Almond Production for the Future - the Aussie Way

December 6, 2016

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Almond Board of California

Almond Production for the Future - the Aussie Way

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Transforming Almond Orchards – Tree architecture and advanced production systems

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Plant & Food Research Australia

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AUSTRALIA

Transforming almond orchards

- The Australian almond industry has under gone rapid growth
- Growers have adopted Californian growing systems and varieties
- Yields per hectare are now similar to those obtained in California

Question was:

“What new growing systems can we develop to lift these yields even further?”

Designing new almond orchards

New orchard systems must:

- Involve no or minimal additional cost to the grower
- Reduce the time taken to produce the first commercial crop
- Reduce the time to reach break-even point on the orchard investment
- Increase productive yield per hectare and grower profit, with improved nut quality

Critical knowledge gaps

- **Physiological responses:** what are the constraints of current growing systems that limit productivity (eg carbon partitioning, light distribution)
- **Tree architecture:** working with the natural growth habit of almond varieties to increase production efficiencies
- **New varieties and rootstocks:** what are the best combinations to increase productivity and profit

1. Summary of results 2014-16

2. New growing systems

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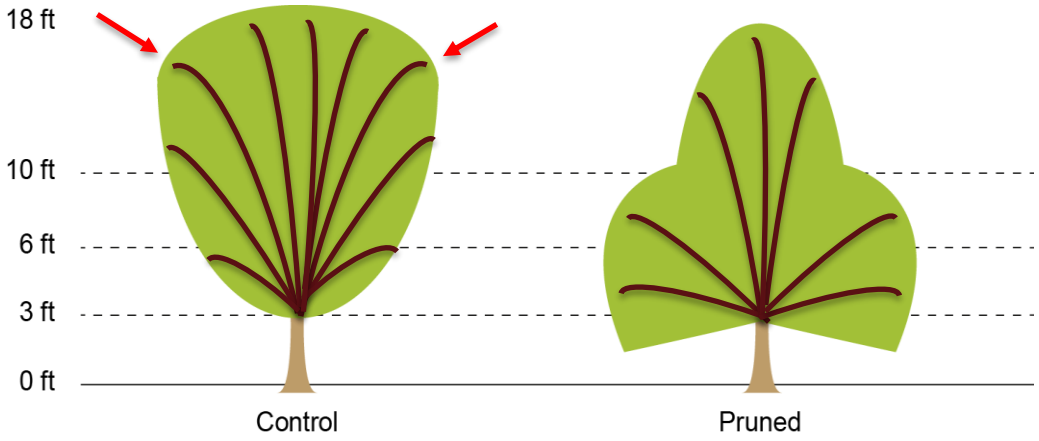
Key results 2014/16

“Selective limb removal” pruning – removing the shoulder branches of cropping trees – created more open, spreading tree canopies compared with unpruned trees, with increased light transmission and nut bearing in the lower canopy zones



Key results 2014/16

“Palmette” style pruning of young almond trees produced trees with a narrow canopy, suitable for blocks with closer row spacing

Nonpareil trees, planted 2012 and pruned in winter 2014

Narrow “palmette” style pruning

Pruned

Planted 2012 and pruned in 2014

No pruning

Images taken 2016

Key results 2014/16

Trunk girdling 'Nonpareil' trees increased return bloom by 30%, but **girdles did not heal** and with subsequent kernel abortion meant no increase in actual yields

Trunk girdles applied to 'Carmel' and 'Monterey' healed within 4 weeks, so girdling offers an opportunity to increase yields of these polleniser varieties

Nonpareil ☒

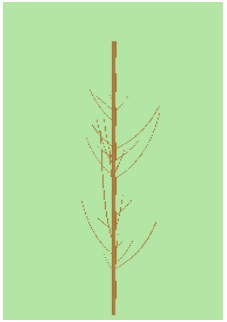
Carmel ☑

Monterey ☑

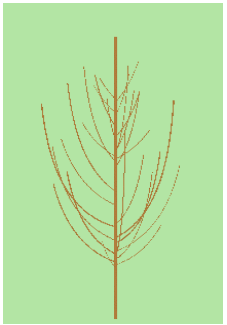
Almond tree architecture

Does the growth of a one-year-old “unpruned” tree in the nursery reflect the form of the mature tree?

‘Nonpareil’

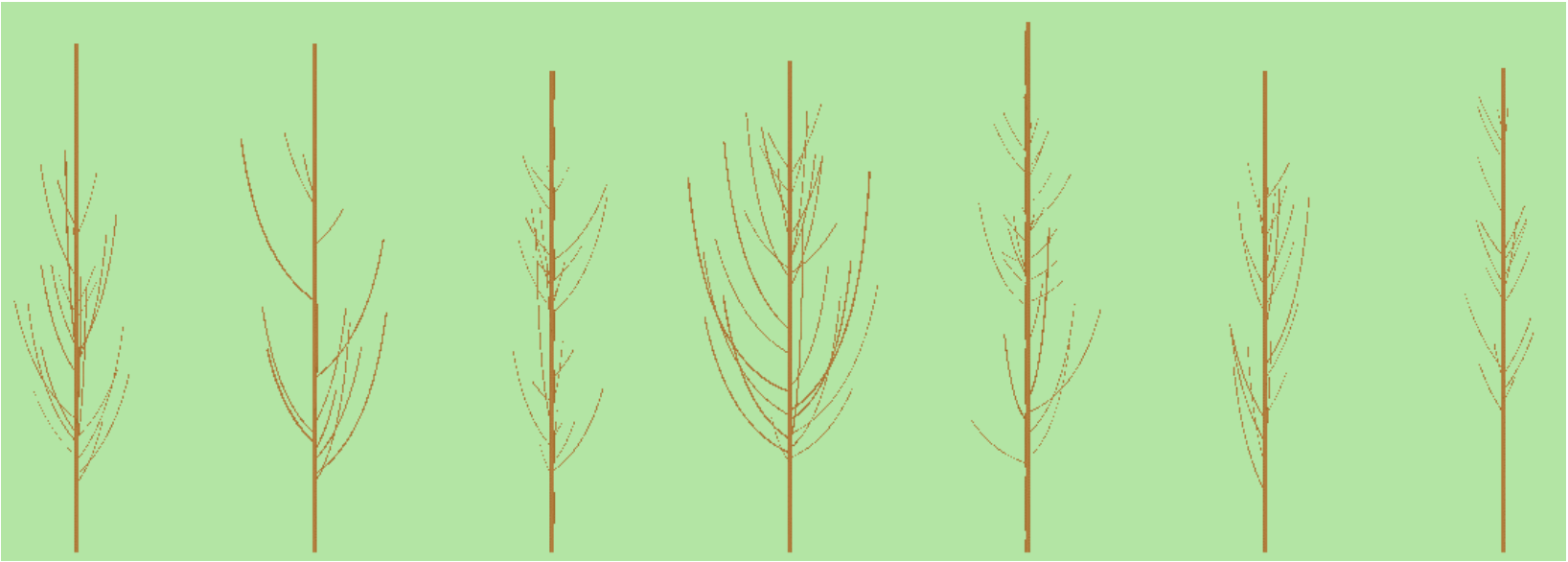


‘Monterey’



Almond tree architecture

Which varieties are better suited to ultra high density growing systems?



Carmel | Wood Colony | Nonpareil | Monterey | Shasta | Fritz | Aldrich

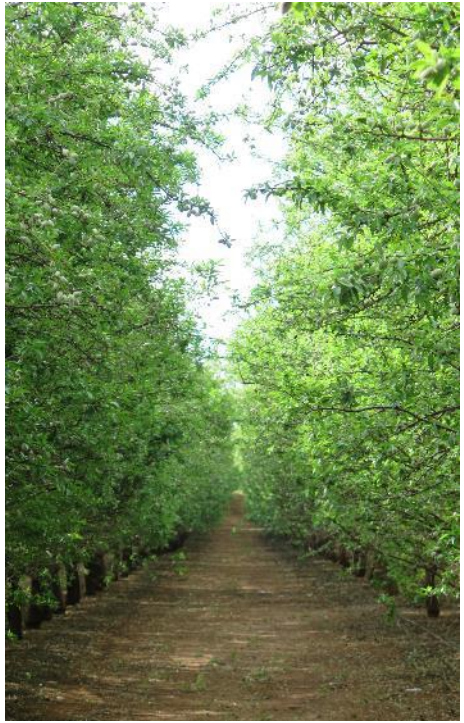
New growing systems

New growing systems #1

New growing systems for traditional orchards with wide row spacing designed for standard harvesting equipment

- Use **“selective limb removal” pruning on ‘Nonpareil’** trees to create more productive, open spreading canopies
- **Prune polleniser trees as a narrow “palmette-style”** to create more space for the ‘Nonpareil’ trees, with **trunk girdles** applied to increase yield of the polleniser trees

(Do not trunk girdle Nonpareil trees)



New growing systems #2

1. **High-density** growing systems with traditional row spacing but with close planting along rows

2. **Ultra-high-density** growing systems with close planting along rows and across rows **(new orchard machinery needed)**

- Grow central leader trees with multiple non-vigorous side shoots (feathers) to produce **a slender pyramid tree shape**
- Alternative with trees that want to spread wide is to apply a **narrow "palmette" style pruning**
- Key will be to select varieties with **architecture** suited to this style of management

Central leader almond trees

Ultra-high-density growing systems:

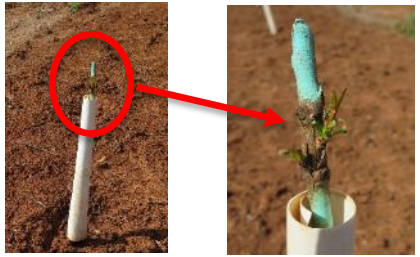
- Grow central leader trees with multiple non-vigorous side shoots (feathers) to produce **a slender pyramid tree shape**

Nectarine

Central leader almond trees

Your nurseryman is your best friend!!

Unpruned trees direct from the nursery



Dormant budded trees

Side branches pruned in nursery, but trunk not headed back

Summary

- There are some new options worth trying
  - Selective limb removal
  - Narrow “palmette” style pruning
  - Trunk girdling (but not with Nonpareil)
  - Central leader trees (slender pyramid shape)
  - High and ultra-high density planting distances
- New systems must:
  - Maintain minimal cost for the grower
  - Produce a commercial crop sooner
  - Increase yield per hectare and **grower profit!!**

Research Team and Collaborators

PFR Australia:	Grant Thorp, Andrew Granger, Belinda Jenkins, Ann Smith, David Traeger
PFR New Zealand:	Stuart Tustin, Jill Stanley, Carlo van den Dijssel, Steve Green, Edouard Périé, Andrew Barnett
DAFQ Australia:	Neil White
California:	John Slaughter, Tom Burchell, Burchell Nursery
Australia:	Ben Brown, John Kennedy, Brett Rosenzweig, Lacton Farms, CMV Farms, Select Harvest, Mossmont Nursery, OLAM, RFM Ltd.

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Queensland Government

Horticulture Innovation Australia

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Thank you

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Professor John Fielke
School of Engineering,
University of South Australia

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Horticulture Innovation Australia

Almond research at UniSA

- Horticulture Innovation Australia project **AL00012: Advanced Processing of Almonds** (2012-2018)
  1. On-farm hulling
  2. Dehydration and conditioning
  3. Shelling

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On-farm hulling – Dried almonds

- Background
  - Retain hulls in orchard (source of nutrients).
  - Cost savings from reduced storage and transport volumes (halved).

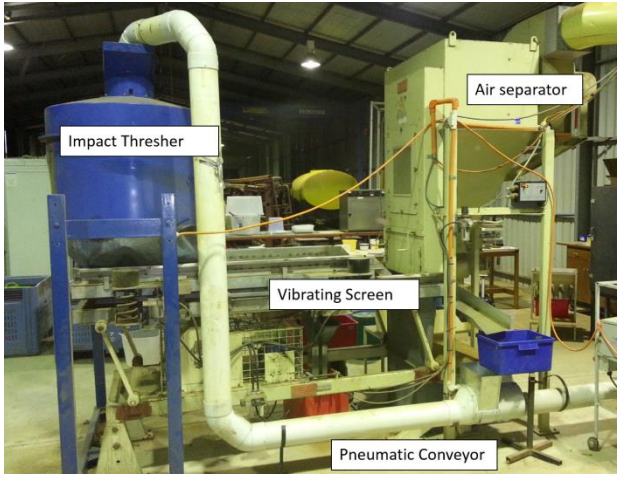
Volume stored can be halved

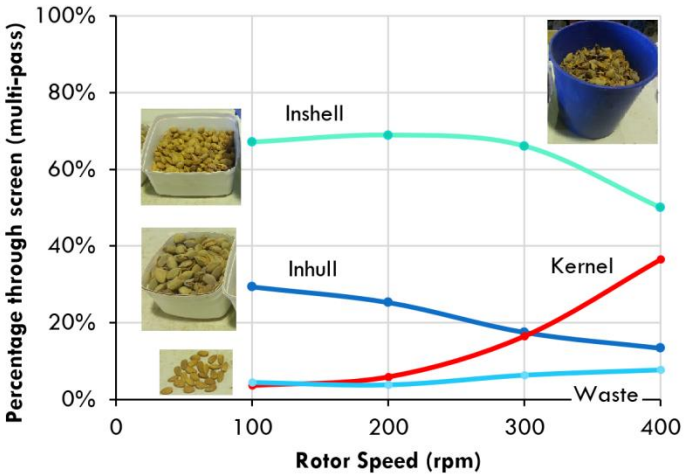
http://superioralmond.com/news/stockpiling/

On-farm hulling – Dried almonds

- Achievements to date
  - Can remove 70% of nonpareil hulls with minimal release of kernel.
  - Need multiple low energy impacts to gain efficient hull removal.
  - Flowrates of 3 t/h.

- Next stages underway
  - Integrate huller into pick up (6 t/hour).
  - Development of hull shredder.
  - Development of high capacity huller for use after pick up (80 t/hour).





On-farm hulling – High moisture almonds

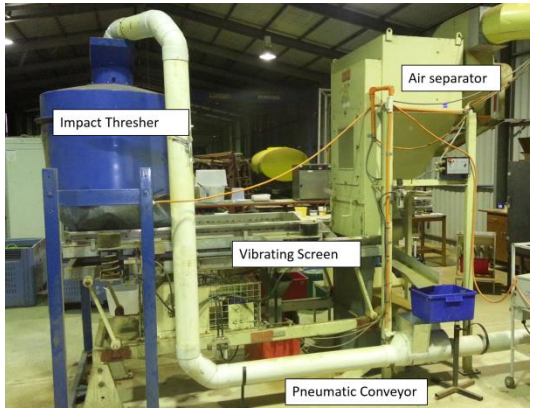
- Background
  - Desire to bring in almonds early (less insect damage and molds).
  - First process after shake and catch (don't drop on ground).
  - Rainfall events do occur.
  - Removing moist hulls reduces drying volumes and moisture to be removed.
  - Leaving hulls in field adds nutrients back to the soil.

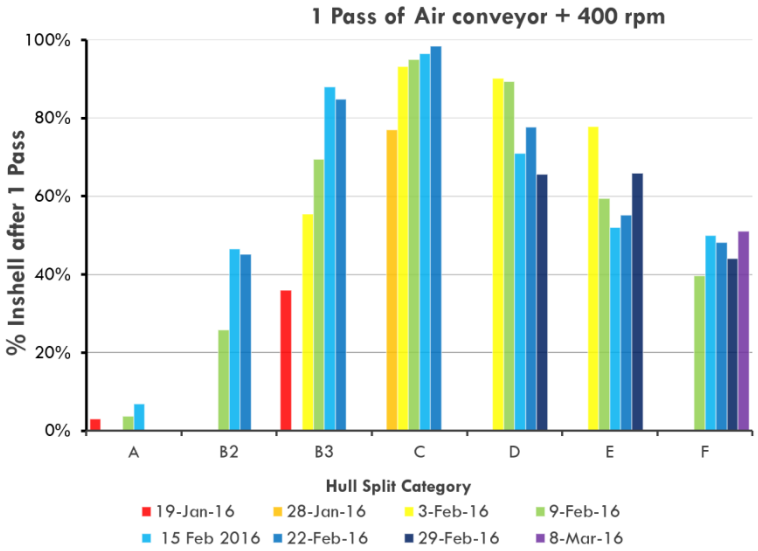
http://www.colorsorter-cn.com/sale-8081966-almond-color-sorting-machine.html

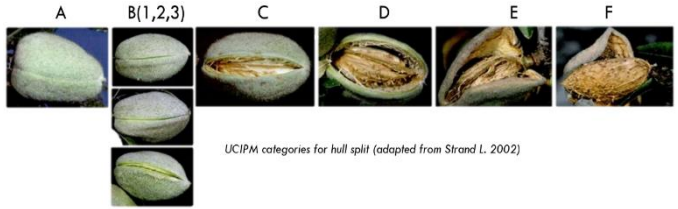
http://thealmonddoctor.com/2016/08/08/catch_frame_harvesting_of_almonds/

On-farm hulling – High moisture almonds

- Achievements to date
  - Easiest to detach hulls as soon as split is fully developed.
  - Impact hulling is preferred method when moist, as shell is flexible.
- Next stages
  - Develop separator to remove detached moist hulls.
  - Integrate with shake and catch system.







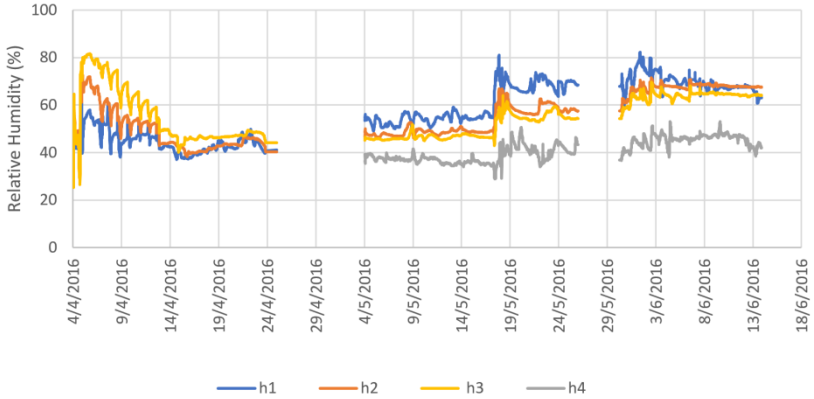
UCIPM categories for hull split (adapted from Strand L. 2002)

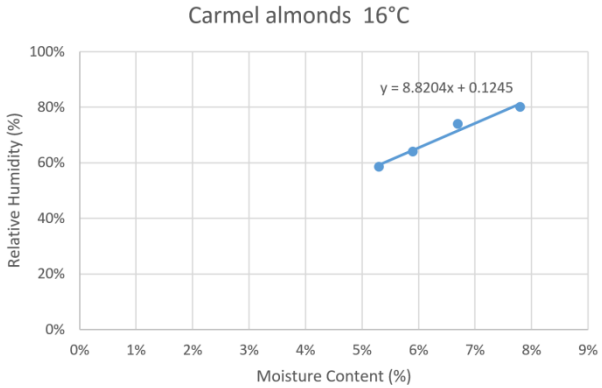
Moisture Management

- Background
  - Dehydration when > 6% kernel mc.
  - Enabler for shake and catch (don’t drop fruit on ground).
  - Conditioning can rehydrate over-dried kernels to 6% mc (improves processability).
  - Reduces spoilage and maximizes income.

Moisture Management

- Achievements to date
  - Can dry almonds after hull split.
  - Can dry wet almonds using ambient dry daytime air.
  - Can rehydrate over-dried almonds using moist night-time air.
  - Real-time control of almond conditioning.
  - Don't dry continuously to avoid hollow centers (splits).
  - Don't heat above 40C to avoid brown centers.
- Next stages
  - Checking on limits to early harvest whilst retaining nutritional value.
  - Commercialization of conditioning controller and sensors (via Ag-IQ Pty Ltd).
  - Evaluation of various styles of conditioning facilities.





Shelling of Almonds

- Background
  - Too many scratches, chips and broken kernel.
  - Shelling factories are large and dusty.
  - Throughput of factories are limited by screen decks and cleaning system.
- Achievements to date
  - Wetting up in-shell almonds before shelling reduces processing damage.
    - Shell is flexible, hence shear rolls don't work but impact does.
    - Skin is tougher and resists damage.
    - > 90% flawless kernels for soft shelled almonds.
    - > 70% flawless kernels for hard shelled almonds.
    - Easy to dry back kernel after wetting up.
- Next stages
  - Develop a commercial sized wetting up process.
  - Increase capacity to at least 50 t/hour.
  - Integrate sealed cleaning with the sheller.
  - Finalize patent.

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Thank you for the invitation

This project (AL12003) has been funded by HIA using the Almond levy, voluntary contributions from industry and matched funds from the Australian Government.

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Neale Bennett,
Almond Board of Australia

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Australian Almond Industry

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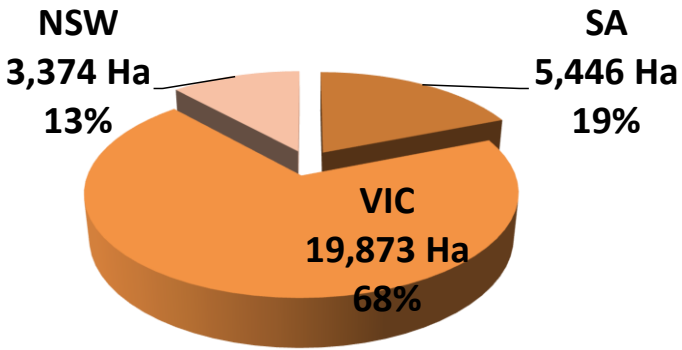
Commercial production is in the Murray Darling Basin.



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- Our “Millennium Drought” lasted between 2001-09.
- Dams, our only source of water storage, dried up and levels fell to record lows.
- Government water restrictions were put in place for irrigators. Some receiving a third of allocation.
- Unlike California, there are no fresh water aquifers to pump water from.
- Water and land have been separated to allow a water market to be established.
- During the drought this was heavily used by growers.

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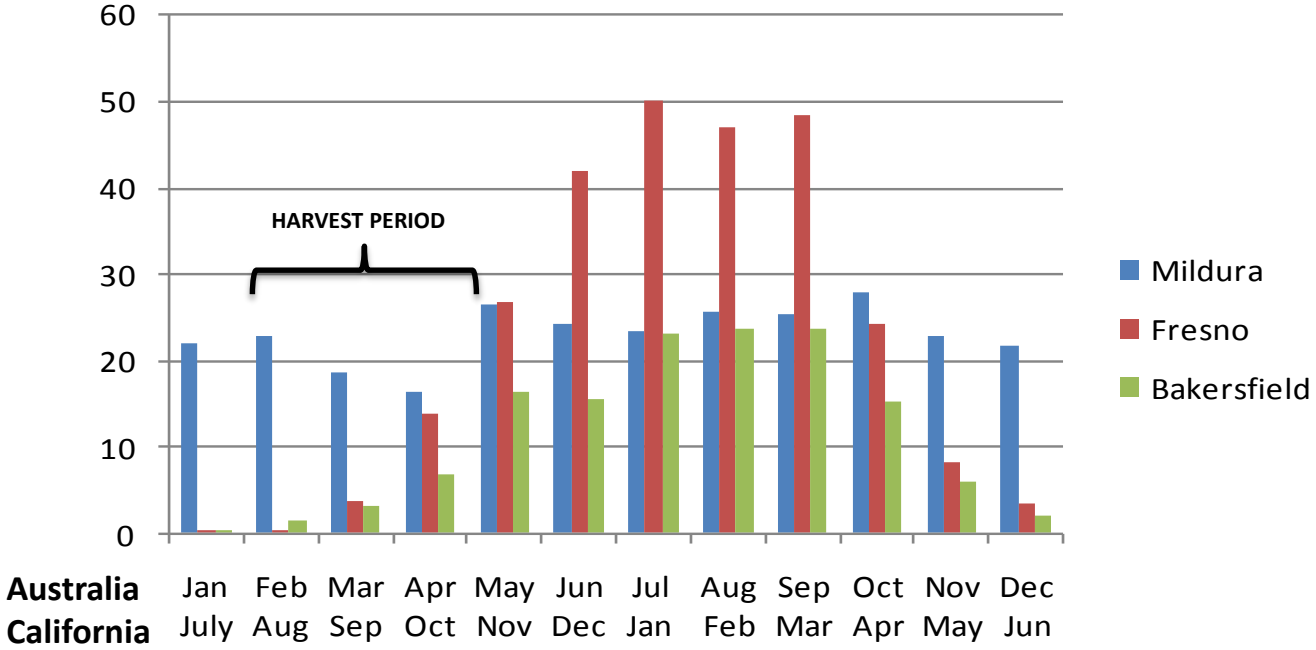
Rain is a Major Risk in Australia

Average Monthly Rainfall (mm)



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2010 Monthly rainfall totals
The Drought Finally Breaks!!!


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2010 Monthly rainfall totals
The Drought Finally Breaks!!!

Month	Rainfall
July	25mm – 1 inch
August (Bloom)	28mm – 1.12 inches
September	55mm – 2.2 inches
October	89mm – 3.56 inches
November	104mm – 4.16 inches
December	141mm – 5.64 inches
January	129mm – 5.16 inches
February	192mm – 7.68 inches
March	122mm – 4.88 inches
April	12.6mm – half an inch

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Problems Caused Going Into Harvest

- Disease problems – Rust, shothole, bacterial spot, anthracnose, gumming around nuts.
- Inability to get onto the orchard to spray led to inadequate coverage and poor timing.
- High humidity levels led to disease heaven.
- Spray material shortage.

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Problems Caused During Harvest

- Flooding led to tree death through drownings.
- Nuts once on the ground were washed away.
- Kernels were stained.
- Shaking was inadequate to get full nut removal.
- Orchard floor washouts.
- Excessive leaf trash, slowed down drying process.
- Machinery was often bogged.
- Poor drying conditions with high humidity.

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The 2011 Harvest Led to a Rethink

The idea of developing an advanced production system to address the Australian risks, maximise yields and achieve input efficiency was developed.

Advanced Production System

The goal is to have a production system that:

- Is high yielding. New varieties are key as is maximising light interception.
- Dwarfing rootstocks and varieties that repeat bear from the same spurs are seen as keys to smaller tree architecture.
- Smaller trees allow better spray coverage to manage pests and diseases, easier nut removal during harvesting with lighter machinery for less soil compaction, tree damage and equipment maintenance.
- Harvesting machinery will be designed once the tree architecture is developed to maximise crop physiology not vice versa.

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Advanced Production System

To reduce the number of passes needed to remove the crop from the orchard shake and catch technology is seen as an important element of an advanced production system.

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Advanced Production System

- Early hull removal on farm may reduce the energy required in drying the kernel only and improve moisture uniformity in product delivered to handlers.
- Returning hulls to the orchard floor should improve our poor soils, particularly helping moisture retention in the rootzone.
- Helps reduce need for fertilizer application.

Advanced Production System

Storage of the nuts in a controlled environment should lead to better quality as moisture and pests can be better managed.

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Advanced Production System

Need to take a holistic approach.

No point addressing one risk or efficiency gain if it leads to problems in other areas.

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Five new almond varieties now PBR'd

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Best of the Best

Carina (Almond 1)
Origin: seedling derived from the cross "Nonpareil" x "Lauranne" made in 1998 at Waite Campus

A self fertile variety

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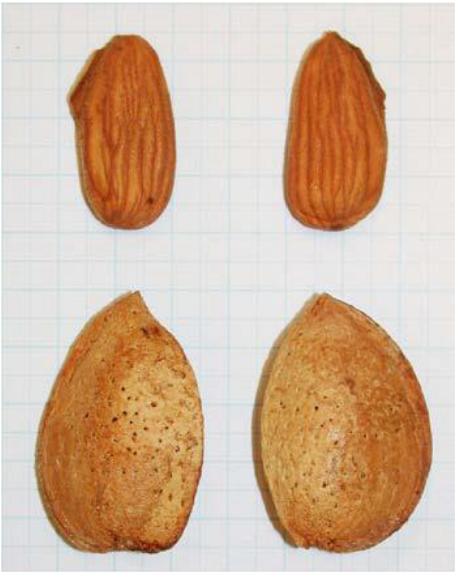
Best of the Best

Maxima (Almond 3)
Origin: seedling derived from the cross “Nonpareil” x “Lauranne” made in 1997 at Waite Campus



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Almond Centre of Excellence

ABA is to manage an Experimental Orchard at Loxton, South Australia.

- 150 acre site.
- Initially to progress advanced production system research and new variety evaluation.

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Thank You

Questions?

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Closing Thoughts

- **Be sure to attend the State of the Industry** session at 4:00 in room 310-311. Following the State of the Industry, the exhibit hall will open. Make sure to check out the 280+ exhibitors and attend the Opening Reception, sponsored by BASF.

- **Pick up the 2016 Research Update Booklet** at the ABC booth. It gives a one-page summary of every current ABC-funded research project, on each page, there is a box directing you to more information, and on the inside back cover there is a CD of last year's projects annual reports.

- **Please plan on attending the general session**, *Industry Roundup – Everyone has a Role in Creating the Almond Industry of the Future tomorrow* morning at 8:30 a.m.

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