

Facilitating the Development of the Australian Almond Industry

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Almond Board of Australia

Project Number: AL05001

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Milestone#3 (Final) Report

Project AL05001:

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June 2006

**Chris Bennett
Industry Development Manager**

Summary of Progress

1. Technology Transfer

Technology transfer activities are a major part of the responsibilities of this project. These responsibilities extend to coordinating the TT for all other projects as applicable. Activities undertaken during the life of the project (July 2005 to June 2006) were:

1. "Biennial Bearing in almonds – a question of imbalance" written for Australian Nutgrower - September 2005
2. Short Updates of various projects for all four editions of Nutgrower (September, December, March and June)
3. A joint presentation with Prof Assaf and John Kennedy (T.O.) at the Almond Conference in November 2005. This provided an update and conclusions on the Almond Management Optimisation Trial.
4. A field day, as part of the conference. Visited a demonstration/evaluation plot of new commercial varieties and two grower properties utilizing the management techniques being developed at the trial. The grower property visits were particularly successful as they demonstrated the ability of the new techniques to be very successfully used in a commercial environment.
5. Advising Timbercorp on the development, planning and management of their 50ha trial area to develop and assess new growing techniques based on the Management Trial. This trial is especially important as it is working with trees from establishment, in a commercial environment and in a large area (50ha).
6. Two field days/meetings with Angle Vale growers to observe the local irrigation management demonstration site. These also included presentations from Prue McMichael who is CI of the Leaf Tatter Project AL05003.
7. Meetings in each of the three regions in June '06 to update levypayers with the R&D program, its planning and progress. This was a component of an ABA "roadshow" which was undertaken to ensure levy payers were involved in the strategic planning process.
8. The development of an Almond Orchard Management Course. Two modules were fully developed and delivered to growers and farm managers. These were "An Introduction to the Almond Management Course" (two hours) and "Irrigation Design Theory" (three hours). The modules were delivered in five regional areas, Angle Vale, Renmark, Berri, Mildura and Griffith. In total, approximately 90 attended (numbers were limited to 20 for each of these sessions to ensure good discussion and group dynamics) and the evaluation sheets indicated the attendees found the modules valuable (details under section 7 below).

2. Omega Demonstration Plot

This trial has been discontinued. After initial success, severe limitations regarding soil type (not identified in the original soil survey, but later identified as a soil type that should have been excluded from the orchard.) made the demonstration of new growing techniques impossible. The trees did initially grow well, by normal standards, attaining the size of normal two year old trees (the control) in the first

season. However drainage problems began to arise, severely impacting on the demonstration.

It is aimed to recommence the trial at another site, which has good soil, is more accessible and has good infrastructure. The property chosen also employs the part-time Technical Officer involved with project AL05002. This will ensure greater control over the trial site and efficient monitoring of treatment implementation. The opportunity will also be taken to include the new rootstock GF677 for comparison against Nemaguard.. The required nursery trees have been budded and the site selected.

3. Demonstration Trial Plot (new cultivars)

There are two small demonstration plots on grower properties to demonstrate and evaluate new varieties. These varieties are all newer commercial varieties grown in California which are considered potentially valuable to the Australian industry to provide improved pollinator cultivars. The sites have progressed very well, with fruit evaluation having commenced in 2005.

The oldest and most comprehensive site was visited during the field days associated with the annual conference in November 2006. Evaluation notes for these cultivars are given under item 8 below.

To date, one cultivar, Monterey, has raised sufficient grower interest that it is now beginning to be planted in small numbers commercially. There are indications that other cultivars are likely to be planted next season. These include Butte and Padre.

4. Chemical Registration

The required MRL trial work was successfully undertaken by Agrisearch, with the final report then being presented to APVMA to secure registration for the permit chemicals under investigation. APVMA are currently evaluating the data and it is expected that they will make their decision known shortly.

The industry will need to reevaluate its pest and disease control strategies regularly in the future. There is a need for a more integrated approach; the identifying of “softer” chemical options and the need to align our pest and disease control measures to the requirements of our markets. This factor will become increasingly important as the industry moves towards a much greater emphasis (and reliance) on export markets in the future.

5. Rootstock Trial Data Analysis

The rootstock trial has now been down-graded. The trial was found to be severely compromised after DNA mapping revealed that one of the nursery suppliers had substituted at least one of the key required rootstocks (GF677) with an unknown rootstock. Other rootstocks, primarily those subject to patent, are no longer easily available to the industry, so are pointless in investigating further. The situation by rootstock is:

Rootstock	Comments
GF677	Not true to type. Substituted with unidentified rootstock
Cadaman	Trees grew well. Patented rootstock with limited availability

Citation	Tree performance erratic and not commercially acceptable
Bright's Hybrid	Performed reasonably well. Possible excessive vigour and late cropping. No longer available commercially. Trial control (with Nemaguard)
Nemaguard	Industry standard and trial control
Hansen 535	Vigorous, now out of favour in California. Limited availability.
Hansen 2168	Vigorous, now out of favour in California. Unavailable.
Atlas	Average performance. Patented and very limited availability
Viking	Average performance. Patented and very limited availability
H184	Very vigorous. Similar cropping to Bright's hybrid. Unavailable without specific development of tissue culture source.

However, the trial site continues to serve the purpose of demonstrating to growers the various characteristics and is a useful teaching resource. It will also provide a useful comparison between performance on typical mallee sands and shallower, more calcareous soils. The trial site was specifically selected to allow this comparison, an important indicator for the future as soil type is potentially limiting, especially with Nemaguard.

The industry is now rapidly moving to the commercial production and use of GF677 based on overseas data with almonds and other *prunus* crops and the experience in Australia with stonefruit.

The IDM has actively encouraged and assisted in the commercialization of this important rootstock. Three commercial sources are now being developed, two via cuttings and the third *in vitro*.

6. R&D Program Coordination

This is an ongoing process with a number of important components:

- Breeding Program:** Both the IDM and Andrew Lacey (member of IAC and contributor of land and management for evaluation site) are members of the almond breeding coordination group and also attend the almond "general" group meetings. The coordination group deals with management issues such as coordinating the field work (evaluation, site development and management etc) and the "general" group is a reporting and discussion forum where all collaborators including students contribute. There were four meetings of each group during the year.

These meetings are very successful in ensuring all collaborators work effectively together and the breeding program outcomes are those desired by industry. The collaboration extends beyond the basic HAL breeding project into a range of ARC funded projects, including molecular biology, which greatly enhances the HAL project.
- Angle Vale Leaf Tatter:** This new syndrome is being investigated by Dr Prue McMichael of Scholefield Robinson Horticultural Services. The IDM provides regular assistance with

field days (2 during the year) and acting in an advisory capacity to the project.

- **New Projects**

The IDM has been instrumental in negotiating and assisting in the development of four new projects to commence in July 2006. These projects are:

- To investigate and prove a simple method of bee impollination to improve pollination efficiency. (WA Dept of Agriculture)
- To refine and prove a Prune Rust predictive model to be incorporated into a simple and commercially available weather station. (SARDI)
- An update of the almond industry financial analysis, last undertaken in 1999. Outcomes will include a CD based financial template to allow growers, developers and investors to undertake their own comparative modeling. (Primary Industries SA).
- Ensuring Market Access through QA. This project is a holistic project aimed at bringing together a number of important QA components, disciplines and experts to provide industry guidelines, HACCP templates, Standard Operating Procedures Manuals and training to ensure consistent and high level performance through the value chain. To be covered will be food safety, chemical registrations and residues, spray guide, nursery phytosanitary practices and product physical quality. (Dr Prue McMichael, Pat Barclay, Kevin Bodnaruk, Elizabeth Frankish and Graham McAlpine).

7. Development of Almond Management Short Course

The development of this course commenced in April 2006 and two modules were delivered (see details in 1 above). A grower survey (101 respondents) assisted in focusing the course topics and proved an extraordinary interest in the strategy. The modules themselves proved very popular and their effectiveness was assessed through anonymous questionnaires given to each participant of each module.

The consolidated tabulated results of the survey are:

	Poor		Average		Excellent	
Rank	1	2	3	4	5	
Was the content adequate?		1%	3%	48.5%	49.5%	
Was the content relevant?			1%	43.5%	55.5%	
Was the presentation interesting?			5%	42.5%	52.5%	
Was the level of detail adequate?		3%	5%	42.5%	49.5%	

Typical comments from the surveys included:

Suggested Improvements:

- Need for more detailed information.
- Increase size of graphs on handouts
- Allow more time for questions

General Comments:

- Very well run
- Interaction between growers was great
- Look forward to doing all the modules, very informative.
- Well researched and documented, informative and thought provoking.
- “A better overview of the practical side of the physics of water and soil than a whole subject on irrigation at uni!”

In general, all the comments indicated quite strongly the value of the courses and the high level of interest in attending them and the general hunger for knowledge through the industry.

However, the delivery of further modules has been delayed pending negotiations with Prof Assaf. The issue of adequate technology transfer surrounding the Optimisation Trial is contentious and is proving difficult to resolve. The growers are hungry for information and this is an issue which will require delicate negotiations with the Professor to settle.

It is becoming increasingly clear that the technologies being developed and proven through the trial are revolutionary and as a result will require a considerable effort to ensure grower understanding and hence effective uptake.

8. Propagate new varieties-evaluation

New varieties planted out on commercial orchard sites are listed below with evaluation comments:

Variety	Crop Potential (Calif. data)	Flowering (Calif)	Harvest (Calif)	Shell	Kernel size colour	Disease Susceptibility		Comments
						Bact spot	A'nose	
Padre	Good 93% Nonpareil	+5 days Nonpareil	+26 days Nonpareil	Hard	Medium-small	?	S	V. upright growth, not fruitful. Butte/Padre combination is the top producer in US.
Livingston	Very Good 109% Nonpareil	+5 days Nonpareil	+8 days Nonpareil	Paper	Medium light brown	?	S	Reasonably attractive kernels.
Butte	Very Good 118% Nonpareil	+5 days Nonpareil	+18 days Nonpareil	Semi-hard	Small-medium	?	S+	Most productive almond variety in California. V fruitful habit in Aust
Sonora	Good 94% Nonpareil	-3 days Nonpareil	+7 days Nonpareil	Paper <i>Poor seal</i>	Medium-large, golden, elongate	?	S	Frost sensitive and tendency to alternate bearing. <i>Appears badly infected with unidentified virus.</i>
Monterey	Very Good 106%	+2 days Nonpareil	+26 days Nonpareil	Soft	Large	?	S+	Large, elongate dark kernels. Up to 20% doubles. Habit does

	Nonpareil	(-2 in Aust?)	(Less in Aust?)					not appear fruitful at 3 rd leaf. Flowering time possibly earlier than California.
Avalon *	Appears Very Good	-3 days Nonpareil	+8 days Nonpareil	Semi soft	Medium	?	S	Relatively new variety, little acreage to date. Long flowering, overlaps Carmel
Savanna*	Reputedly Good	+14 days Nonpareil	+14 days Nonpareil		Medium-large	?	S	Being brought into Australia by commercial nursery
Morley*	Reputedly Good	+14 days Nonpareil	+14 days Nonpareil	Semi-hard	Medium-small	?	S	Being brought into Australia by commercial nursery
Sauret #1	Good 93% Nonpareil	+4 days Nonpareil	+5 days Nonpareil	Well sealed paper	Medium	?	S	Under evaluation in Australia (5 th leaf). Appears to crop well. Flowering times appear to be getting later as trees mature.
Wood Colony *	Reputedly good.	+2 days Nonpareil	+7 days Nonpareil	Semi-soft	Medium, darkish.	?	S	Californian Trials indicate shy bearing at 35% Nonpareil. Not fruitful in Aust at 3 rd leaf. Tasteless kernel.

9. Angle Vale irrigation systems demonstration trial

This demonstration plot has proven very important as a resource to demonstrate improved irrigation and nutrition management. The growth of the trees has progressed well, although the overall outcomes have been severely limited by the ongoing “leaf tatter” problem, which is the subject of project AL05003. This unknown disorder has arisen every year of the trial so far, typically reducing effective tree canopy by at least 50% each year from mid-November.

One of the key outcomes to date is the demonstration of the relative abilities/susceptibilities of the three sprinkler systems and the drip system to manage the build-up of soil salinity with the use of relatively saline bore water. The drip system is proving to be significantly better, reducing the salinity from commercially limiting levels to below the economic threshold of 1.5 ECe in a single season.

Soil Mineral Analysis by Treatment

Site	Depth	ECe	pH	NO ₃ -N	Avail P	Avail K	N	Ammonium
System type.	cm	mS/cm	1:5 CaCl ₂	mg/kg	mg/kg	mg/kg	%	mg/kg
Drippers	0-30	1.120	6.6	9.9	37	270	0.06	3.0
	30-60	0.995	6.7	10	19	330	0.07	2.0
	60-90	1.201	7.1	11	8.6	330	0.07	3.0
Supernet No 1 sprinklers	0-30	2.55	6.5	59	31	230	0.08	65
	30-60	2.51	7.0	57	8.9	270	0.09	31
	60-90	2.37	7.3	73	17	270	0.07	33
Supernet No 2 sprinklers	0-30	1.186	7.3	12	42	240	0.05	2.0
	30-60	3.33	6.9	202	8.1	240	0.09	93
	60-90	3.35	7.2	202	6.8	270	0.09	88
Vibrospray sprinklers	0-30	1.929	7.2	41	21	260	0.06	19
	30-60	3.86	7.2	110	6.7	320	0.09	57
	60-90	3.09	7.3	146	5.3	380	0.10	48

This relationship will be studied further over the next two years and the site will continue to be used as a teaching resource for the local region.

Over the next season data will be collected to form the basis of a major field day at the trial at the end of the season in 2007. This data will include soil mineral analysis (to show longer term trends), yield, tree trunk growth and shelling percentage. In addition, pits will be dug at each of the five treatments (inc control) and the root systems will be compared. It is intended to compare the root system development against the differing moisture and ECe profiles generated by the differing treatments. This should provide the growers with an excellent understanding of the soil moisture dynamics and hopefully we will also observe some significant differences in root system quality and density and the impact of soil salinity levels.

10. Chemical Registration Consultancy

Kevin Bodnaruk was retained to provide professional assistance on a number of matters. These include preparing a submission for the ABA to the Japanese Government regarding the issues surrounding almonds on their Positive List (submitted August 2005), reviewing and providing advice on the provisional Japanese MRL's (July 2005) and undertaking a gap analysis and recommendations on the almond industry's current ability to ensure MRL compliance on the export market (March '06).

Peter Dal Santo has been engaged to manage the almond chemical permit process. The time taken by the APVMA to review residue trial data and progress our permits to full registration has meant that a number of permits have lapsed and/or are in danger of lapsing. The current situation is:

Chemical	Permit Number	Expiry Date	Status
Apollo miticide	PER6904	31 March 2007	Current
Pymetrozine (insecticide)	PER5657	31 March 2006	Extended as PER9244 until March '08
Pyridaben (miticide)	PER5651	31 March '06	No longer manufactured
Propicanizole (fungicide)	PER5652	31 March '06	Seeking extension
Pirimicarbinsecticide)	PER5653	31 March '06	Seeking extension
Captan (fungicide)	PER5654	31 March '06	Seeking extension
Azoxystrobin (fungicide)	PER5655	31 March '06	Seeking extension
Phos Acid	PER7176	13 October '09	Current
Treflan (weedicide)	PER5214	31 March '07	Current
Simazine	PER8061	31 December '08	Current

11. Rust Predictive Model

Progress in developing a project for the model had initially been slower than anticipated. Initial advice from a SARDI pathologist regarding probable budget and

required methodology and work required has proven incorrect and misleading. Further investigation has revealed that a similar system was developed and operational in the Young and MIA areas of NSW for prunes. While now discontinued, the epidemiological work has been done, potentially saving the almond industry considerable time and cost. However, subsequent negotiations achieved an agreed project brief which was subsequently successfully presented to HAL.

12. Food Safety Protocols

These have been very successfully developed by Dr Elizabeth Frankish of Microserve Laboratories in Perth, in consultation with industry. The latest draft was presented for comment in June 2006 at a meeting of the stakeholder reference group. There were a number of changes required to make the document easier to reference for each group in the value chain. Once this is completed the document will be released.

The protocols will form the basis of the industry's guidelines for food safety and will be developed as new issues arise and require addressing. These will include the issue of potential future pasteurization and chemical residue testing and limits. HACCP tables will be developed as templates for the individual businesses and training provided. This will be progressed as a new project in 2006/07 titled "Ensuring Market Access Through Quality Assurance".

13. Spray Program

The spray program was developed and written by Prue McMichael of Scholefield Robinson. Prue has extensive experience in almond pests and diseases, having undertaken a number of pathological projects within the industry. The program incorporated guidelines for the use of the newly permitted and registered chemicals as well as the older materials. The spray guides were printed and distributed to growers for use from the start of the 06/07 season and included sections on disease identification and almond flowering times and phenology.

It is intended to regularly update the spray guide to reflect the changing situation regarding chemical use permits and registrations. In time it is also intended to develop a more sophisticated IPM approach, once the short-term issue of an extreme shortage of registered chemicals for almonds is addressed.

14. Budwood Program

The IDM manages the industry budwood repository. This year the irrigation system was replaced with an automated pulse drip system and 260 new mother trees planted. These new plantings are required to increase production in an attempt to meet future industry requirements. The Nonpareil clones selected are improved clones identified in a clonal trial completed in 1998.

This year, approximately 1,900,000 buds were supplied which equates to approximately 7,500 ha of new plantings. The previous record (last year) was approximately 1,400,000 buds.

A further area has been prepared for planting out GF677 rootstocks in spring to be grafted in March 2007. This planting will assist in

15. Future Directions

The IDM's time is increasingly being targeted towards project and TT management. This has been made possible through the employment of the second part time Technical Officer (0.6 FTE). Both TOs are being trained to allow a greater level of day to day management responsibility to be undertaken by them. They are also becoming more involved in the technology transfer activities as their general level of skills and knowledge increases.

For the 2006/07 year and beyond, it is vital that the level of technology transfer is substantially increased. There is a great danger that we will not provide the growers with the knowledge to understand the new technologies being developed. Without this understanding they will be unable to make good management decisions and ultimately the new technologies will be poorly implemented, *and may in fact lead to negative results in the long term on farm*. Resolving this issue with Prof Assaf is crucial as we must be free to provide the high level of technology transfer required to support the trial work and allow for effective on-farm implementation.

It is also recommended that for the 2006/07 year this project is modified in structure. Over time, as the nature of the work has changed to reflect industry and HAL needs and priorities, the project inputs outcomes have become less transparent. There is a need to incorporate into the other projects where the IDM is involved a definition of the IDM's input, responsibilities and associated budget lines. This would lead to greater clarity for these projects and a better understanding overall of the true cost/benefit for all projects.

Chris Bennett
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