

R&D RO

In this edition of the R&D Roundup we'll look at the future trials planned for the Almond Centre of Excellence (ACE) experimental orchard located at Loxton. Quite a lot of work has occurred in the background over the last nine months to bring together a range of scion and rootstock combinations and formulate these into meaningful trials. The South Australian Research and Development Institute (SARDI) and Plant & Food Research Australia (PFR) researchers have provided much input into the design of these trials. The University of Adelaide (UofA) has also had input through the ongoing Australian Almond Breeding project.

Almond Breeding Trial -(UofA)

In addition to the 34 selections that are still undergoing evaluation at Lindsay Point, the first 8 selections have been planted in 2017 at the ACE experimental orchard in stage 5 of the secondary evaluations. The planting of stage 6 will occur in 2018 with another 23 selections to undergo secondary evaluation. In addition to selections from the Australian Almond Breeding program, 15 international varieties from California, Spain and Israel will also be planted. A further nine selections will be planted as full-length rows as part of the commercial evaluation of the most promising selections from stage 3 of secondary evaluations i.e. these selections may crop heavier in early years or their cumulative yields are higher than Nonpareil.

Soil Amelioration Trial - (SARDI)

Trial 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.*

As Australian soils are generally recognised as shallow and poor compared to those of major production regions like California, this trial seeks to find suitable soil-based methods of increasing production. 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

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of soil will allow more effective supply of water to tree roots under severe conditions, such as heat-waves. This will be investigated by soil treatments including pre and post- planting organic amendments, subsoil ripping and combinations of both. The trial will consist of Nonpareil, Carina, Vela and Carmel planted on Garnem at a tree density of 7m x 4.5m.

H1 to H2 Optimised Density

Trial Aim: *To determine the optimum planting density transition from H1 to H2 for popular new varieties on a full vigour rootstock.*

Many 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 six step increase in orchard density from 5m to 2.5m tree spacing with the row spacing at 6.5m.

Critically, the layout allows three new varieties to be evaluated in addition to Nonpareil. These are Vela, Carina and Shasta.

H2 to H3 Optimised Density and Management - SARDI

Trial 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. Effects on production will be measured and quantified.*

This trial will take the next steps from moderate density (Horizon 2/H2) plantings up to super high density (Horizon 3/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 scions (Shasta and Vela) grafted onto two moderately size controlling rootstocks as best bet combinations to balance and manage overall vigour whilst attempting to keep cropping as high and even as possible. Four tree densities will be assessed that move from H2 and H3:

- 6.5m row width (H2): 3.0m (513 trees/ha) & 1.5m (1026 trees/ha)

- 4.5m row width (H3): 2.5m (888 trees/ha) & 1.5m (1481 trees/ha)

Two simple training modifications will be investigated to facilitate tree management, Central leader and Palmette (Central leader with major row protruding limbs removed). The trial 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.

Scion/Rootstock Compatibility - (SARDI)

Trial Aim: *To screen a likely range of new self-fertile scions with desirable tree growth structures on a range of newly available rootstocks of differing vigour.*

This non-replicated trial is a 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 (6.5m x 3m) and H3 (4.5m x 2m). 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 mainstream industry replacements. The rootstocks trialled include: Nemaguard, the Controller series from UC Davis, the Rootpac series from Agromillora, Krymsk 86, Cornerstone, Atlas, Garnem, Felinem and Monegro. The scions trialled include: Nonpareil, Vela, Almond 21, Shasta and Almond 12.

New Scion/Rootstock Compatibility - (SARDI)

Trial Aim: *To screen a wide range of new scion genotypes from the Australian Almond breeding program for high production, novel architecture, graft compatibility, growth habit and production traits for inclusion in future 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 focuses on promising scion genotypes from secondary evaluations in the Australian Almond breeding program. These genotypes may not all be self-fertile but show potential as high yielding or having novel architecture that may make them suitable for high density growing systems. The scions used include: Nonpareil, Carina, Maxima, Vela and 16 breeding selections. To keep the trial a manageable size with many scions, tree numbers are reduced by

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grafting to a smaller number of “more likely” rootstocks and having one density (6.5m x 3m). These rootstocks are Nemaguard, Controller 6, Rootpac 40 and Garnem.

Tree architecture and advanced production systems PFR

The overall objective here is to better understand almond tree architecture and how different cultivars respond when planted at high density. The approach is to work with the natural growth habit (architecture) of specific cultivars and to use minimal “low input” pruning methods to produce trees suitable for high density plantings. Apart from increasing orchard yields (t/ha) and grower profits, additional benefits will include:

- Reduced time for new orchards to produce their first commercial crop
- Tree shape suitable for “shake and catch” harvesting with more uniform crop maturity and improved nut quality
- Smaller trees for more efficient water use and easier pest and disease management.

It is important to note that whilst the terms ‘central leader’ and ‘pruning’ are used in the description of some of the trials, it is not inferring that future almond orchards will be like modern apple orchards with a classic central leader tree that is trellised and requires high annual inputs costs in the form of pruning. Rather the aim is to observe the natural growth habits of new and existing scions, develop management strategies to establish a desirable canopy structure that will suit higher densities and maintain optimum light interception to drive increased productivity. The management strategies need to be cost effective, simple to implement and preferably a ‘one-off’ at the time of orchard establishment instead of an annual requirement.

1. Commercial high density

Trial aim: *To validate management systems for new almond orchards planted at high density.*

This long-term study will evaluate two self-fertile almond varieties (‘Shasta’ and ‘Vela’) budded on Nemaguard rootstock. 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.

Trial design will ensure that micro-climates expected in a fully commercial high density block are replicated in this trial. This is important to ensure that the trial provides a true indication of the effect of planting density on kernel quality and maturation.

2. Pruning responses – new cultivars

Trial aim: *To optimize 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 ‘Nonpareil’, ‘Maxima’, ‘Carina’, ‘Vela’ and ‘Shasta’ trees suitable for high density plantings. All trees budded on Garnem rootstocks with two sets of trees budded in early-December and mid-January and a third set “dormant budded” in late-March. This produced a range of tree sizes (large, medium and small, respectively) for field-planting in winter. All trees planted with 4.5 m row width and 3.0 m spacing (741 trees/ha) and grown as central leader trees with no or minimal pruning according to tree size at planting.

3. Architectural studies

Trial 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 are taken direct from the nursery and grown with minimal pruning. Branching, spur development and flowering to be quantified on trees in their 2nd and 3rd-leaf. Cultivars include ‘Nonpareil’, ‘Carina’, ‘Capella’, ‘Maxima’, ‘Mira’, ‘Rhea’, ‘Vela’ and 8 advanced selections from the University of Adelaide almond breeding blocks. All trees budded on Garnem rootstock in mid-December and planted in winter with 4.5 m row width and 3.0 m spacing (741 trees/ha). By not heading the trees at planting and not pruning or selecting limbs, the true natural growth habit of the cultivars can be observed. These data will help develop future management guidelines for high density orchards.