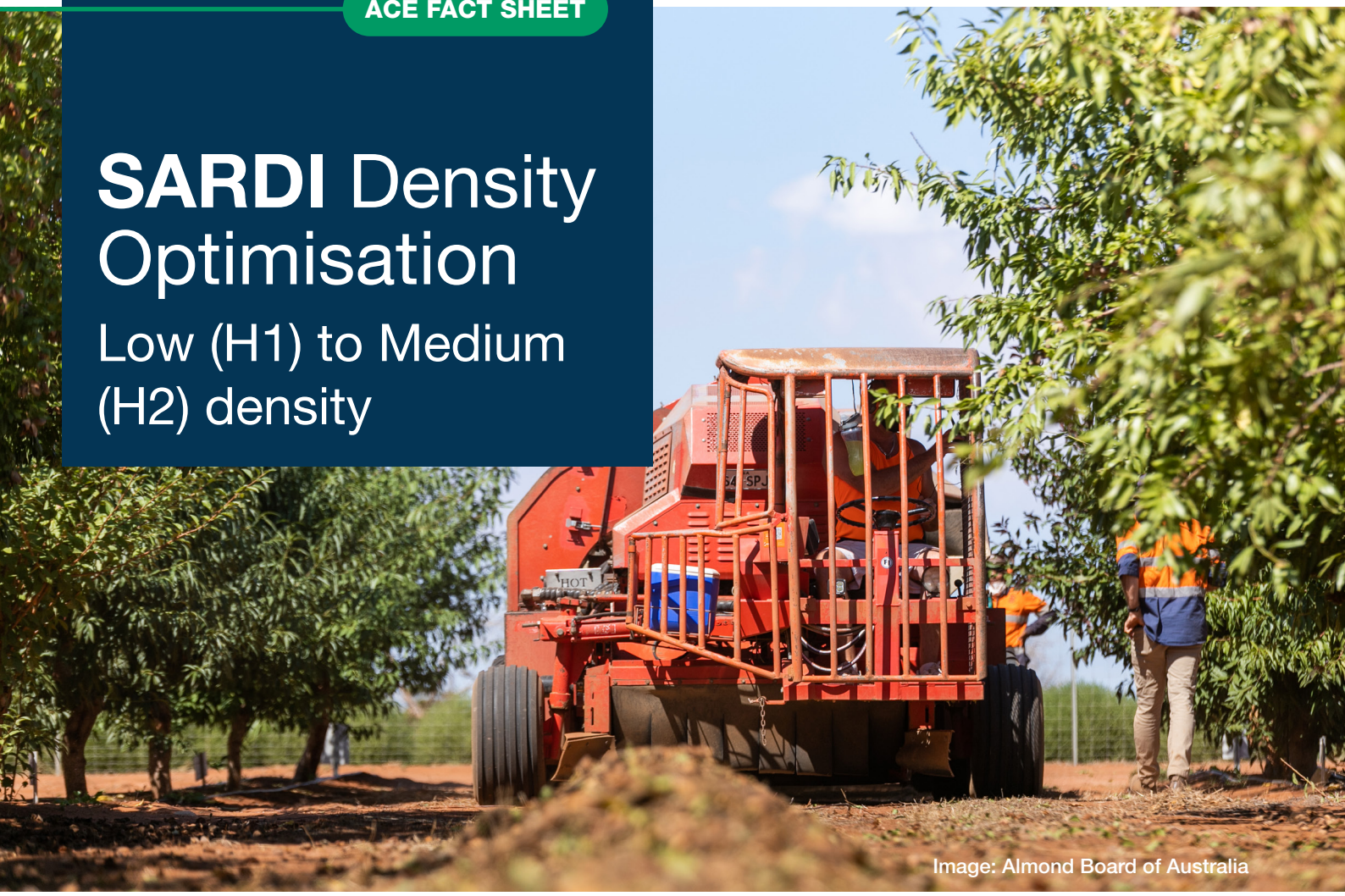

Image: Almond Board of Australia

## Background

While Australian producers are increasingly interested in the development of super-high-density production systems (Horizon 3 at more than 800 trees/ha), an easier step for many remains the progression from lower densities (Horizon 1, at about 300 trees/ha) to medium-high densities (Horizon 2, at about 600 trees/ha). Growers can achieve these closer plantings whilst retaining the benefits of wide inter-row spacings, meaning they may achieve improved production efficiencies without departing from traditional operational practices or diminishing the value of existing orchard machinery. However, the optimal planting density is yet to be defined for industry relevant varieties grown in Australia. In 2018, SARDI established a 5 ha experimental orchard to better understand impacts of planting density and cultivar on orchard productivity and sustainability.

## Aim

To test the performance of four industry relevant varieties across a six-step density transition ranging from Horizon 1 (308 trees/ha) to Horizon 2 (615 trees/ha).

## Trial design

### Six replicates of six treatments
### 2,160 trees / 5 ha

| | |
|---|---|
| Four varieties | Nonpareil, Shasta, Vela, Carina |
| One rootstock | Garnem |
| Six densities (6.5 m rows) | 308, 342, 385, 440, 513, 615 trees/ha |
| Planted | 2018 |

## Results so far

Early results suggest that kernel yield can be improved if the planting density is increased on the full vigour rootstock Garnem. In Nonpareil, the cumulative kernel yield from fifth leaf plantings was 45% higher (7.5 t/ha compared to 5.2 t/ha) when the planting density was increased from 308 trees/ha (5m within row spacings) to 615 trees/ha (2.5m within row spacings). This density effect was less pronounced in the other varieties. Vela and Carina presented less than 10% difference in fifth leaf cumulative yields between low and high densities (Figure 1). However, the total yields for these varieties are proving to be significantly higher than those of Nonpareil, which had a particularly poor crop in 2023. To date, Vela yields are particularly impressive.

Crack-out percentage is yet to be affected by planting density but was different for each variety at roughly 23% for Nonpareil, 25% for Shasta, 20% for Carina and more than 30% for Vela (Table 1). Kernel weights were also stable across the range of densities, with only a 0.1 g kernel weight penalty for the highest compared to the lowest planting density.

Whilst early results show promise for increased production efficiencies for some varieties at closer plantings, results also point to questions of resource availability and biennial bearing. The longer-term implications of higher planting density upon kernel size, total marketable yields and the economics of production remain unknown. SARDI, through Hort Innovation project AL21001, will address this uncertainty by continuing to monitor the yield, kernel quality and water use efficiency characteristics of this experiment through to season 2026.

**Horizon 1**
6.5 x 5.0 m (308 trees/ha)

**Horizon 2**
6.5 x 2.5 m (615 trees/ha)

Not all varieties respond favourably to increased planting density

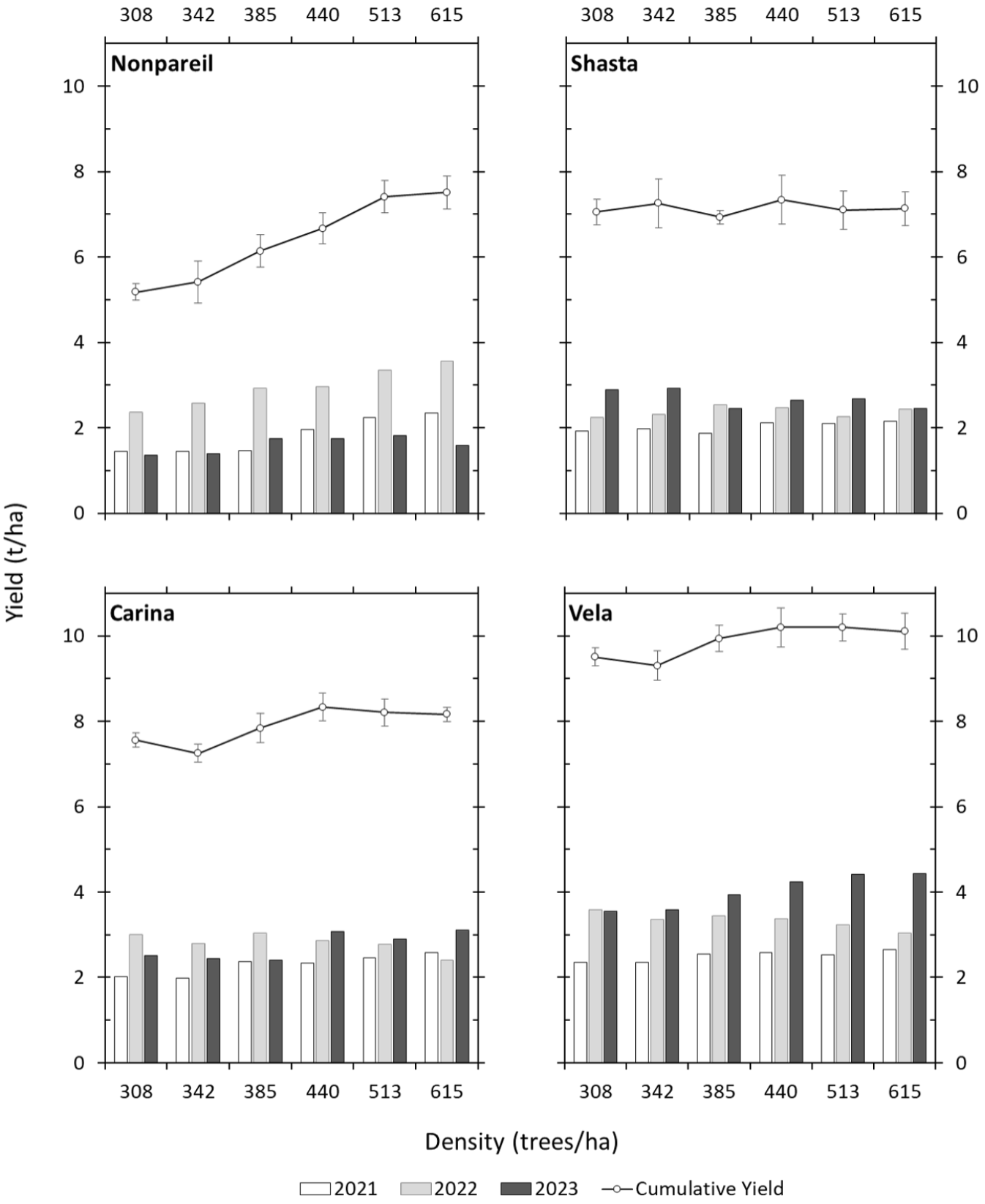


*Figure 1* *Kernel yields (t/ha) in 2021, 2022 and 2023 (3rd to 5th leaf) and the cumulative total yields for four almond cultivars grafted to the Garnem rootstock, planted at a range of densities. Established in 2018 at the ACE Orchard, South Australia. Bars indicate Standard Error of the Mean*.*

**These results were obtained under ACE soil conditions (shallow sandy loam over calcareous base) and may vary at other sites*

*Table 1 Effect of almond cultivar upon average crack-out percent and kernel size (2021–2023)*

| | Crack-out (%) | Kernel size (g) |
|---|---|---|
| **NONPAREIL** | 23.1 [c] | 1.58 [ab] |
| **SHASTA** | 25.9 [b] | 1.46 [b] |
| **CARINA** | 19.8 [d] | 1.24 [c] |
| **VELA** | 34.1 [a] | 1.67 [a] |

Superscript letters indicate significant differences between cultivar means at *P<0.05*

## Ongoing investigations

- Annual yield and kernel quality metrics contributing to cost benefit assessments
- Canopy development and architecture studies using ground and aerial based remote sensing
- Root density and distribution using SARDI DNA prunus root assay
- Integrating the above measures with soil water and plant water use metrics to address questions of water productivity of different densities and scion genotypes.

## Further information

SARDI Loxton – 08 8595 9100
mark.skewes@sa.gov.au

SARDI Waite – 08 8303 9400
dane.thomas@sa.gov.au
tim.pitt@sa.gov.au

*SARDI projects conducted at the ACE experimental orchard have been funded by Hort Innovation using the almond research and development levy with co-investment from the South Australian Government and contributions from the Australian Government. For more information on these funds and strategic levy investments visit* ***horticulture.com.au****.*