Horticulture Innovation Australia

Final Report

Coordination of data management and avocado quality improvement and extension program

John Tyas
Avocados Australia

Project Number: AV12012

AV12012

Contents

Summary

Avocados Australia (AAL) commenced a HAL Project 'AV12012: Coordination of data management and avocado quality improvement and extension program' in March 2013. The Program had two key objectives:

1. To expand on the results of an ongoing HAL project '*AV09001: National avocado quality & information management system*', and

2. Ongoing data management, specifically related to Infocado and OrchardInfo.

The Program aligned with objectives of the '*Avocado Industry Strategic Investment Plan 2011-2015*' and aimed to contribute to the overall outcome to increase percentage of fruit sold at retail level meeting consumer requirements from 75% to 90%.

Key components of the Program included:

- The ongoing coordination of a suite of supply chain improvement projects that collectively form the support systems for the quality improvement and extension program.

- The establishment and implementation of a quality improvement and extension sub-program (Qualicado), which aimed to improve fruit quality.

- Management and improvement of Infocado and OrchardInfo.

The Program co-ordinated and / or contributed resources to a number of other related supply chain and quality projects to ensure synergies between the various projects are captured and extended through coherent, impactful and continuous learning mechanisms, including the Qualicado sub-program and the Best Practice Resource. (BPR).

In total, 16 Qualicado grower workshops were held across 8 major production regions and 10 wholesaler workshops were held in five capital cities over the life of the project. Content for these workshops was tailored to meet the needs of participants. In total 732 people attended the workshops in the first phase of the Program and 488 people attended workshops in the second phase of the Program. Evaluations from these workshops showed they were well attended and well received by the attendees (growers and wholesalers/ripeners). There was also a strong indication that they would likely use knowledge gained at these events to improve their practices.

At these workshops growers were also asked to complete self-assessment scorecards. These scorecards allow growers to assess their businesses operations against best practice recommendations. They also provided an assessment mechanism to determine where production businesses may need extra support to achieve better fruit quality outcomes. In total there were 315 completed and submitted scorecards.

Forty two (42) facility checks (and related report cards and action plans), covering 29 packhouses and 13 ripener/wholesaler facilities, were also completed as part of the Program. These facility checks provided these businesses with an independent one-on-one expert review of their infrastructure and quality management practices, with recommendations where improvements could be made.

Through the Program, the Infocado and OrchardInfo systems were maintained. Weekly and Quarterly Reports were delivered as required over the life of the project. Considerable effort was made to increase the contribution of data to OrchardInfo, so that annual reports could be generated.

A review of crop forecasting techniques and the application of remote sensing technologies to support the industry and business data needs was were also completed.

As part of the project there was an independent mid-term review of the Program to evaluate its progress and provide recommendations for improvement. The review found the Program to be well planned and overall delivery of the Program in regard to outputs and outcomes to be very good.

Keywords, abbreviations and project codes used

Keywords

avocado; avocado quality; Infocado; OrchardInfo; Qualicado; extension; grower workshops; wholesaler workshops; industry data; supply forecasts; pricing; plantings database; facility checks; grower self-assessment; report cards; score cards.

Abbreviations

AAL: Avocados Australia Limited

BPR – Best Practice Resource – Avocados Australia's web based system containing information about best practice management across all sectors of the avocado supply chain.

DAFQ: Queensland Department of Agriculture and Fisheries

HAL: Horticulture Australia Limited

HIA: Horticulture Innovation Australia Limited

HAL / HIA project codes used

- *AV06025: Avocados Australia consumer sensory project*
- *AV07019: Online consumer quality survey*
- *AV07023: Avocado retail price surveys*
- *AV08017 Avocado Supply Chain Education Materials*
- *AV08034: Avocado retail quality surveys phase 2*
- *AV09001: National avocado quality and information management system*
- *AV10002: Avocado information delivery*
- *AV10006: Avocado supply chain education materials - phase 2*
- *AV12007: Data collection to facilitate supply chain transparency*
- *AV11015: Avocado industry fruit quality benchmarking*
- *AV12009: Understanding and managing avocado flesh bruising*
- *AV10019: Reducing flesh bruising and skin spotting in Hass avocado*
- *AV11013: Review of avocado industry and market information systems*
- *AV11015: Avocado industry fruit quality benchmarking*
- *AV12007: Data collection to facilitate supply chain transparency*
- *AV12012: Coordination of data management and avocado quality improvement and extension program (this project)*
- *AV12013: Implementing improvements in the avocado supply chain*
- *AV15004: Avocado data management and quality innovation extension program.*
- *ST15008: Multi-scale monitoring tools for tree crops*

1.0 Introduction

Avocado quality is recognised as one of the key factors affecting product demand. Research undertaken by Avocados Australia[1] has been able to quantify the negative impact of sub-optimal levels of maturity, ripeness and internal quality on consumer purchase behaviour.

The '*Avocado Industry Strategic Investment Plan 2011-2015*' has a strong focus on addressing quality issues and aims to contribute to the overall outcome to increase percentage of fruit sold at retail level meeting consumer requirements from 75% to 90%.

Expanding on the results from *AV09001: National avocado quality & information management system*, Avocados Australia (AAL) commenced a HAL Project '*AV12012: Coordination of data management and avocado quality improvement and extension program*' (the 'Program') in March 2013.

In designing the Program, previous projects and review findings were considered and an industry stakeholder workshop was held with growers, packers and wholesalers to clarify specific needs and capabilities of the industry in regard to quality improvement and extension. As a result, the Program not only had a focus on fruit quality but also the interrelated productivity and supply chain management issues.

The two key objectives of the Program were:

- To expand on the results of '*AV09001: National avocado quality & information management system*'

- Ongoing data management, specifically related to Infocado and OrchardInfo.

The Program aligned with Strategies 1.1, 1.2 and 1.3 in the '*Avocado Industry Strategic Investment Plan 2011-2015*' and had a number of components including:

1) The ongoing coordination and/or contribution to a suite of supply chain improvement projects that collectively form the support systems for the quality improvement and extension program. These include projects:

    o *AV11015: Avocado industry fruit quality benchmarking (7/3/2012-26/2/2016) (and its predecessor AV08034: Avocado retail quality surveys phase 2).*

    o *AV12007: Data collection to facilitate supply chain transparency (1/09/2012-17/11/2016) (and its predecessor project AV07023: Avocado retail price surveys).*

    o *AV12013: Implementing improvements in the avocado supply chain (20/12/2012-30/11/2015) (and its predecessor AV10006: Avocado supply chain education materials - phase 2)*

    o *AV10002: Avocado information delivery*

    o *AV10019: Reducing flesh bruising and skin spotting in Hass avocado.*

    o *AV12009: Understanding and managing avocado flesh bruising*

2) The establishment and implementation of a quality improvement and extension sub-program (Qualicado) which aims to improve fruit quality.

    The aim of the Qualicado program is to provide education, training, identification of issues and continuous improvement in relation to fruit quality, recognising the inter-related areas of productivity and supply chain management.

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[1] Research specifically relates to HAL Projects: '*AV06025: Avocados Australia consumer sensory project*' and '*AV07019: Online consumer quality survey* '

The Qualicado program also allows growers, packers and wholesalers to benchmark their performance, through self-assessment forms (growers) or facility checks (packers and wholesalers), so that they can potentially identify improvements to achieve better quality outcomes.

3) Management and improvement of Infocado

The Infocado system has been very successful in terms of collecting historical production and forecast supply data which assists with decision making both at an industry and business level. Two key reports were generated and distributed:

- Infocado Weekly Report - covering dispatches, supply forecasts and wholesale information on receivals, stock-on-hand and sales. This information was supplemented by information from the wider supply chain improvement program including weekly retail prices (*AV12007: Data collection to facilitate supply chain transparency)* and monthly dry matter recordings (*AV11015: Avocado Industry Fruit Quality Benchmarking*).

- Infocado Quarterly Report – covering seasonal dispatches and supply forecasts.

4) Management and improvement of OrchardInfo.

OrchardInfo is designed to collect production data and provide a productivity analysis at an enterprise, regional, State and whole of industry level. Reports from OrchardInfo provide the necessary baseline information for long term production modelling.

An independent mid-term review of the Program was undertaken in late 2014. Overall it was found the Program had been well planned and overall delivery, in regard to outputs and outcomes, to be very good (see Appendix 16). Recommendations regarding improvements that could be made were adopted in the latter parts of project.

2.0 Methodology

2.1 Objectives

The activities can be split into the two objective areas:

- To expand on the results of '*AV09001: National avocado quality & information management system'*, which involved:

    o ongoing coordination of the supply chain projects that AV09001 managed or participated in (see Section 2.2 below)

    o The establishment, maintenance and improvement of a quality improvement and extension program, including the Qualicado sub-program (see Section 2.3 below)

- Ongoing data management, specifically related to Infocado, OrchardInfo and evaluation of remote sensing technology (see Section 2.5 below).

2.2 Co-ordinating aligned projects

There are a number of related supply chain improvement projects that required coordination. Collectively these projects form the support systems for the quality improvement and extension program. They also provide important feedback and recommendations for future R&D. A diagram showing the relationship between the various supply chain and quality projects is provided in Appendix 1.

The approach for this objective entailed the ongoing coordination and relevant contribution to the related projects listed below:

- *AV10002: Avocado Information Delivery (DAFQ)*: The development of a Problem Solver Guide for growers and development of content for the Growing section of the BPR.
- *AV10006: Avocado Supply Chain Education Materials Phase 2*: The second phase of supply chain education materials including a fruit grading poster, a transport guide and a harvesting guide. This project also focused on transferring these and the materials developed in *AV08017 Avocado Supply Chain Education Materials*, which provided the original supply chain education materials, including handling guides for packhouses, wholesalers and retailers into online, interactive internet based modules. The third component of this project was the development of a retailer training program for approximately 600 retailers across four Australian capital cities.
- *AV10019: Reducing flesh bruising and skin spotting in Hass avocado* and *AV12009: Understanding and managing avocado flesh bruising:* Research providing insights into how bruises develop in avocado flesh and where within the supply chain most bruising is being caused.
- *AV11015: Avocado industry fruit quality benchmarking*. The next phase of *AV08034: Avocado Retail Quality Surveys Phase 2:* which provided ongoing monitoring and reporting of fruit quality in the market place and how this compares with consumer's expectations (Retail level quality monitoring and wholesale level maturity monitoring).
- *AV12007: Data collection to facilitate supply chain efficiency* and its predecessor project *AV07023: Avocado Retail Price Surveys*: aimed at facilitating supply chain transparency by facilitating the collection and reporting of retail pricing data.
- *AV12013: Implementing improvements in the avocado supply chain:* implementation of an extensive retail education program, development of the web-based best practice tool (BPR) and development of on-line and hard copy best practice content across the supply chain sectors.*

2.3 Qualicado

The Quality Improvement and Extension Program (Qualicado) aimed to develop and deliver an up-to-date extension and continuous improvement system to enable the supply chain to improve fruit quality and thus improve the consumers' experience. Avocados Australia collaborated with the Department of Agriculture & Fisheries Queensland (DAFQ) in developing and delivering this part of the Program, to draw on their expertise in supply chain improvement. Other industry experts were also identified and engaged where needed.

Four separate supply chain sectors were targeted with differing levels of service provided: growers; packers; transporters and ripener/wholesalers.

Qualicado Workshops

A key component of the Program was the delivery of Qualicado workshops. These workshop targeted growers, packers, transporters, ripeners and wholesalers and were held in the 8 major growing regions (growers and packers) and 5 capital cities (ripeners and wholesalers) each year.

In total 26 Qualicado workshops were held over the life of the Program, including 16 grower/packer workshops and 10 ripener/wholesaler workshops. Details of workshops held are provided in Appendix 2.

It was intended to undertake three phases of workshops through AV12012. However, due to notice from HIA in early September 2015 indicating that the project may be terminated early, planning for a third phase was suspended.

At the workshops, expert speakers were engaged to present on a range of topics, related to productivity, supply chain and quality management. The content delivered in each workshop was tailored to meet the needs of the specific group and was determined by a range of means including: previous workshop evaluation reports, indications from grower self-assessment scorecards, packhouse and wholesaler facility checks and direct feedback from key stakeholders in each region or market.

The topics across these workshops included:

- Disease management - root and fruit diseases (for growers)

- Fruit Spotting Bug management (for growers)

- Nutrition & irrigation management (for growers)

- Organic crop management principles (for growers)

- Canopy management (for growers)

- Harvest practices (for growers)

- Handling fruit on the farm and through the packhouse (for grower/packers)

- How to use the Best Practice Resource and access training modules (for all)

- Using data to help improve quality - understanding market forces and the importance of keeping fruit moving in the supply chain (for all)

- Understanding the financial divers – quality and returns (for growers / packers)

- Maintaining the cool chain / temperature management (for all)

- Best practice ripening (for ripeners)

- Understanding and managing bruising (for all).

Grower self-assessment scorecards

At the Qualicado workshops growers were asked to complete a self-assessment scorecard related to their production practices. The aim of this process was to allow growers to assess their current practices against recommended best practices that are known to impact fruit quality. By undertaking this exercise it allowed growers to identify areas where they may be able to improve practices and quality outcomes and develop an action plan targeting these areas. See Appendix 3 for details on the scorecard.

Facility checks

Packers, ripeners, wholesalers and transporters, were offered the opportunity to undertake a more detailed 'facility check'. These checks were provided by a supply chain expert from DAFQ and a report card and action plan provided to each business on areas were improvements could be made to improve supply chain efficiency and quality outcomes. See Appendix 4 for details on the facility check report cards.

This initiative was rolled out to industry in a staggered approach, with a number of packers in each region and wholesalers/ripeners from each market targeted in each phase. In total 29 packhouse and 13 ripener/wholesaler facility checks, report cards and action plans were completed over the life of the project. Businesses were encouraged to address issues that were identified as being problematic, such as reducing drop levels; improving padding at critical points on grading lines; improving postharvest fungicide management, and ensuring effectiveness of cooling and ripening systems. If the business required further assistance they were provided with information on relevant experts or other businesses that could provide this.

Expert support

Industry personnel with expertise in areas related to quality improvement were identified and engaged as part of the Program. This included assisting with the development of self-assessment scorecards and report cards, undertaking facility checks, delivering information at Qualicado workshops and developing material for the BPR. Avocados Australia continues to maintain this listing and to draw on expertise as required.

Reporting on quality issues

A system for all supply chain parties to report quality issues was established, including the option to log issues online or phone in, however it was found that the use of this service was very low. As a result, Avocados Australia staff were required to take a more proactive approach and contact key supply chain parties to discuss quality issues related to regions or at wholesale level to be able to focus content for Qualicado workshops, extension articles and developing content for the Best Practice Resource (BPR).

Information from the grower self-assessment scorecards, facility check report cards and Qualicado evaluation forms was also used to gain insights into quality issues and practice areas that may be limiting quality outcomes. In addition to this, results from *AV11015* (retail quality out turn and dry matter testing results) were also used.

2.4 On-going data management - Infocado and OrchardInfo

Infocado

Infocado, the industry data collection and reporting service, is already well established but requires ongoing management and maintenance. The on-going management tasks involved in maintaining Infocado reporting are outlined in Appendix 5.

Through this part of the Program the following reports were required to be delivered:

- The Weekly Infocado Report including the weekly retail prices collected as a part of *AV12007* and the inclusion of the Dry Matter Report monthly (collected as a part of *AV11015*). The report is to be distributed to all contributors.

- The Quarterly Infocado Report (seasonal forecast). The report is distributed to all contributors by the middle of January, April, July and October each year.

- The Individual annual report produced for each individual packhouse at the conclusion of their season. This report is posted to the relevant business.

In addition to this:

- Information articles were provided for all editions of 'Talking Avocados' (the avocado industry quarterly magazine) during the life of the project.

- Infocado reports (delayed) were uploaded to the Avocados Australia website.

- Regular communication and reporting was undertaken to ensure that the system maintains its relevance to contributors and therefore the level of contribution to the system remains high. Consequently, a number of tools and reports that have been developed were maintained and adjusted as required.

- A study detailing established grower and packhouse forecasting practices and techniques that can assist contributors to Infocado in providing more accurate crop forecast data was completed.

OrchardInfo

Like Infocado, OrchardInfo was managed on an ongoing basis. The on-going management tasks involved in maintaining OrchardInfo reporting are outlined in Appendix 6.

Throughout the predecessor project AV09001, grower uptake and contributions to the system were low. Unfortunately without higher contribution levels the aggregated data can be misleading. Following on from recommendations made in *AV11013* and the stakeholder workshop in October 2012, the level of detail requested from growers was simplified to increase the level of participation. Also, incentives were provided to encourage higher participation levels.

Remote sensing

Through the Program, a small scoping study was undertaken to investigate the use of remote sensing technology to independently obtaining orchard specific data as well as providing a validation tool for existing data sets. If successful this could reduce the amount of grower input required and improve the accuracy of orchard data.

The scoping study evaluated the accuracy and feasibility of remote sensing technology to address these needs, as well as its potential to predict the spatial variability of an orchard, in terms of tree health, fruit maturity, quality and yield. This study was undertaken by DAFQ in collaboration with the University of New England. The details of the scoping study are provided in Appendix 15.

2.5 Review

An independent mid-term review of the Program was undertaken by P2P Business Solutions, contracted by Hort Innovation, and was completed in December 2014. The recommendations from this review were considered and relevant changes incorporated were appropriate.

3.0 Outputs

The Program delivered the following outputs:

- Co-ordination and contribution to a number of related productivity and quality improvement projects to ensure synergies between the various projects were captured and extended through coherent, impactful and continuous learning mechanisms, including the Qualicado sub-program and the BPR.

- The establishment of a quality improvement and extension sub-program (Qualicado) which has become well established in both the production/packing and ripener/wholesaler sectors in a short period of time.

- A flyer explaining the Qualicado Program. See Appendix 7.

- Twenty six (26) Qualicado workshops tailored to meet the learning needs of participants. These workshops included 16 grower/packer workshops across 8 major production regions plus 10 ripener/wholesalers meetings across 5 capital cities. The workshops covered a range of topics from production and supply chain management for growers/packers through to ripening and temperature management for ripeners/wholesalers.

    In total 732 and 488 persons attended Qualicado workshops in Phase 1 & 2 of the project respectively. The average response rate across all workshops was 54% (phase 1) and 52% (phase 2) with a higher response rate at the ripener/wholesaler workshops, most likely due to the classroom-style format of these workshops. The evaluations showed the following:

Question	Phase 1 (n=246)	Phase 2 (n=152)
Has the workshop provided you with useful information?	Yes = 99.4% No =0.6%	Yes = 100% No = 0%
Rating of the quality of speakers out of 10 (10 being excellent)	8.3	8.8
Rating of choice of location out of 10 (10 being excellent)	8.5	8.5
Overall did you gain value from attending this workshop?	Yes = 99.6% No =0.4%	Yes = 100% No = 0%
Likelihood of using info gained during this workshop to improve practices (1= strongly disagree and 10 = strongly agree)	7.8	8.2
Would the usage of presentation videos in the workshops and on the BPR be useful?	Yes = 98%* No = 2%	Yes = 91% No = 7%

* - only collected at 3 workshops

A summary of attendance and participant evaluations by region/workshop are provided in Appendix 8.

- In total there were 315 (phase 1 – 176 & phase 2 – 139) completed and submitted grower self-assessment scorecards undertaken by production business over the life of the project. These allowed growers to assess their business operations against best practice recommendations. They

also provided an assessment mechanism to determine where production businesses may need extra support to achieve better fruit quality outcomes. The data has been recorded for each region and a national summary of the scorecards are provided in Appendix 9.

- Forty two (42) facility checks (and related report cards and action plans) were completed, covering 29 packhouses and 13 ripener/wholesaler facilities, over the life of the project. The number of facilities checks falls short of target (52), however this was dependant on the level of interest and availability of supply chain stakeholders. Also, due to notice from HIA in September 2015 indicating that the project may be terminated early, planning was significantly disrupted. A summary of the facility checks is provided in Appendix 10.

- A recognition system for businesses participating in the Qualicado Program was established. Those participating businesses that have chosen to have their participation recognised have been listed and acknowledged in the BPR. In total 105 production businesses, 20 packers and 7 wholesalers are listed on the BPR site. Certificates of attendance have also been provided to growers and other supply chain parties upon request.

- A register of industry personnel with expertise in various fields relating to avocado production and issues affecting quality, on which the avocado industry can draw on to assist with different elements of the Qualicado Program. This continues to be maintained.

- A process to encourage contribution from industry stakeholders, through workshops and direct contact with Avocados Australia, and to identify quality issues through a number of other mechanisms has been developed. This allows long term and topical issues to be addressed through different extension channels.

- Weekly Infocado reports were delivered over the life of the project. These reports provide information on weekly dispatches (volumes, fruit size, variety, origin and destination), supply forecasts (volumes), historical pricing and in-market dry matter assessments (monthly). This data assists industry and businesses in decision making in relation to management and marketing decisions and assists in ensuring good supply/demand balances are maintained. Examples of the Weekly Infocado Report are provided in Appendix 11.

- Quarterly Infocado reports were delivered over the life of the project. This report provides a 15 month seasonal forecast based on data provided by packers, production over the previous 12 months, historical retail price trends and a summary of forecast imports and Australian production versus actual figures. The information again assists in management decisions and market planning to ensure good supply/demand balance is maintained. Examples of this report are provided in Appendix 12.

- Individual Infocado reports for contributors were generated and distributed annually to every participating packer. These reports include weekly forecasts vs. dispatch comparisons for the specific business over the season, as well as a comparison of the business's production with the overall production from the region.

- Annual OrchardInfo reports were completed and disseminated to contributors. The OrchardInfo report provides information on plantings – tree numbers, variety, tree age and hectares as well as production data. This report is important for long term industry forecasting. An example of the Central Queensland 2013 report is provided in Appendix 13.

- A report on the crop forecasting techniques used by other avocado industries and businesses worldwide, other horticultural industries, as well as Australian avocado businesses who have been identified as having a good track record of being able to forecast their crop. This report highlights the different techniques used by different businesses, noting that there is no single method that

delivers the best results. It does however identify some innovative solutions used by the Australian apple industry to determine expected fruit sizing which may be applicable to the Australian avocado industry. A copy of the report is provided in Appendix 14.

- A report on the application of remote sensing for meeting the data needs of the Australian avocado industry. The research found that high resolution satellite imagery, Geographical Information Systems (GIS) and Google Earth were effective tools for tree auditing and for defining the spatial variability of tree condition across two commercial 'Hass' avocado blocks in Childers, Australia. The information derived supports improved tree management and harvest segregation based on fruit size. For the auditing of tree numbers, a more exact method for calculating orchard area and tree density was examined that increased the prediction accuracy of one orchard (30.3 ha) from 90.4 % to 97.3 %. The development of a spatial data base that incorporated every individual tree within an orchard was also investigated. The final report for this research is provided in Appendix 15. This scoping work provided a sound basis for the new Horticulture Innovation Australia project *ST15008 Multi-scale monitoring tools for tree crops,* which is being supported by the avocado industry.

- An independent mid-term review of the Program undertaken in late 2014. This has enabled Avocados Australia to improve the delivery, outputs and outcomes from the Program as a result of fine-tuning some of the work being undertaken. A copy of this report is included as Appendix 16.

The Program has also:

- Promoted and provided industry training on use of the BPR, and uploaded Qualicado workshop presentations on the BPR. Currently there are 530 registered users (businesses and individuals) registered on the BPR. This is an increase of 180 registered users since the mid-term review (November 2014).

- Supported the development and / or delivery of outputs for the following projects: *AV10002; AV10006; AV10019; AV12009; AV11015; AV7023 & AV12007 and AV12013.* The output from these projects included: the development of a Problem Solver Guide; development of online content for the Grower section of the BPR; development of supply chain education materials; developed online information resources; developed and delivered a retailer training program; investigated bruising in avocados; monitored quality of fruit at retail and wholesale level, and reporting of weekly retail pricing.

- Provided Infocado reports (delayed) on the Australian Avocados website.

- Provided information articles in every edition of 'Talking Avocados' (4 per year) since its commencement and has provided Program updates and Qualicado workshop invitations through the industry e-newsletter, *Guacamole*, electronic *Grower Updates,* website notifications and media releases.

4.0 Outcomes

AV12012 has provided the opportunity to address quality issues in the Australian avocado industry. It has done this by providing input and coordination across a range of productivity and supply chain projects delivered through Avocados Australia and other industry service providers. It has also engaged with a wide range of industry stakeholders from growers, to packers, ripeners and wholesalers and provided an opportunity for these businesses to engage in processes that support practice change at an enterprise level. Through a number of mechanisms, these businesses have been able to identify areas for improvement in their operations which will have a direct impact on fruit quality. These mechanisms include self-assessment scorecards for growers and facility checks and report cards for packers, ripeners and wholesalers, as well as information and training provided through Qualicado workshops and the BPR.

Engagement with the Qualicado program has been high and the evaluation reports show that information provided through these workshops has the ability to trigger practice change with a high percentage of participants (as outlined in the previous section). Ultimately the desired outcome is that fruit being supplied to the market is of improved quality.

A number of evaluation mechanisms had been previously identified as being relevant for assessing the outcomes of the project. This included the overall research results from *'AV11015: Avocado industry fruit quality benchmarking',* which monitored internal fruit quality (at retail) and maturity (at wholesale). The results from *AV11015* (final report submitted March 2016) show damage recorded at retail level for Hass and Shepard fruit.

The results for Hass show a clear trend of reduced damage in fruit at retail level. The results for Shepard indicate low levels of total damage - less than 10% over the first 7 years of monitoring, including the years in which this Program was current. However, the spike in total damage in fruit sampled in 2015 requires further consideration. Similarly, the maturity monitoring program found that immature fruit continues to be a problem at the commencement of harvest in many regions but particularly at the beginning of the Shepard and Hass seasons in North Queensland and for the Hass season in Central Queensland. These results are discussed in more detail in the next section of this report.

Comparison of data from scorecards in phase 1 and phase 2 of the Program show some change in regard to production practices, although this is indicative data only. Indications are that there was improved uptake of phytophthora, irrigation management and nutrition management practices and an overall improvement in pre-harvest and post-harvest crop management activities. At this stage it is not possible to assess what practice change has occurred through the supply chain as a result of facility checks.

Both Infocado Weekly and Quarterly reports continue to be highly valued by the packhouse and wholesaling sectors. There has been ongoing work to try to increase participation as well as accuracy of data that is entered for both of these reports, as they provide valuable information for both industry and business planning purposes. The crop forecasting guidelines report (Appendix 14) will provide growers with more insights into how other industries and growers undertake their forecasting activities. This will hopefully have a positive effect on the overall accuracy of forecast supply data entered into the Infocado system. Without good information from Infocado, market planning would be a significantly more difficult task and the result would be reduced supply chain efficiency, which ultimately impacts quality, returns to growers and customer experience.

A comparison of annual Infocado data with annual levy income shows a close alignment. An exact alignment would be unexpected due to the timing variance between the two data sets (levy income can be up to three months later than the sale date). Nevertheless, the annual variance across the past four years is within 4% as shown in the table below.

	2011/12	2012/13	2013/14	2014/15
Tonnes (Infocado)	51,113	54,877	48,715	57,595
Levies ($)	3,935,387	4,282,216	3,652,284	4,151,817
Tonnes (calculated from levies)	52,472	57,096	48,697	55,358
Variance	-2.7%	-4.0%	0%	+4%

Gaining the support of growers to provide OrchardInfo data continues to be challenging and there are considerable resources committed to contacting growers and attempting to access their data, so that OrchardInfo Annual Reports can be generated. Having good production and productivity data is however considered vitally important particularly as the industry continues to experience higher supply as a consequence of significant new planting in recent years. Without this data it is difficult to model and plan what the future avocado market might look like. Compared with ABS data, OrchardInfo data currently represents about 70% of national avocado plantings. Data for younger plantings (less than 6 years old) represents 81% of ABS data.

The remote sensing research undertaken as part of this Program, which validated the usefulness of this technology for undertaking tree audits and for defining the spatial variability of tree condition, has resulted in the establishment of a significantly larger multi-industry project that will likely lead to the provision of improved data in a shorter timeframe. If successful, this data will support the data collected through OrchardInfo and overall will provide more accurate data for analysis and decision making. At the farm level, it offers an improved method of recording orchard data and 'paddock to plate' traceability.

A mid-term review of *AV12012* undertaken in 2014, found the quality improvement and extension component (Qualicado) of the Program had become well established in the production sector in a short period of time and this was attributed to good planning, consultation with stakeholders, a collaborative approach with service providers, development of appropriate resources (background documentation, scorecards, report cards etc.) and execution of a strong communication plan.

The report stated:

 "Evaluations show that Qualicado workshops have been well attended and received by the production and wholesale/ripener sector. Attendees at the workshops (growers and wholesalers/ripeners) strongly indicated that they would likely use knowledge gained at these events to improve their practices. This will hopefully lead to improved fruit quality.

Avocados Australia have developed a flexible and responsive approach to the Qualicado workshops, which provides the best chance to maintain engagement with the various sectors of the supply chain and to be able to influence practice change and quality outcomes.

Infocado, the industry's crop forecasting system continues to provide valuable information to the sector on a weekly and quarterly basis. There has been considerable effort since the commencement of the Program to encourage greater participation and accuracy of data.

Promotion of OrchardInfo, which captures planting and productivity data, has seen an increase in contributions. There is still further work to be done to improve data quality and Avocados Australia through this Program have investigated the opportunity to use remote sensing technologies to gain better insight into plantings and other tree health and yield parameters.

This review has found that the Program was well planned and, to date, overall delivery of the Program against the milestone schedule and output and outcome requirements had been very good."

A number of recommendations were made for the remainder of the project. The recommendations support the continuation of all current activities and some recommendations have suggested minor

changes and additional activities to help improve the outcomes. All of the recommendations were accepted by Avocados Australia (subject to resource constraints) and some of these have been implemented since the mid-term review was delivered.

5.0 Evaluation and discussion

The Program has numerous components, as well as oversight and engagement with other HIA quality and supply chain projects. This approach has been effective in facilitating a range of activities which together has enabled the industry to address quality, which is considered one of the major limiting factors to demand growth.

Overall the feedback from the Qualicado workshops has been very positive, as indicated by the evaluation results (Appendix 8). Holding grower workshops on farm, presenting information on current quality and productivity issues, and ensuring material is delivered by knowledgeable and quality speakers has achieved strong attendance at workshops. By analysing information from the grower scorecards and facility checks (report cards) it has been possible to target content area where stakeholders require addition support, hence ensuring topics presented are relevant to the audience. This is supported by evaluation data showing that nearly 100% of attendees across all Qualicado events gained value from attending the event and the likelihood of the information being used to improve practices was 7.8 out of a possible score of 10 and 8.2 out of 10 for phase 1 and phase 2 of the Program respectively.

In the later part of the Program, the Qualicado workshops have been integrated with *AV14000: Achieving more consistent yields of quality fruit in the Australian avocado industry* productivity workshops when appropriate. This has further helped to achieve strong industry attendance. Large avocado operations continue to attend the workshops with key staff. Local consultants and rural merchandise personnel have also been encouraged to attend with the hope that key messages will be consistently disseminated throughout the industry.

Feedback suggests that growers place very high value on local field days where they can access targeted information related to production, packing, supply chain and quality issues delivered by subject matter experts. They also value the opportunity to see how other growers farm and how they manage activities.

Determining the benefits the packers, ripeners and wholesalers will realise from the facility checks is more difficult to determine, however the assessments (report cards) undertaken by DAFQ indicate there are numerous areas where improvements can be made.

One of the observations from the facility checks was that although each business may have effective infrastructure and systems in place, the facility checks were not able to identify weaknesses in the linkages and communication between the businesses in the supply chain.

Infocado and OrchardInfo continue to be maintained and improved, both from a process and data quality perspective. This is an on-going process that requires consistent encouragement and engagement with growers and wholesalers to maintain participation. In the future it is hoped that new technologies such as remote sensing can support data collection, improve data accuracy and reduce data collection costs for the industry.

In taking a higher level evaluation of the Program, the complexity of interactions of the market (supply, demand and pricing) become evident. The results from *'AV11015: Avocado industry fruit quality benchmarking',* which monitored internal fruit quality (at retail) and maturity (at wholesale) highlight this issue (final report submitted March 2016). Below, figures 1 & 2 show the total damage recorded at retail level for Hass and Shepard fruit, respectively, over the life of the project (and during earlier projects).
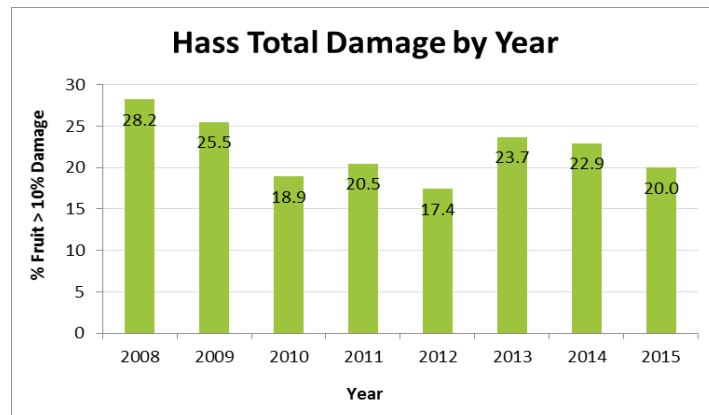
Figure 1: Hass – Total Damage by Year – 2008 -2015
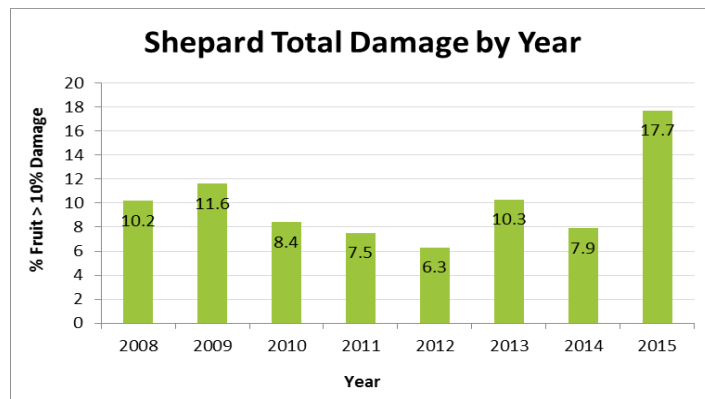
Figure 2: Shepard – Total Damage by Year – 2008 -2015

The results for Hass show a clear trend of reduced damage in fruit at retail level. The results for Shepard indicate low levels of total damage, then a spike in total damage to 17.7% of fruit sampled in 2015. The underlying data shows that bruising, diffuse flesh discolouration and vascular browning in May 2015 were the main contributors to this increased damage. This may be due to larger than normal volumes of late season Shepard overlapping with increasing volumes of new season Hass. As a result Shepard fruit may have been stored for too long and on the retail shelf longer than the optimal time, resulting in increased bruising damage.

Increased Hass damage over the last three years (2013 – 2015), observed in Figure 1, which is predominantly due to increased bruising levels, is possibly the result of higher retail prices during this period encouraging consumers to be more discriminating and handling the fruit more before they making a selection in store, which has manifested as increased bruising in fruit on display.

When looking at incidence of defects by variety, the two main quality issues identified through monitoring were bruising followed by body rots in both Hass and Shepard (see figures 3 & 4 respectively below), although body rots have declined significantly in Shepard.

In Hass, the incidence of diffuse flesh discolouration has gradually improved over the last 7 years. Whilst in Shepard stem end rot and body rots can be seen to have both improved, however diffuse flesh discoloration is an increasing problem (Years 2012 – 2015). This defect will need greater attention and awareness of the issue will be highlighted with supply chain parties through future Qualicado programs, in an attempt to reduce its incidence.
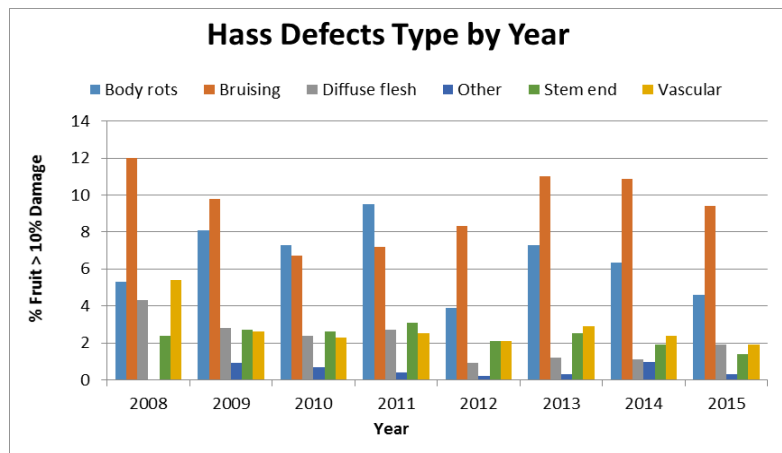
Figure 3: Hass Defects – Type by Year, January 2008 – December 2015
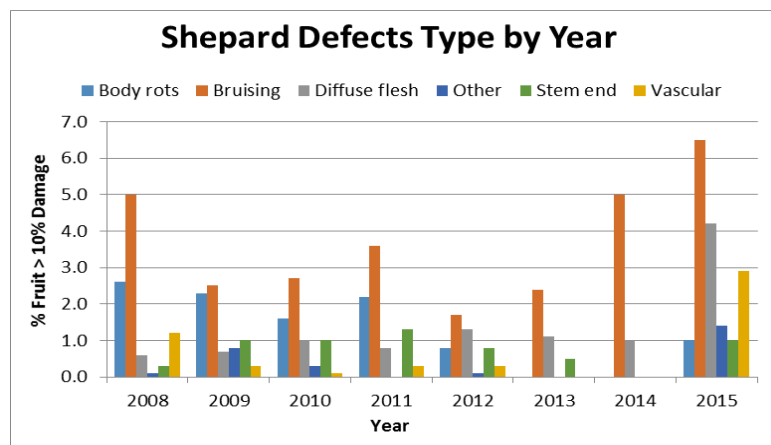
Figure 4: Shepard Defects – Type by Year, January 2008 – December 2015

Throughout the retail quality monitoring, bruising and body rots were continually identified as the major defects leading to poor consumer experiences. Research undertaken in *AV10019: Reducing Flesh Bruising and Skin Spotting in Hass Avocado* aided and complemented AV11015 by identifying that a large portion of bruising was caused by supply chain handling, with most of the bruising occurring at retail level. Body rots however are initiated in the orchard and manifest as a result of practices throughout the supply chain.

The maturity monitoring program succeeded in capturing a snapshot of the dry matter (DM) levels for each region from the commencement of harvest. Results show the average and range of DM levels of fruit collected for a region on a given day and the expected increase in DM levels as a region progresses through harvest. The results show that immature fruit continues to be a problem at the commencement of harvest in many regions but particularly at the beginning of the Shepard and Hass seasons in North Queensland and for the Hass season in Central Queensland.

These results show the complexity around achieving high quality fruit outcomes for the consumers and the need for on-going attention to many areas that contribute to poor quality through the supply chain. The improvement trend showing in Hass fruit is positive, however there is still need for further improvement to meet the goal of 90% of fruit meeting customers' expectations. Incidence of emerging disorders in Shepard highlight the need for constant monitoring of the market and interventions to address such problems.

The achievement of minimum DM levels of harvest fruit presents consistent challenges at the commencement of season with each new region. This is often driven by logistic and commercial imperatives that override the benefit of presenting quality fruit to the market. However, this does not negate the consumers' desire for mature high quality fruit.

6.0 Recommendations

The following recommendations are made in regard to the project:

Infocado

- All Infocado reports (Weekly, Quarterly & Individual) should continue on the basis used in AV12012. These are highly valued by stakeholders.

- All non-contributing packhouses should continually be asked to provide data to improve accuracy and reduce Avocados Australia time to manage the overall system.

- All non-contributing wholesalers that handle avocados should continually be asked to provide data to improve accuracy within the wholesale sector and greater transparency of fruit movement.

- Ongoing effort is required to identify key wholesale staff and encourage greater exchange of information. The inclusion of more informed comment on market conditions and specific quality issues when they arise would be beneficial to the report.

- Continue to seek other data sources to validate Infocado figures including potentially accessing carton manufacturing figures, transport figures and other data from Central Market authorities e.g. Brismark Credit Service or FreshState.

- Feedback on the system and reports should be gathered on an ongoing basis to ensure the information generated is of value or to identify where improvements could be made.

- Development of an Excel tool should be investigated to assist smaller non-contributing packhouses with collating and inputting data. The scoping work should detail the time and cost required to develop a tool that is adaptable to the various business systems.

OrchardInfo:

- The OrchardInfo program should continue as it is the only measurement for long term forecasting and planning (i.e. 10+ years).

- All growers should be continually encouraged to provide their data. Where there are non-contributing growers those with larger planting should be targeted as the priority.

- Continue to seek other data sources to validate OrchardInfo figures including potentially accessing carton manufacturing figures, transport data and avocado nursery sales.

- Feedback on the system and reports should be gathered on an ongoing basis to ensure the information generated is of value or to identify where improvements could be made.

Qualicado (Extension):

- Extension workshops should continue for both the grower/packhouse and ripener/wholesaler sectors. The evaluation of workshops shows that these are well received by participants and there has been solid attendance over both phase 1 & 2 of the project.

- There should be greater effort to work with the transport sector and consideration of a new approach is needed if this is to be successful.

- The contents of workshops should continue to be informed by industry feedback.

- Each workshop conducted should be evaluated at the end of the day with incentive prizes given for completion (i.e. draw for a $50 gift card).

- The process of growers completing scorecards at Qualicado workshops has met its objective and therefore there is limited value from continuing this activity at this point. Growers will now be directed to the BPR where the self-assessment form is available, if they wish to

continue this process as part of their business activities. Growers should be encouraged to utilise this tool.

- Facility checks should continue for those that have expressed an interest in having this process completed.

- Beyond facility checks, it is recommended that a series of full supply chain studies are completed to allow fruit to be followed through the chain. This will allow the effectiveness of linkages to be understood, to observe fruit through the chain in real time, to determine the major contributing factors to poor quality through the supply chain and to understand limitations of different types of supply chains. From this exercise, improved best practice recommendations will be able to be developed to facilitate better fruit quality outcomes.

Crop forecasting

- More accurate crop forecasting will assist with planning at both a business and industry level. Growers should be encouraged to consider the practices they use for crop forecasting and to improve their skills. Suitable information should be extended through the BPR, industry publications and Qualicado workshops.

Remote Sensing (ST15008):

- Remote sensing was a small sub-project within this project. Its objective was undertaken to understand the usefulness of technology to gain better industry data with a particular focus upon using aerial imagery. This project was completed in full with strong findings recorded. Since then HIA have funded *ST15008: Multi-scale monitoring tools for tree crops,* which is multi-industry and has significantly greater capacity and scope. If the outcomes of this project are positive for the avocado industry then it should continue to be supported.

- The outcomes of *ST15008* should be extended through Qualicado workshops*.*

7.0 Scientific refereed publications

The following paper was published as a result of this project:

Robson, A.J., Petty, J., Joyce, D.C., Marques, J.R., and Hofman, P.J. (2014). High resolution remote sensing, GIS and Google Earth for avocado fruit quality mapping and tree number auditing. Proceedings of the 29th International Horticultural Congress 2014. Brisbane Convention and Exhibition Centre, Brisbane, Queensland, Australia.

8.0 Intellectual property / commercialisation

There are no intellectual property considerations or commercialisation activities resulting from this project.

9.0 References

*Avocado data management and quality innovation extension program – project proposal.*2015. HIA Project AV15004. Horticulture Australia.

Avocado industry fruit quality benchmarking. 2016. HAL Project AV11015. Horticulture Australia.

Avocado information delivery. 2015. HAL Project AV10002. Horticulture Australia.

Avocado quality retail surveys. November 2008. HAL Project AV07018. Horticulture Australia.

Avocado retail price survey. August 2012. HAL Project AV07023. Horticulture Australia.

Avocado retail quality surveys phase 2. November 2011. HAL Project AV08034. Horticulture Australia.

Avocado supply chain education materials. June 2010. HAL Project AV08017. Horticulture Australia.

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Coordination of data management and avocado quality improvement and extension program – milestones 102-107. September 2013 – September 2015. Avocados Australia.

Data collection to facilitate supply chain transparency. 2016. HIA Project AV12007. Horticulture Australia.

Guacamole e-news. Various dates 2013 - 2015. Avocados Australia.

Implementing improvements in the avocado supply chain. 2016. HIA Project AV12013. Horticulture Australia.

Infocado Weekly Reports and *Quarterly Reports*. Various dates. Avocados Australia

National avocado quality and information management system. March 2013. HAL Project AV09001. Horticulture Australia.

Reducing flesh bruising and skin spotting in Hass avocado. 2015. HIA Project AV10019. Horticulture Australia.

Review of avocado industry and market information systems. July 2012. HAL Project AV11013. Horticulture Australia.

Talking Avocados. All editions 2012 - 2015. Avocados Australia.

10.0 Acknowledgments

The following people should be acknowledged for their contribution to this project:

- Mr Nathan Symonds, Program Manager, Avocados Australia

- Ms Amanda Madden, Administration Assistant, Avocados Australia

- Ms Maree Tyrell, Office Manager/Executive Assistant, Avocados Australia

- Mr Simon Newett, Principal Extension Horticulturalist, DAFQ

- Mr Terry Campbell, Principal Extension Horticulturalist, DAFQ

- Mr Noel Ainsworth, Principal Supply Chain Horticulturist, DAFQ

- Ms Julie Petty, formerly Program Manager, Avocados Australia

- Dr Andrew Robson, Researcher, University of New England

- Mr Chad Simpson, Agronomist, Simpson Farms

- Professor Daryl Joyce, Principal Horticulturalist, DAFQ

Appendix 1: Related projects

Diagram showing the main quality management projects undertaken since 2005 and the relationship between AV12012 and other projects that support quality improvement across the avocado supply chain (source: AV12012 mid term review)
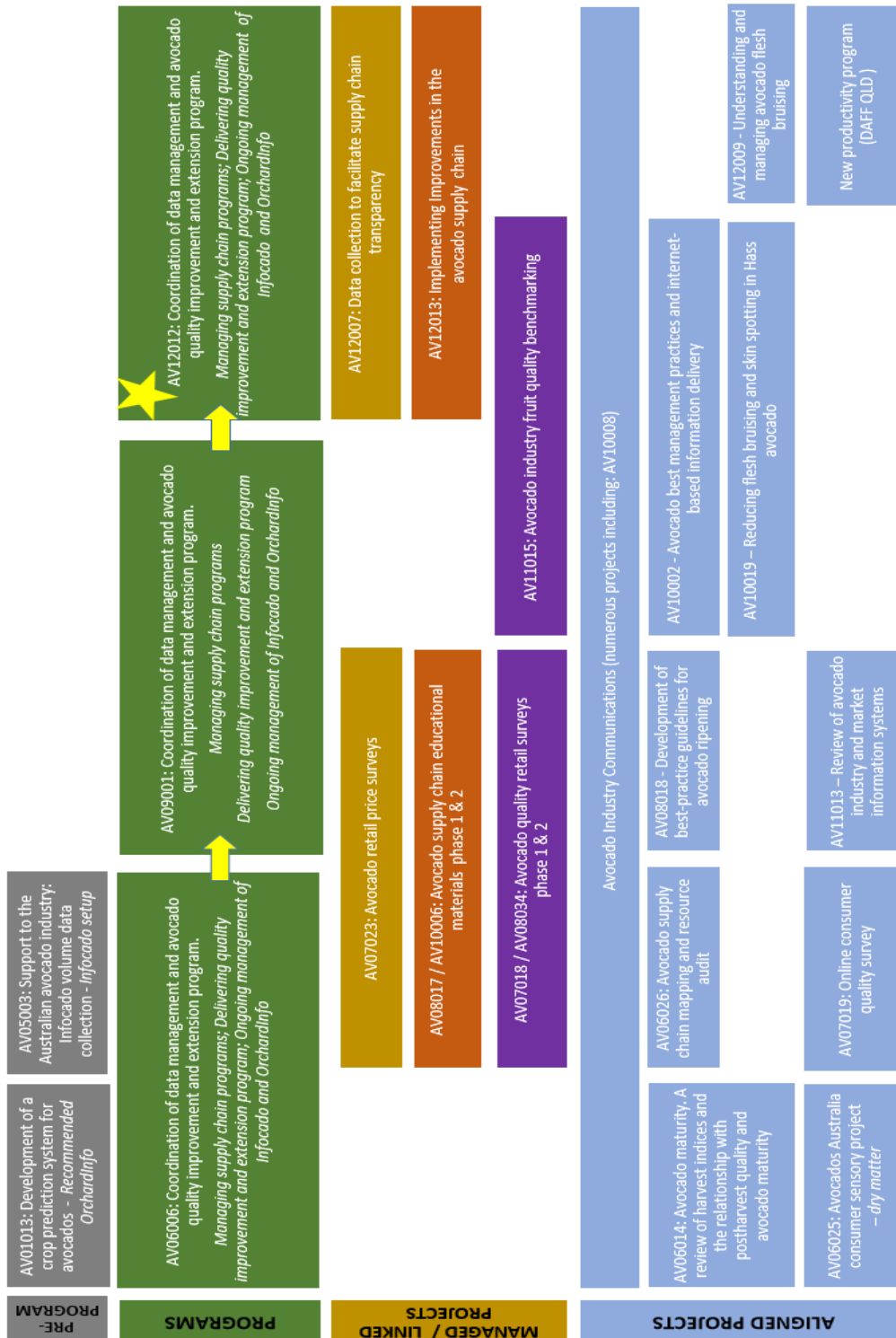
Appendix 2: Qualicado event schedule

Phase 1 - Qualicado Event Schedule		
Date	Event	Location
15-Aug-13	North Queensland Grower Qualicado Workshop	Atherton
13-Nov-13	Melbourne Wholesaler Qualicado Workshop	Footscray Markets
14-Nov-13	Tri State Grower Qualicado Workshop	Robinvale
20-Feb-14	Brisbane Wholesaler Qualicado Workshop	Rocklea Markets
13-Mar-14	Sydney Wholesaler Qualicado Workshop	Flemington Markets
20-Mar-14	Sunshine Coast Grower Qualicado Workshop	Nambour
03-Apr-14	Tamborine/Northern Rivers Grower Qualicado Workshop	Kyogle
08-May-14	South Queensland Grower Qualicado Workshop	Blackbutt
22-May-14	Adelaide Wholesaler Qualicado Workshop	Pooraka Markets
11-Jun-14	Central New South Wales Grower Qualicado Workshop	Comboyne
16-Jul-14	Perth Wholesaler Qualicado Workshop	Cannington Markets
17-Jul-14	Western Australia Grower Qualicado Workshop	Manjimup
11-Sep-14	Central Queensland Grower Qualicado Workshop	Childers
Phase 2 - Qualicado Event Schedule		
04-Dec-14	North Queensland Grower Qualicado Workshop	Mareeba
13-Feb-15	Sunshine Coast Grower Qualicado Workshop	Nambour
26-Feb-15	Brisbane Wholesaler Qualicado Workshop	Rocklea Markets
12-Mar-15	Sydney Wholesaler Qualicado Workshop	Flemington Markets
26-Mar-15	Tamborine/Northern Rivers Grower Qualicado Workshop	Alstonville
07-May-15	South Queensland Grower Qualicado Workshop	Gatton
21-May-15	Tri State Grower Qualicado Workshop	Waikerie
04-Jun-15	Central New South Wales Grower Qualicado Workshop	Comboyne
24-Jun-15	Perth Wholesaler Qualicado Workshop	Cannington Markets
25-Jun-15	Western Australia Grower Qualicado Workshop	Pemberton
07-Jul-15	Adelaide Wholesaler Qualicado Workshop	Pooraka Markets
09-Jul-15	Melbourne Wholesaler Qualicado Workshop	Footscray Markets
06-Aug-15	Central Queensland Grower Qualicado Workshop	Childers

Appendix 3: Grower self-assessment scorecards

Production businesses that attended Qualicado workshops were encouraged to complete a self-assessment scorecard. The scorecards were adapted from the Positive Points Assessment developed by Department of Agriculture, Fisheries and Forestry (Queensland) through project AV06003 and also the 'Reef Rescue ABCD Framework'.

The scorecard allowed growers to assess their current practices against 'best recommended' practices that are known to impact fruit quality. By undertaking this exercise, growers were able to identify areas where they may need to improve their practices.

Where the grower agreed, the information provided by individual growers was collected, collated and used to inform the education/improvement needs for an area (i.e. South Queensland).

The scorecard can also be completed online, through the Best Practice Resource (BPR).

A copy of the scorecard is provided on the next page.

Grower Qualicado Assessment for Maximising Avocado Yields and Quality

What is Qualicado?

Qualicado is a program which has been developed to provide support and monitoring systems to enable and encourage avocado supply chain members to improve fruit quality and thus the end consumer's experience. Qualicado is focused on education, training, identification of issues and continuous improvement. It is not an accreditation system like Freshcare. It is avocado specific. Avocados Australia is collaborating closely with the Department of Agriculture, Fisheries and Forestry (DAFF) in the delivery of this program.

What is this grower assessment?

The attached assessment is available for all Australian growers to undertake self-assessments. These assessments are designed to be a useful aid for growers to monitor their practices and identify areas for improvement. An action plan template has also been provided to assist in strategizing how each business will make changes to their existing practices based on the results of the assessment. The survey and action plan are designed to be reviewed annually to check on progress and develop new goals. The assessment can either be completed anonymously or business names can be included on the form so each business can be acknowledged as Qualicado participant on the Avocados Australia website. Experienced personnel from DAFF have developed this grower assessment with assistance from Avocados Australia. All recommendations referenced in this assessment are based on the most up to date R&D research findings.

How will my information be used?

First and foremost the results from this assessment should are designed to be used by each business to identify areas for improvement. Improved fruit quality means improved pack out rates and thus more marketable fruit and income. To assist the wider industry each business's survey results will be fed back to Avocados Australia and used to help identify information gaps which can then be addressed. This may include the development of additional content or training modules on the Best Practice Resource (BPR) or delivering other training or presentations.

Instructions for completing the assessment

The assessment is broken up into different categories and each recommended practice has been assigned different weightings depending on its level of importance in relation to maximising yields or improving quality. Below is an example of the Climate & Aspect section.

			Max. points	Your score	Your score
1	Row direction, winds, frosts & aspect.	Tree rows run north-south where the slopes allow it. Orchard is not prone to frosts and is protected from strong prevailing winds (naturally or with windbreaks). Steeper blocks have predominantly E, NE or N aspects.	5		1
TOTAL			5		

Recommended practice.

Maximum points which can be awarded. 0 is the lowest rating.

Scores recorded here. Keep this copy for your records.

Repeat your score here. Tear off this copy for Avocados Australia to use. The existing number in the box refers to the question number.

1. Simply give yourself a score ranging from 0 to the maximum number based on your feeling of how well you are performing. 0 is the lowest rating.

2. Record your score as noted above, once for your reference and one copy to give to Avocados Australia. Be sure to total your score at the bottom of each category.

3. Once this has been done for all categories, the total scores should be recorded on the last page. Again keep one copy for yourself and tear one copy off (along the dotted line) to give to Avocados Australia.

4. The assessment can be completed anonymously if preferred or the business name can be recorded on the sheet. The business name can then be listed on the Avocados Australia website as a Qualicado participant. The ratings can also be used in future annual reviews.

Grower Pre-Harvest Qualicado Assessment
Maximising Avocado Yields & Quality

Date: ..../.............../20 ....

Section 1: ROOTSTOCKS & VARIETIES

			Max. points	Your score	Your score
1a	Suitability of varieties	The varieties you grow are suitable for your environment.	2		1a
1b	Rootstocks	Rootstocks have a proven history of good performance, are uniform, have some tolerance to *Phytophthora* root rot and do not make fruit unduly susceptible to anthracnose.	6		1b
	TOTAL		**8**		

Section 2: PHYTOPHTHORA ROOT ROT CONTROL

			Max. points	Your score	Your score
2a	Surface and internal drainage	There is at least 1.5 metres of well-drained soil (sandy, sandy loam, loam, or well-structured clay loam). Trees are planted on mounds. Underground drains have been installed if necessary to eliminate any wet spots. Water drains away quickly after rain and does not pond anywhere in orchard.	6		2a
2b	Nursery trees	Trees are purchased from ANVAS accredited nurseries. Upon arrival at the orchard, trees are never placed on the ground but are stored on an open mesh structure above the ground to prevent infection by *Phytophthora* and to allow excess water to drain away immediately.	3		2b
2c	Early establishment	Ground is prepared according to best practice recommendations with cover crops and incorporation of manure or compost and calcium well before planting (12 months). Young trees are mulched with coarse free draining material and preventative *Phytophthora* root rot control measures are taken: metalaxyl (e.g. Ridomil®) granules are applied to the soil, trees are drenched with phosphorous acid the day before planting and water is never allowed to pool around the tree.	3		2c
2d	Soil health	Steps are taken to improve the root environment especially in the under-tree area. These measures include maintaining a 10+cm mulch of coarse free draining material under tree canopies and adopting practices to minimise/alleviate soil compaction. Other practices could include the application of good quality compost.	3		2d
2e	Application of phosphorous acid	Root phosphonate levels are monitored annually and the results used to tailor phosphorous acid treatments. Healthy trees are treated in autumn either by injecting 20% phosphorous acid or by applying on average three 0.5% phosphorous acid foliar sprays. Sick trees are treated by injection, both in autumn **and** late spring. Timing of applications strictly follow recommended times (linked to the root growth cycle).	5		2e
2f	Irrigation and nutrition	Irrigation and nutrition is managed carefully to ensure adequate moisture and nutrient balance at all times; excessive or insufficient water and nutrients cause stress in avocado trees which pre-disposes them to *Phytophthora* root rot.	2		2f
	TOTAL		**22**		

HAL
Horticulture Australia

Avocados Australia

Queensland Government

Business Name:........................

Section 3: CLIMATE & ASPECT

			Max. points	Your score	Your score
3	Row direction, winds, frosts & aspect	Tree rows run north-south where the slopes allow it. Orchard is not prone to frosts and is protected from strong prevailing winds (naturally or with windbreaks). Steeper blocks have predominantly E, NE or N aspects.	5		3
	TOTAL		**5**		

Section 4: IRRIGATION

			Max. points	Your score	Your score
4a	Water quantity & quality	For each year there are between 9-16 megalitres (depending on locality) of irrigation water available per hectare of planted orchard area. The water supply is tested regularly and contains less than 80 mg/kg chloride and a conductivity of less than 0.6 dS/m (384 ppm). If conductivity is higher than this adequate leaching irrigations are applied.	4		4a
4b	Irrigation system	An irrigation system appropriate for the orchard conditions is used. The system uniformly waters each tree in the orchard and is regularly inspected. The uniformity of the system is tested at least once per year.	4		4b
4c	Irrigation scheduling	Irrigation scheduling is based on the readings from a reliable soil moisture monitoring system which is read several times per week. Special care is taken not to overwater or underwater trees. During the period from flowering through until the completion of rapid fruit growth, soil moisture is monitored more frequently and irrigations are more responsive. Irrigation to *Phytophthora* affected and smaller trees in the block (e.g. replants) is reduced to prevent waterlogging.	7		4c
	TOTAL		**15**		

Section 5: NUTRITION

			Max. points	Your score	Your score
5a	Monitoring	Full leaf tissue analysis is conducted between April and May every year. Full soil analysis is conducted at least every 3 years.	5		5a
5b	Fertiliser applications	Fertiliser applications are based on interpretation of soil and leaf analysis by an expert. Crop load is also taken into account, as soon as it is apparent, in determining nitrogen rates (higher rates for heavier crop loads). Foliar boron sprays are applied at flowering time to supplement soil applications if leaf levels are deficient.	4		5b
5c	Application interval	The interval between applications of nitrogen, potassium and boron is appropriate for the soil texture (e.g. ranging from weekly on sands to every 2 to 3 months on clay loam krasnozems).	3		5c
	TOTAL		**12**		

Section 6: ANTHRACNOSE MANAGEMENT

			Max. points	Your score	Your score
6a	Fungicide applications	Regular applications of copper fungicides are applied as foliar sprays between fruit set and harvest. The interval of 28 days during fine weather is shortened to 21 days following rain and 14 days during prolonged wet weather. Azoxystrobins (e.g. Amistar®) are used and specific resistance management guidelines are followed.	7		6a
6b	Other preventive measures	Other measures are applied including orchard hygiene (removal of old fruit, dead twigs and branches), good ventilation through the tree (achieved by means of canopy management), good insect control, and snipping rather than snap picking during humid conditions.	5		6b
	TOTAL		**12**		

Section 7:   INSECT MANAGEMENT

			Max. points	Your score	Your score
7a	Monitor insect pests	Regular pest monitoring (scouting) is conducted for the main avocado insect pests that can occur in your area e.g. fruitspotting bug, fruit fly, leaf eating beetles, ivy leaf roller, scale insects, caterpillars, tea red spider mite.	2		7a
7b	Sprayer	Sprayer configuration and spray volumes are appropriate for the orchard. Mature orchards require 2,000-2,500L/ha for high volume sprays. Sprayer is calibrated at least once per year and takes into account tree size.	3		7b
7c	Control of insect pests	Appropriate registered pesticides are applied effectively when required.	5		7c
	TOTAL		**10**		

Section 8:   POLLINATION

			Max. points	Your score	Your score
8	Pollinators and pollinisers	Insect pollinators are plentiful, if not beehives are brought in. In cool production areas effective polliniser varieties are interplanted in the orchard to assist with pollination and fruitset.	5		8
	TOTAL		**5**		

Section 9:   CANOPY MANAGEMENT

			Max. points	Your score	Your score
9a	Access	Harvesters are able to reach all fruit.	3		9a
9b	Pruning	A suitable canopy management system has been chosen and is carried out as part of a planned program on a regular cycle. Trees are kept at a manageable size to facilitate effective spraying, efficient harvesting and adequate light penetration through the canopy (as judged by there being ground-cover plants (e.g. grass) in the inter-row space and minimal shading of lower branches).	8		9b
	TOTAL		**11**		

Pre-Harvest Summary

		Max. points	Your score	Your score
1	**Rootstocks & Variety**	8		
2	**Phytophthora Root Rot Control**	22		
3	**Climate & Aspect**	5		
4	**Irrigation**	15		
5	**Nutrition**	12		
6	**Anthracnose Management**	12		
7	**Insect Management**	10		
8	**Pollination**	5		
9	**Canopy Management**	11		
	TOTAL	100		

Grower Post-Harvest Qualicado Assessment
Maximising Avocado Yields & Quality

Section 1:   HARVESTING

			Max. points	Your score	Your score
1a	Rain	Prior to rain events foliar fungicide program was maintained. After rain or heavy dew fruit is completely dry before harvesting and harvesting is delayed by 48 hours in the case of heavy or prolonged rain.	5		1a
1b	Maturity	Ripening and dry matter tests are conducted on fruit before harvesting. Only Hass with a minimum of 23% Dry Matter or Shepard with 21% Dry Matter are harvested.	9		1b
1c	Equipment	Regular maintenance is conducted on harvesting equipment and there is adequate suspension on bin trailers/runners.	5		1c
1d	Training	Pickers have been fully trained and instructed on which blocks to harvest and which fruit to pick. Pickers know that fruit dropped from more than 30cm is unmarketable and should be rejected. Fruit is handled gently.	8		1d
1e	Training	Pickers are trained to assess each piece of fruit for physical damage that would render it unmarketable and therefore should be rejected.	8		1e
1f	Field Bins	Immediately after filling, field bins are covered to reduce risk of sunburn. Within 30 minutes of filling, filled bins are collected from blocks to a shaded area to bring the core temperature down. Bins are not overfilled.	5		1f
	TOTAL		**40**		

Section 2:   QUALITY ANALYSIS

			Max. points	Your score	Your score
2a	Receival Bin Analysis	Bins are assessed for quality and picking issues such as harvesting damage and sunburn.	10		2a
2b	Reject Bin Analysis	If your packhouse produces Reject Bin Analysis Reports, this information is used to identify areas for improvement.	10		2b
	TOTAL		**20**		

Post-Harvest Summary

		Max. points	Your score	Your score
1	**Harvesting**	**40**		
2	**Quality Analysis**	**20**		
	TOTAL	**60**		

1. My average yield over the last 3 years was:

☐ Less than 10 tonne/hectare   ☐ 10–15 tonne/hectare   ☐ More than 15 tonne/hectare

2. My overall percentage of marketable fruit last season was:…………………………

3. Of last season's marketable fruit, my class/grade breakdown was as follows
(please refer to Australian Avocado Grading Guide if needed):

………… % Class 1 fruit   ………… % Class 2 fruit   ………… % Class 3 fruit

☐ Yes, I would like my business name listed on the Avocados Australia website as a Qualicado participant and I have recorded my business name below as it should appear on the website..

Business Name: ……………………………………………   Signed: ……………………………………………

Qualicado Action Plan

Business Name: …………………………………………………………… Date: …………………………………

Purpose:	To create a "script" for changing/improving my practices.
Usage:	1. This template is a guide only and is designed to assist you in developing a work plan for each goal identified through the Qualicado Assessment process. Please modify this template to suit your needs. 2. Copies of this action plan should be distributed to the members of your businesses involved in its delivery. 3. Keep copies handy to review and update as you achieve your goals. At the very least this document should be reviewed annually.

Action Steps What will be done?	Responsibility Who will do it?	Timeline By when?	Resources A. Resources available B. Resources needed (financial, human, other)	Potential Barriers A. What or who? B. How to overcome the barrier?
Step 1:			A. B.	A. B.
Step 2:			A. B.	A. B.
Step 3:			A. B.	A. B.

Step 4:			A. B.	A. B.
Step 5:			A. B.	A. B.
Step 6:			A. B.	A. B.
Step 7:			A. B.	A. B.

Appendix 4: Facility check report card

Qualicado Packhouse Facility Check

Interview schedule

Steps

1. **Introduction and scope of meeting.**
   - Not an audit (don't check records and give an accreditation, but a look at practices and give recommendations)

2. **Walk the handling system from receival to dispatch + 2 days.**
   - Step by step handling with important times, temperature, who makes decisions about the fruit and what records are kept.

Step	Times and variation	Temperatures and variation	What checks and records	Who is responsible	Industry practice recommends.

3. **Recommendations and follow up.**

Interview overarching questions

Q1: Best contact

Q2: Shed through put and complexity

Q3: Customers

Q4: Quality and food safety system (e.g. Woolworths quality vendor system, Coles HACCP, ICA audit, BFA accreditation, Food safety audit)

Q5: Quality Issues

Q6: How do you decide when to harvest which blocks (what tests?)

Step	Current Practice	Industry practice recommends.
Bin receival Times and variation Temperatures and variation Dry matter tests	Q7	Bin ID records to track to blocks 24 hrs max (@ <15°C for precooling) Variation for rain First in = first out handling. Receival analysis Dry matter testing
Bin Dumping Times and variation	Q8	No drop over 300mm Wet less than 2 mins in wet dumps Sanitiser (sodium hypochlorite) Water changed daily or sooner if dirty Cleaning record
Washing Cleaning Times and variation	Q9	Sanitiser 1 minute max brushing (ideally 30sec) Clean brushes (check every 3 hours) Worn brushes General check for sharp edges, fruit jamming, worn brushes and rollers, padding

Step	Current Practice	Industry practice recommends.

Step	Current Practice	Industry practice recommends.
Fungicide treatment Times and variation	Q10	Sportak at correct ppm and pH (55ml/100L=250mg/L) (lower pH if alkaline) Non recirculated for <15 seconds <100 mm max fruit drop Post-harvest chemical record (No dimethoate or fenthion for EU markets) Clean brushes daily
Drying Times and variation Temperatures and variation	Q11	50°C max temperature <100 mm max fruit drop
Quality sorting Times and variation	Q12	Record of staff training Record of packed product monitoring Fruit flow, lighting, injury points Product specs/posters displayed to remind staff <100 mm max fruit drop Record of reject bin analysis

Step	Current Practice	Industry practice recommends.
Size grading Times and variation Temperatures and variation What checks and records Who is responsible and evidence	Q13	Calibration weekly Check condition of singulator and cups and clean daily Packed product monitoring <100 mm max fruit drop Equipment check and cleaning records
Packing Times and variation Temperatures and variation	Q14	Product Specifications identified for each client/market and communicated to packers Packed product monitoring. Carton weights checked Library trays kept Reject bin analysis MRL test sample if required Carton design for purpose with appropriate airflow Staff training

Step	Current Practice	Industry practice recommends.
Palletising Times and variation Temperatures and variation	Q15	Consignment IDs Incomplete pallets in coolroom. Palletising according to destination.
Precooling Times and variation Temperatures and variation **How did decide on this.**	Q16	Precool (to 5°C Hass or 7°C Shepard) within 24 hours of harvest. Check pallet positioning in coolroom to allow gaps Cooling logs with pallet ID's Handling logs 10 – 12 hour maximum of forced air.
Storage Times and variation Temperatures and variation	Q17	Handling log Storage (at 5°C Hass or 7°C Shepard) 48 hrs max No forced air 50 mm gaps around all sides
Transport Times and variation Temperatures and variation	Q18	Transport logs Transhipment 5°C Hass or 7°C Shepard
Cleaning	Q19	
Training	Q20	Use of AAL Best Practice Resource videos Training manuals and posters

Key Recommendations

Small enterprise	Medium enterprise	Large enterprise
Dry matter testing of fruit at receival Q6	Dry matter testing throughout first 6 weeks of packing. Q6	Detailed feedback on ripening performance of each block using retention samples. Q6
Post-harvest fungicide pH adjusted Q10	Machine improvements/design to remove impacts equivalent to greater than 100 mm drop	Staff training using AAL packages Q20
Fruit probed at dispatch. Transport temperature with 48 hours of receival Q16 17 18	Pre cooling processes driven by temperature results for each cool room and pallet position and room load. Q16 17 18	Pre cooling and transport processes driven by temperature logging results. Q16 17 18
	Improved communication in chain Q3 4 5 6	

Key
Small enterprise: Owner packing for limited number of suppliers. High control of staff and processes.
Medium enterprise: Includes pack shed expanding to increase number of suppliers and blocks. Staff delegation occurring.
Large enterprise: Direct supermarket suppliers with large number of farms/suppliers. Complex staff management.

Handouts available
- Review of Pack Shed Practices Phase 1
- Evaluation of the use of prochloraz in the control of post harvest diseases of papaya in Australia
- Postharvest chlorination
- Maturity and dry matter testing
- Ripe fruit inspection guide

Appendix 5: Infocado – management tasks

Below are the operational tasks that are required to maintain the standard of data and reporting required with Infocado.

- A weekly reminder email is sent to all packhouses and wholesalers who should be contributing data for that particular week (based on the time of the year) on the last day of the Infocado week (Friday).

- Every week follow up phone calls made to those packhouses/wholesalers that have not as yet entered their weekly data into the system as of 11am Monday.

- On a weekly basis, once all the data has been entered by packhouses and wholesalers who have fruit that week, an activity report is generated to compare that packhouses dispatch data against what their forecasts. If there are large discrepancies the individual packhouse is contacted to determine whether there is an error or if not, whether there is a reason for the discrepancy. This reason can then be reported in the weekly report if needed.

- Annual reviews of each region are conducted to check whether there are new packhouses in the region who need to be included in the system. If so, then the following process is undertaken:

    - Introduction phone call to potential pre-qualified participants to provide information about Infocado and encourage their participation where eligible – ideally just prior to commencement of their season.

    - Follow up email to businesses to provide additional information, including a more detailed overview of Infocado, instructions, and passwords for accessing the system

    - Introduction phone call to administration contact (if different person from manager).

    - Follow up phone call/email to manager or administration contact after first few weeks entering data to address any issues of concern.

- Follow up phone calls are made to all those packhouses who were already contributing to the weekly system to provide them with the information they needed to start entering their seasonal forecast data.

- Articles are provided for all editions of 'Talking Avocados' (the avocado industry quarterly magazine) during the life of the project.

- Infocado reports (delayed) are uploaded to the Avocados Australia website.

- Regular communication and reporting is required to ensure that the system maintains its relevance to contributors and therefore the level of contribution to the system remains high. Consequently, a number of tools and reports have been developed which need to be maintained and adjusted as needed.

- Weekly, quarterly and individual annual reports are produced and sent to all contributors.

    - The Weekly Report includes the weekly retail prices collected as a part of AV12007 (new format now part of AV15004) and once a month the dry matter report is also included (previously collected as a part of AV11015, project now terminated).

    - The Quarterly Report is produced and emailed to contributors by the end of January, April, July and October each year.

    - The Individual annual report is produced for each individual packhouse at the conclusion of their season and is posted to that enterprise.

Appendix 6: OrchardInfo – management tasks

The management of OrchardInfo requires that Orchard Profile forms to be sent to all growers in all regions on an annual basis, preferably in March and preferably by email. Hard copies are only sent to growers that don't have an email or who specifically request a hard copy.

The following activities are undertaken:

1. Industry communication sent out 1 month prior actual data collection to inform of the incentive prizes and encourage participation.
2. A list of all known growers is generated and checked. This list will receive access to their Orchard Profile form.
3. Emails are sent to the listed growers (via database developer). The email contains a link to their Orchard Profile form, user instructions and upgrade browser instructions.
4. (Hard copy forms with cover letter and instructions are sent to growers who don't have an email or if they are specifically requested.
5. The data collection period is recommended to be 4 - 6 weeks.
6. A reminder sent 2 weeks after original email is sent.
7. Also, after 2 weeks after the original email is sent, large growers that are identified as having low or no records for their orchard are contacted and encouraged to contribute data. The grower is assisted as necessary, so that data can be collected.
8. A week before the close of the data collection period a 'Grower Update' is sent to further encourage contribution (details of incentive prizes are included).
9. Once the data collection period has finished, the list of contributors is compiled and the winners are selected. Prizes are organised and distributed.
10. The winners of the incentive prize are announced through the industry communications program.
11. Assuming sufficient data has been collected for each region, the reports are generated (This process is complex and detailed processes are well documented).

- Reports are then emailed to all growers via email.

- Growers without an email receive copies of the report via post

- Findings are communicated to the broader industry.

Appendix 7: Qualicado facts sheet

Qualicado Fact Sheet

What is Qualicado?

The goal of Qualicado is to provide support and monitoring systems to enable and encourage supply chain members to improve fruit quality and thus the end consumer's experience. Qualicado is focused on education, training, identification of issues and continuous improvement. It is not an accreditation program like Freshcare. It is avocado specific.

Why has Qualicado been established?

A key strategy within the industry strategic plan states that industry needs to ensure consumers can confidently purchase consistently high quality fresh avocados at retail level.

Retail Quality Monitoring Surveys conducted by Avocados Australia indicate that the quality of Hass avocados available to consumers in retail outlets has improved by 38% since 2008. Shepard quality has also improved. In particular avocado fruit in retail stores are showing less bruising then they did five years ago. However, industry still has a long way to go in improving fruit quality.

Qualicado has been developed as an alternative to a formal accreditation system as industry feedback in 2012 opposed the implementation of such a program. Industry was supportive of a nationwide quality improvement and extension program aimed at supporting continuous improvement by avocado industry members. The Qualicado program will achieve this.

Who can participate in Qualicado?

All Australian growers, packers, wholesalers, ripeners and transporters are encouraged to participate in the program.

Qualicado Fact Sheet

What services are available through Qualicado?
A roadshow of workshops is scheduled to roll out to all regions in the coming months. Guest speakers on a range of quality related topics will be invited to attend the workshops. Topics will be determined based on regional feedback and speaker availability. Growers, packers, wholesalers, ripeners and transporters are all encouraged to attend and participate in the workshops. The proposed meeting times are listed below. For the most part these timings are based directly on industry feedback on the most suitable times for local events.

Table 1: Draft Event Timings

	2013					2014											
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CQ														▊			
CNSW											▊						
NQ	▊												▊				
SQ										▊							
SC								▊									
Tam/NR									▊								
Tri				▊												▊	
WA												▊					
Perth																	
Melbourne				▊													
Brisbane							▊										
Sydney								▊									
Adelaide									▊								

Growers, packers, wholesalers, ripeners and transporters are also encouraged to utilise the Best Practice Resource (BPR) which is an online one-stop-shop for all sectors of the supply chain for all information relating to best practice. The information uploaded to this system has been sourced from the latest R&D and checked by industry experts so is constantly kept up to date. New information is continuously being added to ensure the system is as comprehensive as possible. Several training modules are also available for businesses to use in staff training or to refresh their own skills.

Growers
Growers can undertake self-assessments which are designed to be a useful aid to monitor practices and identify areas for improvement. The survey results will be fed back to Avocados Australia and used to help identify information gaps which can then be actioned. This may include the development of additional content or training modules on the BPR or delivering other training or presentations. Growers can also use an action plan (template can be provided) to assist in strategizing how they will make changes to their existing practices. The survey and action plan are designed to be reviewed annually at regional workshops or over the phone. Growers can either complete the surveys anonymously or include their business names on the form so they can be acknowledged as Qualicado participants on the Avocados Australia website.

Qualicado Fact Sheet

Packers/Wholesalers/Ripeners/Transporters

Packers, wholesalers, ripeners and transporters will be eligible to undertake a system review with a qualified service provider contracted by Avocados Australia who can offer advice and suggestions for improving practices and thus quality. Following this 2-3 hour on site review an action plan will be developed in consultation with the business to address the issues identified. The cost of this consultation is covered through the Qualicado program, however should further expertise be needed; this would be at the businesses' own cost. Spaces are limited for this opportunity so if you are keen to volunteer for this service please let Avocados Australia know. These reviews are scheduled to be undertaken around the same time as the local workshops.

Identification of quality issues

Through Qualicado the goal is to over time establish a comprehensive register of quality issues. This would allow program administrators to identify common problems and take steps to address them through for example, training modules in the BPR or regional workshops. These services may not help to rectify the issue in time for the current season, but should assist in developing preventative measures for next season.

Industry members where appropriate will be able to register quality issues with Avocados Australia which they have encountered. Obviously the parties involved should take steps to resolve the problem themselves before contacting Avocados Australia. The purpose of the program is _not_ dispute resolution, but simply to identify people within the supply chain who may need more targeted education and assistance to improve their practices. Some examples of how the program could work are outlined below:

- If rotten fruit is seen displayed at a retail outlet, the issue should be firstly taken up with the store or fresh produce manager. Avocados Australia could then be contacted so that additional services/resources might be offered to that store i.e. in store training.
- Wholesalers might have encountered an issue where a number of growers in a particular growing region are supplying fruit with stings. The wholesaler should raise the issue with the individual growers concerned. If it is a broader issue for the region, Avocados Australia could initiate education in that region on control measures for Fruit Spotting Bug.

Avocados Australia will also be drawing on the programs already in place to monitor quality. In summary there are a number of ways issues might be logged:

- Industry members providing feedback through the BPR
- Industry members contacting Avocados Australia directly on supplychain@avocado.org.au or 07 3846 6566
- Reports to Avocados Australia from contractors undertaking retailer training, retail price collection and retail quality surveys.

Qualicado Fact Sheet

What are the advantages of being involved in this program?

- Expert advice and services will be available to assist you in identifying production or quality issues as well as improving your practices. This means more money in your pocket, improved fruit quality for consumers and therefore in the long term, increased avocado demand.
- This is an opportunity to learn new skills and techniques in improving quality.
- You will have access to a program where quality issues can be identified and action taken to assist the involved parties in rectifying the problem.
- All participating businesses can opt to have their business names listed on the Avocados Australia website as contributors to this program. Links to business websites can be facilitated.

What are my obligations if I participate in this program?

As a Qualicado participant you are making a commitment to continuous improvement. This means that:

- Growers will undertake self-assessments, create action plans to address the issues identified and review these annually. It's important for this information to feed into Avocado Australia (anonymously or otherwise) to assist in determining industry's information gaps.
- In the case of packers, wholesalers and ripeners they can undertake a system review as outlined above. They would assist in the development of the action plan including activity timelines and review these annually.
- Growers, packers, wholesalers and ripeners should undertake internal monitoring to assess if the action plan recommendations are helping to solve the issue.
- Businesses should ensure key, relevant staff undertake regular training. For example undertaking BPR training courses, attending workshops or other personal development.
- Commit to working to resolve the problem if the business is connected to serious quality issues reported to Avocados Australia.

How is Qualicado funded?

Qualicado has been funded by Horticulture Australia Ltd using the national avocado levy and matched funds from the Australian Government. Services such as workshops, businesses assessments and content additions to resources such as the BPR will be provided free of charge to industry members.

Qualicado Fact Sheet

Who is Qualicado run by?

Avocados Australia has established and will oversee the management of Qualicado. The program and services will be rolled out to industry in collaboration with qualified service providers from Department of Agriculture, Fisheries and Forestry (DAFF) and other organisations.

Who should I contact if I have further questions?

Questions about this program as well as feedback on fruit quality can be registered through the Feedback facility within the BPR or by contacting Julie Petty at Avocados Australia on 07 3846 6566 or supplychain@avocado.org.au

Appendix 8: Qualicado workshop evaluations summary

GROWERS' & WHOLESALERS' QUALICADO WORKSHOPS	SERIES 1													Cumulative
Feedback collected from the Event Evaluation Form to date.		NQ	TRI	MEL	BRIS	SC	SYD	TNR	SQ	ADEL	CNSW	PER	WA	CQ	
Total number of stakeholders in attendance:		120	70	12	14	33	9	44	86	8	78	7	167	84	**732**
Total number of respondents:		40	35	10	11	11	8	16	39	8	23	6	22	17	**246**
Response rate (%):		33%	50%	83%	79%	33%	89%	36%	45%	100%	29%	86%	13%	20%	**53.7%**
Has this workshop provided you with useful information? (%)	Yes	98	100	100	100	100	100	100	100	100	100	100	95	100	**99.4**
	No	3	0	0	0	0	0	0	0	0	0	0	5	0	**0.6**
Rating of the quality of speakers:	Average	7.0	8.0	8.0	8.0	8.6	8.0	9.0	8.7	8.5	8.6	8.7	7.7	8.5	**8.3**
(1 to 10 where 1 is poor, 10 is excellent)															
Rating of the choice of location:	Average	9.0	8.0	8.0	8.8	9.1	8.0	8.8	8.5	8.9	8.6	8.2	7.8	9.1	**8.5**
(1 to 10 where 1 is poor, 10 is excellent)															
Overall did you gain value from attending this event? (%)	Yes	100	100	100	100	100	100	100	100	100	100	100	95	100	**99.6**
	No	0	0	0	0	0	0	0	0	0	0	0	5	0	**0.4**
Likelihood of using info gained during this workshop to improve practices:	Average	8.0	7.0	8.0	7.0	7.7	7.0	8.8	8.1	8.5	8.3	7.4	7.4	7.7	**7.8**
(1 to 10 where 1 is strongly disagree, 10 is strongly agree)															
Would the usage of presentation videos in workshops & on the BPR be useful? (%)	Yes											100	95	100	**98.3**
N.B.: This is a question that was added to the questionnaire only recently.	No											0	5	0	**1.7**
	Neither														

Other comments:
Refer to individual workshop worksheets.

Topics suggested for the next workshop:
Refer to individual workshop worksheets.

GROWERS' & WHOLESALERS' QUALICADO WORKSHOPS	SERIES 2													Cumulative
Feedback collected from the Event Evaluation Form to date.	NQ	SC	BRIS	SYD	TNR	SQ	TRI	CNSW	PER	WA	ADEL	MEL	CQ	
Total number of stakeholders in attendance:	90	33	13	5	43	48	53	48	4	72	6	12	61	**488**
Total number of respondents:	8	13	9	4	16	19	17	11	4	19	6	11	15	**152**
Response rate (%):	9%	39%	69%	80%	37%	40%	32%	23%	100%	26%	100%	92%	25%	**52%**

Has this workshop provided you with useful information? (%)														
Yes	100	100	100	100	100	100	100	100	100	100	100	100	100	**100**
No	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Rating of the quality of speakers:	Average	9.1	9	8.9	9.5	8.8	8.0	8.5	8.6	10	8.5	8.8	8.6	8.7	**8.8**
(1 to 10 where 1 is poor, 10 is excellent)															

Rating of the choice of location:	Average	8.6	9.2	9.3	8.8	8.9	8.5	8.5	9.5	7.5	8.5	9	4.5	9.1	**8.5**
(1 to 10 where 1 is poor, 10 is excellent)															

Overall did you gain value from attending this event? (%)														
Yes	100	100	100	100	100	100	100	100	100	100	100	100	100	**100**
No	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Likelihood of using info gained during this workshop to improve practices:	Average	8	8.2	8.1	8.5	8.8	7.7	7.5	8.6	8.5	8.2	8.8	7.2	8.7	**8.2**
(1 to 10 where 1 is strongly disagree, 10 is strongly agree)															

Would the usage of presentation videos in workshops & on the BPR be useful? (%)	Yes	75	100	89	75	94	89	93	100	100	95	83	100	93	**91.23**
N.B.: This is a question that was added to the questionnaire only recently.	No	25	0	11	25	6	11	7	0	0	5	17	0	7	**8.77**
	Neither														

Other comments:
Refer to individual workshop worksheets.

Topics suggested for the next workshop:
Refer to individual workshop worksheets.

Appendix 9: Grower self-assessment scorecards summary

Phase 1 Grower Pre-Harvest Qualicado Assessment Maximising Avocado Yields & Quality				Nat. Summary	
			Max. Points	**Average**	**%**
	Section 1: ROOTSTOCKS & VARIETIES		Max. Points	Average	%
1a	Suitability of varieties	The varieties you grow are suitable for your environment.	2	1.9	93.57%
1b	Rootstocks	Rootstocks have a proven history of good performance, are uniform, have some tolerance to *Phytophthora* root rot and do not make fruit unduly susceptible to anthracnose.	6	4.0	66.10%
	TOTAL		8	5.8	72.96%

	Section 2: PHYTOPHTHORA ROOT ROT CONTROL		**Max. Points**		
2a	Surface and internal drainage	There is at least 1.5 metres of well-drained soil (sandy, sandy loam, loam, or well-structured clay loam). Trees are planted on mounds. Underground drains have been installed if necessary to eliminate any wet spots. Water drains away quickly after rain and does not pond anywhere in orchard.	6	4.4	72.64%
2b	Nursery trees	Trees are purchased from ANVAS accredited nurseries. Upon arrival at the orchard, trees are never placed on the ground but are stored on an open mesh structure above the ground to prevent infection by *Phytophthora* and to allow excess water to drain away immediately.	3	2.5	83.15%
2c	Early establishment	Ground is prepared according to best practice recommendations with cover crops and incorporation of manure or compost and calcium well before planting (12 months). Young trees are mulched with coarse free draining material and preventative *Phytophthora* root rot control measures are taken: metalaxyl (e.g. Ridomil®) granules are applied to the soil, trees are drenched with phosphorous acid the day before planting and water is never allowed to pool around the tree.	3	2.1	70.46%
2d	Soil health	Steps are taken to improve the root environment especially in the under-tree area. These measures include maintaining a 10+cm mulch of coarse free draining material under tree canopies and adopting practices to minimise/alleviate soil compaction. Other practices could include the application of good quality compost.	3	2.1	70.24%
2e	Application of phosphorous acid	Root phosphonate levels are monitored annually and the results used to tailor phosphorous acid treatments. Healthy trees are treated in autumn either by injecting 20% phosphorous acid or by applying on average three 0.5% phosphorous acid foliar sprays. Sick trees are treated by injection, both in autumn **and** late spring. Timing of applications strictly follow recommended times (linked to the root growth cycle).	5	3.2	64.67%
2f	Irrigation and nutrition	Irrigation and nutrition is managed carefully to ensure adequate moisture and nutrient balance at all times; excessive or insufficient water and nutrients cause stress in avocado trees which pre-disposes them to *Phytophthora* root rot.	2	1.6	79.05%
	TOTAL		22	15.9	72.22%

	Section 3: CLIMATE & ASPECT		**Max. Points**		
3	Row direction, winds, frosts & aspect.	Tree rows run north-south where the slopes allow it. Orchard is not prone to frosts and is protected from strong prevailing winds (naturally or with windbreaks). Steeper blocks have predominantly E, NE or N aspects.	5	3.9	78.29%
	TOTAL		5	3.9	78.16%

	Section 4: IRRIGATION		**Max. Points**		
4a	Water quantity & quality	For each season there are between 9-16 megalitres (depending on locality) of irrigation water available per hectare of planted orchard area. The water supply is tested regularly and contains less than 80 mg/kg chloride and a conductivity of less than 0.6 dS/m (384 ppm). If conductivity is higher than this adequate leaching irrigations are applied.	4	2.9	72.20%
4b	Irrigation system	An irrigation system appropriate for the orchard conditions is used. The system uniformly waters each tree in the orchard and is regularly inspected. The uniformity of the system is tested at least once per year.	4	3.2	78.93%
4c	Irrigation scheduling	Irrigation scheduling is based on the readings from a reliable soil moisture monitoring system which is read several times per week. Special care is taken not to overwater or underwater trees. During the period starting from flowering through till the completion of rapid fruit growth, soil moisture is monitored more frequently and irrigations are more responsive. Irrigation to *Phytophthora* affected and smaller trees in the block (e.g. replants) is reduced to prevent waterlogging.	7	4.5	64.95%
	TOTAL		15	10.6	70.58%

		Section 5: NUTRITION	Max. Points		
5a	Monitoring	Full leaf tissue analysis is conducted between April and May every year. Full soil analysis is conducted at least every 3 years.	5	3.8	76.43%
5b	Fertiliser applications	Fertiliser applications are based on interpretation of soil and leaf analysis by an expert. Crop load is also taken into account, as soon as it is apparent, in determining nitrogen rates (higher rates for heavier crop loads). Foliar boron sprays are applied at flowering time to supplement soil applications if leaf levels are deficient.	4	3.1	78.03%
5c	Application interval	The interval between applications of nitrogen, potassium and boron is appropriate for the soil texture (e.g. ranging from weekly on sands to every 2 to 3 months on clay loam krasnozems).	3	2.4	81.18%
	TOTAL		12	9.4	78.15%

		Section 6: ANTHRACNOSE MANAGEMENT	Max. Points		
6a	Fungicide applications	Regular applications of copper fungicides are applied as foliar sprays between fruit set and harvest. The interval of 28 days during fine weather is shortened to 21 days following rain and 14 days during prolonged wet weather. Azoxystrobins (e.g. Amistar®) are used and specific resistance management guidelines are followed.	7	4.9	70.09%
6b	Other preventive measures	Other measures are applied including orchard hygiene (removal of old fruit, dead twigs and branches), good ventilation through the tree (achieved by means of canopy management), good insect control, and snipping rather than snap picking during humid conditions.	5	3.7	74.24%
	TOTAL		12	8.6	71.82%

		Section 7: INSECT MANAGEMENT	Max. Points		
7a	Monitor insect pests	Regular pest monitoring (scouting) is conducted for the main avocado insect pests that can occur in your area e.g. fruitspotting bug, fruit fly, leaf eating beetles, ivy leaf roller, scale insects, caterpillars, tea red spider mite.	2	1.8	87.80%
7b	Sprayer	Sprayer configuration and spray volumes are appropriate for the orchard. Mature orchards require 2,000-2,500L/ha for high volume sprays. Sprayer is calibrated at least once per year and takes into account tree size.	3	2.5	83.91%
7c	Control of insect pests	Appropriate registered pesticides are applied effectively when required.	5	4.4	88.07%
	TOTAL		10	8.7	86.77%

		Section 8: POLLINATION	Max. Points		
8	Pollinators and pollinisers	Insect pollinators are plentiful, if not beehives are brought in. In cool production areas effective polliniser varieties are interplanted in the orchard to assist with pollination and fruitset.	5	4.4	87.17%
	TOTAL		5	4.4	87.28%

		Section 9: CANOPY MANAGEMENT	Max. Points		
9a	Access	Harvesters are able to reach all fruit.	3	2.7	90.52%
9b	Pruning	A suitable canopy management system has been chosen and is carried out as part of a planned program on a regular cycle. Trees are kept at a manageable size to facilitate effective spraying, efficient harvesting and adequate light penetration through the canopy (as judged by there being ground-cover plants (e.g. grass) in the inter-row space and minimal shading of lower branches).	8	6.1	76.63%
	TOTAL		11	8.8	80.42%

		PRE-HARVEST SUMMARY	Max. Points		
	1	ROOTSTOCKS & VARIETY	8	5.8	73.00%
	2	PHYTOPTHORA & VARIETIES	22	15.9	72.22%
	3	CLIMATE & ASPECT	5	3.9	78.29%
	4	IRRIGATION	15	10.6	70.61%
	5	NUTRITION	12	9.4	78.15%
	6	ANTHRACNOS MANAGEMENT	12	8.6	71.82%
	7	INSECT MANAGEMENT	10	8.7	86.77%
	8	POLLINATION	5	4.4	87.17%
	9	CANOPY MANAGEMENT	11	8.8	80.42%
	TOTAL		100	76.1	76.11%

		Phase 1 Grower Post-Harvest Qualicado Assessment Maximising Avocado Yields & Quality				
		Section 1: HARVESTING	**Max. Points**		
1a	Rain	Prior to rain events foliar fungicide program was maintained. After rain or heavy dew fruit is completely dry before harvesting and harvesting is delayed by 48 hours in the case of heavy or prolonged rain.	5	3.9	78.26%
1b	Maturity	Ripening and dry matter tests are conducted on fruit before harvesting. Only Hass with a minimum of 23% Dry Matter or Shepard with 21% Dry Matter are harvested.	9	7.9	87.85%
1c	Equipment	Regular maintenance is conducted on harvesting equipment and there is adequate suspension on bin trailers/runners.	5	4.6	91.04%
1d	Training	Pickers have been fully trained and instructed on which blocks to harvest and which fruit to pick. Pickers know that fruit dropped from more than 30cm is unmarketable and should be rejected. Fruit is handled gently.	8	7.3	91.05%
1e	Training	Pickers are trained to assess each piece of fruit for physical damage that would render it unmarketable and therefore should be rejected.	8	7.1	88.25%
1f	Field Bins	Immediately after filling, field bins are covered to reduce risk of sunburn. Within 30 minutes of filling, filled bins are collected from blocks to protect against sunburn and to bring the core temperature down. Bins are not overfilled.	5	4.8	95.37%
	TOTAL		40	35.5	88.71%

		Section 2: QUALITY ANALYSIS	**Max. Points**		
2a	Receival Bin Analysis	Bins are assessed for quality and picking issues such as harvesting damage and sunburn.	10	8.7	87.39%
2b	Reject Bin Analysis	If your packhouse produces Reject Bin Analysis Reports, this information is used to identify areas for improvement.	10	8.0	80.26%
	TOTAL		20	16.8	83.82%

		POST-HARVEST SUMMARY	**Max. Points**		
	1	Harvesting	40	35.5	88.71%
	2	Quality Analysis	20	16.8	83.82%
		TOTAL	60	52.2	87.08%

			Majority of growers produced <10 tonne/hectare	
1	My average yield over the last three years was: less than 10 tonne/hectare, 10-15 tonnes/hectare or more than 15 tonne/hectare			
2	My overall percetnage of marketable fruit was:		90%	Average
3	Of last season's marketable fruit, my class/grade breakdown was as follows:			
	Class 1		71%	Average
	Class 2		21%	Average
	Class 3		8%	Average
	Note:			
	Number of Growers that Completed Score Cards in Phase 1 Qualicado Workshops		176	

Phase 2 Grower Pre-Harvest Qualicado Assessment Maximising Avocado Yields & Quality				Nat. Summary	
Section 1: ROOTSTOCKS & VARIETIES			**Max. Points**	**Average**	**%**
1a	Suitability of varieties	The varieties you grow are suitable for your environment.	2	1.9	93.62%
1b	Rootstocks	Rootstocks have a proven history of good performance, are uniform, have some tolerance to *Phytophthora* root rot and do not make fruit unduly susceptible to anthracnose.	6	4.3	70.88%
	TOTAL		8	6.1	76.56%

		Section 2: PHYTOPHTHORA ROOT ROT CONTROL	**Max. Points**		
2a	Surface and internal drainage	There is at least 1.5 metres of well-drained soil (sandy, sandy loam, loam, or well-structured clay loam). Trees are planted on mounds. Underground drains have been installed if necessary to eliminate any wet spots. Water drains away quickly after rain and does not pond anywhere in orchard.	6	4.7	77.57%
2b	Nursery trees	Trees are purchased from ANVAS accredited nurseries. Upon arrival at the orchard, trees are never placed on the ground but are stored on an open mesh structure above the ground to prevent infection by *Phytophthora* and to allow excess water to drain away immediately.	3	2.7	88.85%
2c	Early establishment	Ground is prepared according to best practice recommendations with cover crops and incorporation of manure or compost and calcium well before planting (12 months). Young trees are mulched with coarse free draining material and preventative *Phytophthora* root rot control measures are taken: metalaxyl (e.g. Ridomil®) granules are applied to the soil, trees are drenched with phosphorous acid the day before planting and water is never allowed to pool around the tree.	3	2.3	75.61%
2d	Soil health	Steps are taken to improve the root environment especially in the under-tree area. These measures include maintaining a 10+cm mulch of coarse free draining material under tree canopies and adopting practices to minimise/alleviate soil compaction. Other practices could include the application of good quality compost.	3	2.3	76.31%
2e	Application of phosphorous acid	Root phosphonate levels are monitored annually and the results used to tailor phosphorous acid treatments. Healthy trees are treated in autumn either by injecting 20% phosphorous acid or by applying on average three 0.5% phosphorous acid foliar sprays. Sick trees are treated by injection, both in autumn **and** late spring. Timing of applications strictly follow recommended times (linked to the root growth cycle).	5	3.4	68.94%
2f	Irrigation and nutrition	Irrigation and nutrition is managed carefully to ensure adequate moisture and nutrient balance at all times; excessive or insufficient water and nutrients cause stress in avocado trees which pre-disposes them to *Phytophthora* root rot.	2	1.7	82.59%
	TOTAL		22	17.0	77.16%

		Section 3: CLIMATE & ASPECT	**Max. Points**		
3	Row direction, winds, frosts & aspect.	Tree rows run north-south where the slopes allow it. Orchard is not prone to frosts and is protected from strong prevailing winds (naturally or with windbreaks). Steeper blocks have predominantly E, NE or N aspects.	5	3.9	78.95%
	TOTAL		5	3.9	78.95%

		Section 4: IRRIGATION	**Max. Points**		
4a	Water quantity & quality	For each season there are between 9-16 megalitres (depending on locality) of irrigation water available per hectare of planted orchard area. The water supply is tested regularly and contains less than 80 mg/kg chloride and a conductivity of less than 0.6 dS/m (384 ppm). If conductivity is higher than this adequate leaching irrigations are applied.	4	3.0	75.19%
4b	Irrigation system	An irrigation system appropriate for the orchard conditions is used. The system uniformly waters each tree in the orchard and is regularly inspected. The uniformity of the system is tested at least once per year.	4	3.3	83.52%
4c	Irrigation scheduling	Irrigation scheduling is based on the readings from a reliable soil moisture monitoring system which is read several times per week. Special care is taken not to overwater or underwater trees. During the period starting from flowering through till the completion of rapid fruit growth, soil moisture is monitored more frequently and irrigations are more responsive. Irrigation to *Phytophthora* affected and smaller trees in the block (e.g. replants) is reduced to prevent waterlogging.	7	5.0	71.32%
	TOTAL		15	11.3	75.60%

		Section 5: NUTRITION		Max. Points		
5a	Monitoring	Full leaf tissue analysis is conducted between April and May every year. Full soil analysis is conducted at least every 3 years.	5	4.2	83.90%
5b	Fertiliser applications	Fertiliser applications are based on interpretation of soil and leaf analysis by an expert. Crop load is also taken into account, as soon as it is apparent, in determining nitrogen rates (higher rates for heavier crop loads). Foliar boron sprays are applied at flowering time to supplement soil applications if leaf levels are deficient.	4	3.4	85.81%
5c	Application interval	The interval between applications of nitrogen, potassium and boron is appropriate for the soil texture (e.g. ranging from weekly on sands to every 2 to 3 months on clay loam krasnozems).	3	2.6	86.87%
	TOTAL		12	10.2	85.28%

		Section 6: ANTHRACNOSE MANAGEMENT		Max. Points		
6a	Fungicide applications	Regular applications of copper fungicides are applied as foliar sprays between fruit set and harvest. The interval of 28 days during fine weather is shortened to 21 days following rain and 14 days during prolonged wet weather. Azoxystrobins (e.g. Amistar®) are used and specific resistance management guidelines are followed.	7	4.5	64.81%
6b	Other preventive measures	Other measures are applied including orchard hygiene (removal of old fruit, dead twigs and branches), good ventilation through the tree (achieved by means of canopy management), good insect control, and snipping rather than snap picking during humid conditions.	5	3.7	74.25%
	TOTAL		12	8.2	68.74%

		Section 7: INSECT MANAGEMENT		Max. Points		
7a	Monitor insect pests	Regular pest monitoring (scouting) is conducted for the main avocado insect pests that can occur in your area e.g. fruitspotting bug, fruit fly, leaf eating beetles, ivy leaf roller, scale insects, caterpillars, tea red spider mite.	2	1.6	80.39%
7b	Sprayer	Sprayer configuration and spray volumes are appropriate for the orchard. Mature orchards require 2,000-2,500L/ha for high volume sprays. Sprayer is calibrated at least once per year and takes into account tree size.	3	2.5	82.59%
7c	Control of insect pests	Appropriate registered pesticides are applied effectively when required.	5	4.3	86.57%
	TOTAL		10	8.4	84.14%

		Section 8: POLLINATION		Max. Points		
8	Pollinators and pollinisers	Insect pollinators are plentiful, if not beehives are brought in. In cool production areas effective polliniser varieties are interplanted in the orchard to assist with pollination and fruitset.	5	4.2	84.31%
	TOTAL		5	4.2	84.31%

		Section 9: CANOPY MANAGEMENT		Max. Points		
9a	Access	Harvesters are able to reach all fruit.	3	2.7	89.90%
9b	Pruning	A suitable canopy management system has been chosen and is carried out as part of a planned program on a regular cycle. Trees are kept at a manageable size to facilitate effective spraying, efficient harvesting and adequate light penetration through the canopy (as judged by there being ground-cover plants (e.g. grass) in the inter-row space and minimal shading of lower	8	6.3	78.98%
	TOTAL		11	9.0	81.96%

		PRE-HARVEST SUMMARY		Max. Points		
	1	ROOTSTOCKS & VARIETY	8	6.1	76.48%
	2	PHYTOPTHORA & VARIETIES	22	17.0	77.16%
	3	CLIMATE & ASPECT	5	3.9	78.86%
	4	IRRIGATION	15	11.3	75.60%
	5	NUTRITION	12	10.2	85.28%
	6	ANTHRACNOS MANAGEMENT	12	8.2	68.74%
	7	INSECT MANAGEMENT	10	8.4	84.14%
	8	POLLINATION	5	3.7	74.08%
	9	CANOPY MANAGEMENT	11	9.0	81.96%
	TOTAL		100	78.0	77.99%

		Phase 2 Grower Post-Harvest Qualicado Assessment Maximising Avocado Yields & Quality				
		Section 1: HARVESTING	**Max. Points**		
1a	Rain	Prior to rain events foliar fungicide program was maintained. After rain or heavy dew fruit is completely dry before harvesting and harvesting is delayed by 48 hours in the case of heavy or prolonged rain.	5	4.2	83.45%
1b	Maturity	Ripening and dry matter tests are conducted on fruit before harvesting. Only Hass with a minimum of 23% Dry Matter or Shepard with 21% Dry Matter are harvested.	9	8.5	94.09%
1c	Equipment	Regular maintenance is conducted on harvesting equipment and there is adequate suspension on bin trailers/runners.	5	4.5	90.57%
1d	Training	Pickers have been fully trained and instructed on which blocks to harvest and which fruit to pick. Pickers know that fruit dropped from more than 30cm is unmarketable and should be rejected. Fruit is handled gently.	8	7.3	90.91%
1e	Training	Pickers are trained to assess each piece of fruit for physical damage that would render it unmarketable and therefore should be rejected.	8	5.1	63.64%
1f	Field Bins	Immediately after filling, field bins are covered to reduce risk of sunburn. Within 30 minutes of filling, filled bins are collected from blocks to protect against sunburn and to bring the core temperature down. Bins are not overfilled.	5	4.6	91.28%
1g	Temperature	Fruit is delivered to the packhouse as soon as possible. Once arrived fruit core temperature is cooled to 10 - 14°C	4	3.5	88.71%
	TOTAL		**40**	**37.6**	**94.12%**

		Section 2: QUALITY ANALYSIS	**Max. Points**		
2a	Receival Bin Analysis	Bins are assessed for quality and picking issues such as harvesting damage and sunburn.	10	8.9	88.51%
2b	Reject Bin Analysis	If your packhouse produces Reject Bin Analysis Reports, this information is used to identify areas for improvement.	10	8.3	82.81%
2c	Dry Matter Testing	A Dry Matter (DM) test is undertaken on harvested fruit to ensure correct fruit has been harvested. At least one DM test done in first week of harvest.	10	8.0	79.84%
	TOTAL		**30**	**25.1**	**83.72%**

	POST-HARVEST SUMMARY		**Max. Points**		
1	Harvesting		40	37.6	94.12%
2	Quality Analysis		30	25.1	83.72%
	TOTAL		**70**	**62.8**	**89.66%**

			Majority of growers produced <10 tonne/hectare	
1	My average yield over the last three years was: less than 10 tonne/hectare, 10-15 tonnes/hectare or more than 15 tonne/hectare			
2	My overall percetnage of marketable fruit was:		**90%**	Average
3	Of last season's marketable fruit, my class/grade breakdown was as follows:			
	Class 1		**72%**	Average
	Class 2		**19%**	Average
	Class 3		**6%**	Average
	Note:			
	Number of Growers that Completed Score Cards in Phase 2 Qualicado Workshops		139	

Appendix 10: Facility checks summary

Packhouse - Codes of Recommendations	
Code	Recommendations
1	Dry matter testing of fruit at receival.
2	Post harvest fungicide pH adjusted.
3	Fruit probed at dispatch. Transport temperature with 48 hours of receival.
4	Dry matter testing throughout first 6 weeks of packing.
5	Machine improvements/design to remove impacts equivalent to greater than 100 mm drop.
6	Pre cooling processes driven by temperature results for each cool room and pallet position and room load.
7	Detailed feedback on ripening performance of each block using retention samples.
8	Staff training using AAL packages.
9	Pre-cooling and transport processes driven by temperature logging results.
10	Improved communication in chain.

Qualicado Packhouse Facility Checks - Summary **Phase 1**

Location	Question Code	Grower 1 - Atherton, Qld	Grower 2 - Dimbulah, Qld	Grower 3 - Mildura, Qld	Grower 4 - Mildura, Vic	Grower 5 - Blackbutt, Qld	Grower 6 - Pemberton, WA
Quality Plan	Q2, 3, 4, 5	Not documented some training and use of AAL training education materials	Not fully documented but very complete training and use of AAL training education materials	Not fully documented some training and use of AAL training education materials	NA small, well supervised system	Coles supplier and Freshcare Highly trained staff AAL materials used	Nil
Receival assessment and dry matter assessment	Q6, 7	Pre pick dry matter test.	A pre pick analysis is undertaken but not checked at receival or after packing	Partial receival analysis not documented.	Highly trained staff.	No recieval but used extensive dry metter teating of 10 fruitt.	100 fruit checked! No DM testing
Precooling and temperature management for spotting	Q7, 8	Some pre cooling to 5/7 C, fruit held up to 48 hours.	Storage times limited to 24 hours. Fruit not pre cooled.	Some pre cooling to 5/7 C, when temperatures high. Fruit held up to 8 hours.	NA as packing within 2 hours.	NA as packed in 2 hours	Packed in 24 hours
Sanitiser and Fungicide	Q8, 9, 10	Nil Sanitiser Non buffered Sportac for 15 Secs.	No sanitiser or fungicide applied.	Sanitiser used but not monitored.	NA no wash used.	NA	Nil used
Drying systems	Q11	30 - 40 C over brushes.	NA	41 C for 3 mins.	NA.	NA	NA
Quality/Sorting Packed product monitoring	Q12	High level of training and supervision No packed product monitoring.	A high level of training and supervision of packers was observed. Packed product monitoring could document this and provide evidence to customers.	A high level of training and supervision of packers was observed. Packed product monitoring could document this and provide evidence to customers.	A high level of training and supervision of packers was observed.	Highly trained and valued staff	High level training and supervision
Size Grading	Q13	As above	As above	As above	As above	As above	As above
Packing	Q14	As above	As above	As above	As above	As above	As above
Palletising	Q15	Auto	Strapping system.		As above	Straps	Strapping
Precooling	Q16	NA, coolrooms observed. No forced air cooling.	NA, coolrooms observed. No forced air cooling.	All fruit held in coolroom overnight. Temperature reached in 12 hours,	Nil as fruit packed continuously.	Room cooling no log or probing used	Room cooling no log or probing used
Storage	Q17	Up to 24 hours	NA daily dispatch	Up to 48 hours.	Up to 48 hours no precooling.	Maybe longer than 48 hours	max 6 hours
Transport	Q18	No temperature logging undertaken accredited transporters	NA daily dispatch accredited transporters	NA daily dispatch accredited transporters	Dispatch 2-3 times each week.	No logs or evidence transhipment very common	Tranship perth
Temperature logs	Q18	NA,	NA,	NA	NA	Nil	NIL
Calibrated sphere results		Two runs completed with spikes at the bin tipper and just before the singulator.	Three runs completed with spikes at the bin tipper and just before the singulator.	Three runs completed with spikes at the bin tipper and just before the singulator.	One run with spikes at the bin tipper.	One run Bin tipper and rollers gave high level of impact.	one run short with two impacts prior to graging.
Library tray system	Q6	Nil	Informal monitoring.	Small samples taken each day (6 fruit).	Nil as fruit packed continuously.	Nil but maybe useful for organic status.	informal monitoring
Key recommendations		Upgrade to the system planned to overcome fruit drops. Recommend 1 2 3 5	Library tray system discussed. Recommend 1 2 3 7	Upgrade to the system planned to increase through put. Recommend 4 5 6 8	Correction of the bin tipper discussed.Recomend 2 3 5	Library tray discussed Recommend 7 4 9	Packline improvements discussed. Recommend 6 5 2

Qualicado Packhouse Facility Checks		Phase 1					
Location	Question Code	Grower 7 - Ravensbourne, Qld	Grower 8 - Blackbutt, Qld	Grower 9 - Ravensbourne, Qld	Grower 10 - Port Macquarie, NSW	Grower 11 - Port Macquarie, NSW	Grower 12 - Port Macquarie, NSW
Quality Plan	Q2, 3, 4, 5	Fresh care	Woolworths	Yes	Yes Woolworths 6 8 growers ripener	HACCP	Nil
Receival assessment and dry matter assessment	Q6, 7	Each bkock sampled before harvest	dry matter and ripening test	dry matter seed coat ripening test	yes 23% ripening test	yes 23%	no
Precooling and temperature management for spotting	Q7, 8	Vague could be 72 hours	24 hour max 4-7 C	max 5 days storage under 5 in 24 hours	Pre cool to 10C	Precool	Nil
Sanitiser and Fungicide	Q8, 9, 10	Nil santiser used sportak not ph altered.	Nil used no sportak	Nil santiser sportak	No saniitser Sometimes sprtak depending on history PH 7	Sportak No sanitiser	no sanitiser sportak
Drying systems	Q11	NA	NA	NA	Dry air	Air	Nil
Quality/Sorting Packed product monitoring	Q12	Packed product moniyoting iused	Yes 2 trays/pallet continuous monitoring	Packing line monitoring	Trained staff	No formal training high degree of supervision	same staff each year
Size Grading	Q13	As above trays weighed.	yes continuos	Packed product monitoring	Packed product monitoring	No formal system	No formal system
Packing	Q14	As above trays weighed.	as above	As above	As above	As above	Nil
Palletising	Q15	Auto	auto	as above	As above	As above	Nil
Precooling	Q16	Room cooling no log storage times vague		Yes room cooling	Temp logger data	No records	Nil
Storage	Q17	Suspect longer storage	24 hours max	up t 5 days	Dispatch daily	Up to 7 days	No on farm cooling
Transport	Q18	Tranship	cooling log probes fruit	cooling log	Some monitoring of transhipment	Tranship Sydney	Transport depot
Temperature logs	Q18	no evidence	temp log	temp log used with probing	Yes	Nil	Nil
Calibrated sphere results		One run with bin tipper high level of impacts through out line. Severe bin tipper	Two runs with tipper, many small bumps	large pack line low impacts.	Low level of impact 2 runs	low levels of impact 5 runs	1 run small line low impacts
Library tray system	Q6	Nil	1 fruit/day	3 rd grade fruit	ripened fruit check	No formal system	Nil
Key recommendations		Pack line improvements discuused Recommend 2 3 6 5	Recommend 2 4	Recommend 2 6	Recommend 2 5	Recommend 2 4 5 6	NA

Qualicado Packhouse Facility Checks		Phase 1				Phase 2	
Location	Question Code	Grower 13 - Pemberton, WA	Grower 14 - Pemberton, WA	Grower 15 - Bundaberg, Qld	Grower 16 - Bundaberg, Qld	Grower 17 - Mareeba, Qld	Grower 18 - Mareeba, Qld
Quality Plan	Q2, 3, 4, 5	Yes Haccp	yes	Yes coles	Yes coles and WW	Avolution Freshcare	Costas Harvest Natues sunfresh Freshcare ICA
Receival assessment and dry matter assessment	Q6, 7	NA	NA	yes on blocks	blocks only	1 or 2 samples Back packer strip	4 - 5 tests thru DAFF Mix sample
Precooling and temperature management for spotting	Q7, 8	yes precool to 5 24 hours	Yes precool	<24 hours packing	pre cool to 10 C	with in 24 hrs	Delay harvestLarge bump here
Sanitiser and Fungicide	Q8, 9, 10	Sportak No sanitiser	Sportak No sanitiser	Sportak No sanitiser	Sportak No sanitiser	Sportac ph 7.5	Sportac no ph adjust change twice each day
Drying systems	Q11	nil	nil	dry air	forced air	Brushes 1 min	60 C
Quality/Sorting Packed product monitoring	Q12	Trained staff	NA	Trained staff	Trained staff	Standards poster Continous supervision	PPM as per shepard quality manager
Size Grading	Q13	Packed product monitoring	NA	Packed product monitoring	Packed product monitoring	Check carton weoghts	Check carton weights
Packing	Q14	as above	as above	as above	as above	continous supervision	PPM and reject analysis
Palletising	Q15	auto	Auto	Auto	Auto	Finished to cooler	auto
Precooling	Q16	logger results	NA	logger results	probe reults	12 - 24 hours no check room cool	12 - 18 hrs
Storage	Q17	24 hour max	24 hour max	24 hour max	24 hour max	12 hours	Costas have checked
Transport	Q18	Tranship Perth	NA	Tranship BNE	Tranship Lindsy	MRT	Lindsay
Temperature logs	Q18	yes	NA	yes	Discussed		Costas have checked
Calibrated sphere results		NA excellent facility	NA	Yes 2 runs high level imnpact	Yes low level impacys	Mnil	Nil many 100 mm drops
Library tray system	Q6	Informal	NA	Yes highly developed library tray.	No	Nil	Nil
Key recommendations		Recommend sphere trial, recommend 6 9 10	Recommend sphere trial	Recommend 2 4 10	Recommend 2 4 6 10	Recommend 1 3 4 7	Recommend 1 5 7

Qualicado Packhouse Facility Checks

<table>
<tr><td colspan="2"></td><td colspan="3"></td><td>Phase 2</td><td colspan="2"></td></tr>
<tr><td>Location</td><td>Question Code</td><td>Grower 19 - Atherton, Qld</td><td>Grower 20 - Mooball, NSW</td><td>Grower 21 - Carabooda, WA</td><td>Grower 22 - Carabooda, WA</td><td>Grower 23 - Ban Ban Springs, Qld</td><td>Grower 24 - Kumbia, Qld</td></tr>
<tr><td>Quality Plan</td><td>Q2, 3, 4, 5</td><td>Costas WW Coles</td><td>Woolworths QA
HACCP
Freshcare</td><td>ICA
Freshcare</td><td>ICA30 in case of interstate transfer
Freshcare</td><td>Good freshtrack system as part of Freshcare + ICA30 in case of moving fruit to WA</td><td>Freshcare for Coles plus ICA02 approved</td></tr>
<tr><td>Receival assessment and dry matter assessment</td><td>Q6, 7</td><td>DM over 3 weeks 3 sizes</td><td>Visual check by farm manager on dispatch plus at receival in bins DM across orchard but normally well above minimum for Hass</td><td>DM checks prior to start of picking Start when consistently 24-25%DM</td><td>DM tests in week or two before picking</td><td>DM tests in week or two before picking Full traceability from block to box</td><td>Work with Sunfresh to do preharvest dry matter testing then Sunfresh to testing on first consignments.</td></tr>
<tr><td>Precooling and temperature management for spotting</td><td>Q7, 8</td><td>Creep feed 12 hour delay max</td><td>Pack same day, no precooling</td><td>Pack same day in Aug-Sept. Precool if late pick monitoring temp with probe.</td><td>Hold fruit at 7-8°C if required</td><td>Hold fruit at 6.5°C if required</td><td>Pick 3-4 days a week for packing twice a week. Hold @ 8°C if required</td></tr>
<tr><td>Sanitiser and Fungicide</td><td>Q8, 9, 10</td><td>Sportac no ph adjust</td><td>Water, no sanitiser Sportac no pH adjust</td><td>Water + sanitiser, pH adjusted. 10-20 sec under sportac spray</td><td>Run to waste water used without sanitiser
Sportak mix records kept, no pH adjustment</td><td>Fully automated chlorine generator in full emersion dump Sportak + dimethoate 30 sec tmt, no pH adjustment</td><td>1-10 min in straight water bath dump without sanitiser. Cleaned daily. Spray clean using recirc water changed daily. Add sportak with vinegar to move to pH4.0.</td></tr>
<tr><td>Drying systems</td><td>Q11</td><td>no dry</td><td>Ambient fans used when cooler wet fruit come through shed</td><td>No drying</td><td>No drying</td><td>Ambient air knife drying</td><td>No drying</td></tr>
<tr><td>Quality/Sorting Packed product monitoring</td><td>Q12</td><td>Quality poster</td><td>Standards poster, continuous supervision, daily training and feedback through reject fruit monitoring</td><td>Own quality poster developed for grade 1&2 sorting. 2% PPM for freshcare.</td><td>Tuula does PPM as part of QA</td><td>PPM as art of QA selecting one tray for every half hour of packing for each size.</td><td>QA PPM one tray in 160(pallet) plus oversight of owners</td></tr>
<tr><td>Size Grading</td><td>Q13</td><td>check weights</td><td>Calibrated daily</td><td>Auto calibrate + check weights</td><td>Calibrate daily, weekly cleaning</td><td>Auto calibate plus weight checks using calibration balls</td><td>Machine calibrated annually plus self calib daily</td></tr>
<tr><td>Packing</td><td>Q14</td><td>Monitoring</td><td>Continuous supervision and sticker person casts final eye over quality. >100m fruit drop into boxes on packing line</td><td>Packed product monitoring. Continuous supervision Inspect at labelling</td><td>Packers normally only work 3-4 hours a day so keep fresh, No reject bin analysis, Match blemish standard to market.</td><td>PPM feedback to packers. No library trays. Visual check for reject bin analysis.</td><td>PPM feedback to packers. No library trays. Visual check for reject bin analysis. >90% packout to first grade</td></tr>
<tr><td>Palletising</td><td>Q15</td><td>auto</td><td>Shed manager linking to QA system</td><td>Owner or pack-shed manager palletises and consigns every 2nd day or 3-5 days if wholesalaer wants to hold fruit</td><td>Standard</td><td>Standard</td><td>Standard</td></tr>
<tr><td>Precooling</td><td>Q16</td><td>12 hours no checks</td><td>Overnight precooling not as imprtant for direct to local woolworths stores</td><td>Pulp temp testing in cartons before dispatch</td><td>Take pulp temperature at dispatch so that fruit are 8-10°C into truck</td><td>Packed, cooled and gone the next day</td><td>Precool to 8°C, with most fruit seeing coolroom before transport</td></tr>
<tr><td>Storage</td><td>Q17</td><td>No checks Costas have sampled</td><td>No forced air needed, Do own ripening for local store supply</td><td>No forced needed</td><td>Ambient</td><td>Ambient</td><td>Ambient</td></tr>
<tr><td>Transport</td><td>Q18</td><td>Lindsay</td><td>Local or direct to Brisbane, Sydney and Melbourne.</td><td>To Perth and possibly east depending on wholesaler</td><td>Not refrigerated into truck for short trip to Perth to Etherington's for distribution to wholesalers</td><td>DRT Logistics use 6°C in trucks</td><td>Lindsay Transport @ 6°C</td></tr>
<tr><td>Temperature logs</td><td>Q18</td><td>Costas have checked</td><td>Temp logging 2-3 times per season</td><td>1hr to Perth with fruit precooled to 5-7°C</td><td>Not monitored</td><td>Not monitored</td><td>Not monitored</td></tr>
<tr><td>Calibrated sphere results</td><td></td><td>Many 100 mm drops issues with skin spotting</td><td>None done</td><td>Not done</td><td>Not done</td><td>Not done</td><td>Not done</td></tr>
<tr><td>Library tray system</td><td>Q6</td><td>Nil</td><td>Yes and individual fruit but could be more rigorous</td><td>Library trays only kept towards end of season.</td><td>No but monitor if there is an emerging problem</td><td>No but monitor if there is an emerging problem</td><td>No but monitor if there is an emerging problem</td></tr>
<tr><td>Key recommendations</td><td></td><td>Recommend 1 5</td><td>Recommend 5 plus sanitiser in wash over rollers</td><td>Recommend 5 (100mm drop) plus monitor time in bath dump</td><td>Recommend 5 (100mm drop) and 9 to monitor fruit temperature after departing packing shed.</td><td>Recommend 3 (probe fruit to confirm expected pulp temperatures) & 5 (check padding on drop after dump ramp)</td><td>Recommend 2 plus sanitiser</td></tr>
</table>

Qualicado Packhouse Facility Checks

Location	Question Code	Grower 25 - Kumbia, Qld	Grower 26 - Childers, Qld	Grower 27 - Mareeba, Qld	Phase 2 Grower 28 - Mareeba, Qld	Grower 29 - Mareeba, Qld
Quality Plan	Q2, 3, 4, 5	Freshcare plus accreditation for Coles through Sunfresh	Freshcare only (No ICA/fenthion)	QA for AE Chave P/L & LaMannas (Brisbane market)	Freshcare & mainly through Muray Bros (Brisbane) to Aldi/ Coles/ Woolworths/ Independents.	ICA, Freshcare, Coles environmental
Receival assessment and dry matter assessment	Q6, 7	Liaise with Sunfresh re DM testing and try to linger late in the season	Start when others start, particularly when Jim Carney starts. Has done DM testing in past. Start by selective picking on blocks with earlier flowering.	Use DAF DM testing service in Mareeba. Four blocks in different stages of recovery.	Use DAF to check DMs with careful supervision of pickers in small operation.	Use DAF to check DMs with checking of fruit size of blocks on three farms.
Precooling and temperature management for spotting	Q7, 8	Precool to 6°C if need to.	No precooling, just pick, store overnight and pack ambient fruit the next day. Stops condensation on fruit through line.	Pick and then pack next day. Overnight in ambient temperature.	Prefer to pick and pack same day in small operation	First picked is first packed with max of 1 day in ambient in shade in shed.
Sanitiser and Fungicide	Q8, 9, 10	No sanitiser in dump. Fruit can be in dump more than 2 mins. No wash on brushes. No pH adjustment with Sportak (water pH 6.0) with dimethoate	Chlorine dioxide (Vibrex) plus HCl sanitiser after fruit dump. 55 secs under soft brushes. 60secs under run to waste Sportak.	Run to waste Sportak for at least 15secs. No water (or sanitiser) over brushes after fungicide spray. Water pH at 6.5.	45secs through Sportak spray. pH adjusted to 4.5. Recycle spray but change daily. Bump through on brushes	No spray or samitiser used over brushes. Brushes after sorting and fungicide in case rotten fruit come through preventing them from getting to brushes. Run to waste Sportak and changed daily.
Drying systems	Q11	No drying causes some challenges with stickering	Diesel powered dryer at 50-55°C	Ambient temp using two blowers for drying	Ambient temp using blower for drying	Ambient temp using two blowers for drying
Quality/Sorting Packed product monitoring	Q12	Simple system of marks up to $2 coin in first grade and 20c piece is second grade. Staf retained for 2-4 years.	First sorter separates out rejects while packers separate into premium and first grades. Two staff monitor reject bins 3-4 times a day and packers grading. Basic PPM.	First sorter separates out rejects and then into premium and first grades. Matt monitors reject bin a number of times a day and packers grading. Basic PPM.	First sorter separates out rejects and then into premium and first grades. Matthew monitors reject bin a number of times a day and packers grading. Basic PPM.	First sorter separates out rejects and then into premium and first grades. Lucy monitors reject bins and PPM.
Size Grading	Q13	Machine checked once a year with tray weights checks for sizes in morning then 2X per pallet.	Machine calibrated daily plus all size range checked through day.	Calibrated once per season plus checks trays to ensure over 5.5kg especially in first two days of operation.	Calibrated once per season plus checks trays to ensure over 5.5kg.	Calibrated once per season plus hourly checks trays to ensure over 5.5kg.
Packing	Q14	PPM 2 trays per pallet plus at stickering and palletising.	Informal PPM	Basic PPM	Informal PPM	PPM
Palletising	Q15	Standard plus barcode tracking to also help preselling.	Use pallet cards through pallet cutting chimney, tape and corner pallets.	Traceability from pallet back to blocks using barcode scanner. Mix sizes on pallets based on negotiation with wholesaler.	Small operation but would normally separate 18-22 count on one pallet and smaller plus bulk on another.	Palletising by size
Precooling	Q16	Precool to 6°C, with most fruit seeing coolroom before transport	Don't precool prior to transport and aggregation in Bundaberg.	Precool to 5-7oC but no measures taken. JAT refrigerated Services track fruit temperatures with probes.	Have done testing on room to ensure it drops to 6-7°C. Lindsay's can probe fruit. Talks to George at Murray's twice a week to ensure good outturn at wholesalers	Precool to 7oC using forced rooms with tarps set to 5oC. Monitor temp on dispatch.
Storage	Q17	Ambient	Ambient	Forced air room	Forced air with no tarp	Forced air room with tarps in two rooms
Transport	Q18	Lindsay Transport @ 6°C	Into trucks at 25°C with trucks set at 5°C	Into trucks at 6°C	Lindsay Transport @ 7°C	Into trucks at 7°C
Temperature logs	Q18	Not monitored	Not monitored	Not monitored on farm	Not monitored	Temps recorded
Calibrated sphere results		Not done	Not done	Not done	Not done	Not done
Library tray system	Q6	No but monitor if there is an emerging problem	Yes	Use of one library tray per day per grade.	Use of one library tray per week.	(Didn't ask in follow up call to Peter)
Key recommendations		Recommend 2 and 5 (100mm drop) plus monitor time in bath dump, plus use of sanitiser.	Recommend 1 and 4, consider 2 and 10	Recommend 4, 3 and 6. order of fungicide brushes plus source for digital thermometer probes australia	Recommend run to waste fungicide spray despite good pH adjustment, fruit temp probing (9), 4, 10.	Recommend 1, 5, consider better receival monitoring and value of switching sportak to after brushes to increase effectiveness of fungicide application

Qualicado Wholesale Facility Checks - Summary

	Recommended Practices	Wholesaler 1 - Brisbane, QLD	Wholesaler 2 - Perth, WA	Wholesaler 3 - Perth, WA	Wholesaler 4 - Perth, WA	Wholesaler 5 - Sydney, NSW
Receival	Receival assessment Temperature, Fruit age, Stage of season Staff training Receival assessment record. Feedback to growers and transporters.	Recieval check Record, Trained staff 4 fruit temp probed from 3-4 trays	Receival check as per Brisbane. Good communications.	Maturity levels checked. Temperature checked on arrival, Feed back to growers. QA check and record.	Receival assessments for fruit and handling conditions.	Assessed subjectively with receival assessment documented. Verbal feedback to growers and transporters.
Plan ripening schedule	Storage times and temperatures and variation according to variety, fruit age, stage of season, orders. Ripening conditions and temperatures and variation according to variety, fruit age, stage of season, orders. Decisions	Yes but decisions not documented Feed back to growers a priority	Decisions on ripeneing on arrival according to condition. Perth wants ripe fruit greater than East Coast.	High level of planning. Highly documented.	Decisions based on seasonality maturity and arrival conditions excellent computer documentation. Excellent monitoring.	All planning done but subjective
Facilities	Ripening temperatures and room variation documented..Ethylene injection systems, duration and concentrations.Venting systems for CO2.Forced air cooling/heating.	Hands on and a contractor. Tarped forced air cooling	Trickle injection, no forced air	Trickle ethylene Forced air cooling/heating.	Excellent venting and temperature control. Conditions monitored and used to control ripening.	No documentation of ripening temperatures and room variation. No ethylene injection systems. Venting of rooms for carbon dioxide practiced with low rigour.
Ripening and storage conditions monitored	TemperatureSet and actual temperatures monitored.Variations monitored.EthyleneSet and actual concentrations monitored.Carbon Dioxide set and actual concentrations monitored. Ripeness Shelf Life assessment monitoring records. Staff training.	Constant fruit checks, no monitors, no ripe fruit checks	No monitoring and problems with equipment. Known hot spots.	No condition monitoring.	Fully monitored by portable and fixed monitors for CO 2 and temperature.	Set temperatures used but not monitored. Variations not monitored. Fixed ethylene injections not monitored Regular venting for CO2 with regular venting but not monitored. No shelf life assessment, or staff training undertaken.
Dispatch check	Dispatch assessment. Feedback to growers and transporters.	Dispatch assesment undertaken	As per Brisbane	Shelf life assesment 1 tray retnetion sampled. No Monitoring. Good staff training. Dispatch check.	State of the art sytems and facilities. Ex DPI project collaborators. All parts of the system monitored and documented.	Dispatch documentation kept, Feedback to growers and transporters done verbally and verbal feedforward to retailers
Recommendations		Greater use of room condition and temperature monitoring. Greater use of retention samples. Greater documentation of decisions.	Monitoring of room conditions essential. Forced air systems a priority.	Greater documentation of retention samples. Greater temperature and condition monitoring.	Ethylene monitors. Training videos for staff.	A. Implement a formal documentation and review process foreach and every incoming to outgoing consignment B. In concert, implement a monitoring to manage measuring and data logging system for critical control parameters; e.g. temperatures, ethylene concentrations C. Review your 'best practice' principles, including in relation to operations review meetings and staff training, in a commitment to continuous improvement context D. Extend the check based on the initial visiti to include a ripening facilities inspection

Qualicado Wholesale Fa

	Recommended Practices	Wholesaler 6 - Sydney, NSW	Wholesaler 7 - Perth, WA	Wholesaler 8 - Adelaide, SA	Wholesaler 9 - Adelaide, SA	Wholesaler 10 - Melbourne, VIC
Receival	Receival assessment Temperature, Fruit age, Stage of season Staff training Receival assessment record. Feedback to growers and transporters.	Subjective receival assessment with documentation recorded. Questionable staff training rigour. Verbal feedback to growers and transporters.	Receival assessments include probing fruit in top middle and bottom of pallets. Email growers and transporters re receival.	Utilise muddy boots system that Coles' use. QC person does receival assessment incl firmness temp etc to spec then sent to national coordinator in Melb. With feedback from James Peik to growers	Under ICA arrangement inspect min of 3 trays per consignment for fruit fly, quality, temp and photos taken. Ipad based reporting that is communicated locally and nationally then back to supplier grower.	Manage their risk by undertaking receival assessment against grade standards examining temperature, fruit quality and look from growers of any issues. Record issues if they exist taking photos and contacting growers.
Plan ripening schedule	Storage times and temperatures and variation according to variety, fruit age, stage of season, orders. Ripening conditions and temperatures and variation according to variety, fruit age, stage of season, orders. Decisions	Either not gas ripened or this aspect is attended to by banana ripeners.	Prefer fruit not too advanced re ripening, want hard green fruit	Plan orders for Coles & Woolies for following week. Plan to movbe quickly. No real storage post ripening.	Encompasses what happens at receival for fruit at different stages of ripeness. Quite set for major retailers but ripening for independents depends on market value at the time. Expect that at the start of the season for an area that will need an extra 2-3 days ripening. Ideally a 5 day turnaround.	Whilst awaiting move to new market facilities, Granieri's have no ripening room capacity, so store at 6-8°C and limited ripening in ambient conditions. Not pursuing ripening when about to move and price dropping in market.
Facilities	Ripening temperatures and room variation documented..Ethylene injection systems, duration and concentrations.Venting systems for CO2.Forced air cooling/heating.	Sub-contracted to banana ripeners when relevant	Individuals checking fruit temperatures. Facilities basic with ethylene trickle system but not monitored. Operation is more like a shot approach with open door venting two times a day with door open for 15 mins.	Indivs checking temps at 5-6°C initial storage, 20°C ripening and 5°C post ripening storage. Trickle computer controlled but regular opening/checking of fruit. Outside contractor checks room venting.	Trickle room setup to automatically monitor CO_2 with appropriate venting. Training undertaken as a team.	Currently just ambient coolrooms set at 6-8°C
Ripening and storage conditions monitored	TemperatureSet and actual temperatures monitored.Variations monitored.EthyleneSet and actual concentrations monitored.Carbon Dioxide set and actual concentrations monitored. Ripeness Shelf Life assessment monitoring records. Staff training.	Ripening aspect sub-contracted to banana ripeners when relevant	Good forced air capacity in ripening rooms but not used. Poor monitoring in of ethylene in existing rooms but tolerance range of 2°C in temperature monitoring. Best monitoring is repeat sales with other wholesalers purchasing from F-E.	Good forced air capacity but fruit in post ripening forced air for up to 24hr in high humidity room	Monitor room and fruit temperature. Calibrate equipment once a month and keep records. Challenged with carton collapse with some suppliers (e.g. Simpson Farms).	No ripening facility at inspection
Dispatch check	Dispatch assessment. Feedback to growers and transporters.	Medium rigour in documented dispatch assessment with verbal feedback to growers and transporters and feedforward to retailers	Temperature records as part of QC check against specifications. Email feedback to growers and transporters on stem end rot if supplied in rainy periods. If issues resolve by negotiating on price.	Full dispatch assessment of quality against specs, photos taken and fruit cut to examine internal quality. Info on report sent to avo technologist and tracing if there is an issue. DC's do their own receival assessment.. National QC Manager feeds back to grower	Probe fruit to monitor temperature at receival and dispatch. Feedback to growers if required as a corrective action report, particularly if an issue emerges on day 2 of 5 in the ripening process. Dispatch chcek done knowing DC will do their own spec check but these aren't shared but used as form of risk management and insurance in case of dispute	No quality assessment on dispatch , relying on negotiating price on quality. Explain to grower is different to market floor price with photos if need be.
Recommendations		A. Implement a formal documentation and review process for each and every incoming to outgoing consignment B. In concert, implement a 'monitoring to manage' measuring and data logging system for critical control parameters; e.g. temperatures, ethylene concentrations C. Review your 'best practice' principles, including in relation to operations review meetings and staff training, in a commitment to continuous improvement context D. Consider the negative implications of not gas ripening on avocado fruit quality as seen by the shopper (e.g. greater variability in ripeness in a display) and consumer (e.g. greater decay incidence and severity, more bruise damage) E. Extend the check based on the initial visit to include a ripening facilities inspection, albeit they being those of a collaborating banana ripener F. Consider developing in-house avocado ripening capacity	Given new facilities planned for commissioning in Feb 2016, seek assurance of greater control, monitoring and alert system installed re ethylene and temperature monitoring, particularly if contract ripening for other wholesalers	Highly detailed monitoring and documentation plus detailed feedback to growers. Potential issue with length of time fruit stored post ripening under forced air (>12hr)	Good systematic approach to management of the handling and ripening processes. Good use of local and national capacity of LaManna group.	Provide detailed postharvest management information to encourage best practice approach to handling and ripening at new Melbourne market facility.

Qualicado Wholesale Fa				
	Recommended Practices	Wholesaler 11 - Brisbane, QLD	Wholesaler 12 - Melbourne, Vic	Wholesaler 13 - Melbourne, Vic
Receival	Receival assessment Temperature, Fruit age, Stage of season Staff training Receival assessment record. Feedback to growers and transporters.	Staged assessment of consignments based upon emergent risk. QA person trained and monitored by sales personnel. Records kept of ripeness, edibility, photos but not dry matter. Feedback to growers with full QA via email. Phone call to negotiate price if needed.	2 staff who report to Joe Manariti do QA reports. Minor issues dealt with by FYI emails, major issues renegotiate on price and redirect to different buyers or sale off the floor.	Delivery details are checked. Quality assessment is standard on all fruit based on supermarket specs checking quality size, temp and weight. All reports are emailed on all consignments.
Plan ripening schedule	Storage times and temperatures and variation according to variety, fruit age, stage of season, orders. Ripening conditions and temperatures and variation according to variety, fruit age, stage of season, orders. Decisions	Have standard procedures to meet varous client ripeness stage needs. Have agreed colour stage (3-4 for woolies, 6-7 for food service) and timeframe for delivery to retail. Traceability of consignments with barcoding.	Hold for up to 4 days at 10-12°C. Keep closer eye on NZ fruit temperatures., Then Shot ripening foloowed by a day or two back in the 10-12°C room.	Fruit held at 8°C under forced air for 2 days prior to ripening. Standard shot ripening plus 1 day cooling prior to dispatch.
Facilities	Ripening temperatures and room variation documented..Ethylene injection systems, duration and concentrations.Venting systems for CO2.Forced air cooling/heating.	22 rooms in Brisbane, electronically controlled with alarm systems and manual checking, most with shot ripening venting 2-3 times a day. High humidity for up to 4 days (2 days ripen, 1 day cool, 1 day to dispatch) in use for past 3 years	Standard shot ripening rooms opening doors for 15 mins twice daily. Monitor condition of batches watching colour and texture. Careful about early WA fruit (uneven ripening) and cautious with Sheperds.	Standard shot rooms vented twice per day with annual (or perhaps better) calibration.
Ripening and storage conditions monitored	TemperatureSet and actual temperatures monitored.Variations monitored.EthyleneSet and actual concentrations monitored.Carbon Dioxide set and actual concentrations monitored. Ripeness Shelf Life assessment monitoring records. Staff training.	Electronic monitoring with 0.5°C tolerance with alarms, manual check against coolroom door chart instructions. Fruit probed at front, rear and middle of load. Data recorded into QA systems for Coles & Woolies.	Electronic alarms and alerts systems. Door charts on rooms for comms between staff. Keep retention samples for 1--14 day period.	Standard alarms and alert systems. Door charts for backup comms. Fruit and air monitoring.
Dispatch check	Dispatch assessment. Feedback to growers and transporters.	Comprehensive QA check against Coles & Woolies specs. Visual check for independents. Alter ripeness specs if distant market. Have check meetings to review procedures. If issues emerge with rots, QA photos taken to send to grower, renegotiate price and assign to less discerning buyer.	Premium fruit never an issue but Class 1 fruit checked closely. Ripeness can be renegotiated when fruit in short supply.	Dispatch docs out to growers and used with retailers if necessary. Buyers do their own assessment at DC receival.
Recommendations		Better integration of the LaManna consignment/batch tracking system with the systems of LaManna's retail clients to enable more comprehensive tracking systems of fruit consignments	Seek provision of dry matter information from grower to inform ripening. Consider winding down temperature in holding rooms. More attention to staff training ands keeping records of the staff training.	Continue to look for greater opportunities for communication and increasing supply chain value.

Appendix 11: Weekly Infocado report (example)

INFOCADO WEEKLY REPORT: 23rd — 29th January 2016 (Week 5)

Horticulture
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Australia

Click here to learn How to conduct Dry Matter tests at home

Click here to for a refresher on how to contribute to Infocado

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Click here to download avocado supply chain education materials

Comments

- The weekly dispatch volume (246,679 trays) was slightly higher than the week's forecast by about 18,042 trays (8%).

- The four weekly forecast continues to indicate varied volumes through February with WA and NZ finishing their harvest and NQ nearing the start of theirs. NQ packers are reminded to carefully monitor fruit maturity as the harvest season approaches, to ensure consumer satisfaction which drives future purchases.

- The largest volume of dispatches in week 5 originated from Western Australia (128,115 tray eqv.). The Sydney market received the highest volume (101,615 tray eqv.), size 20 was the dominant size (45,150 tray eqv.) (refer P 3).

- NQ Infocado packhouse contributors are reminded to update their four week forecast a month before they start harvesting (refer P 2).

- There has been a lot of media attention over the past week regarding avocado supply, demand and pricing. Some comments made by industry members can be very damaging to the industry and we encourage you to work with Avocados Australia in relation to any public comments about industry matters to ensure we have a consistent and positive message. Avocados Australia has expertise in media management and will continue to work with the media as required to minimise consumer backlash from recent comments.

Marketing Update:

Following on from the success of the 'mashed-up' and 'chef series' – the next round of content videos is about to begin production. The creative this time will have a 'love theme' which will be launched on Facebook on February 14 – Valentine's Day.

For a full brief please refer to the Guacamole Enewsletter - 22 Jan 2016.

Upcoming Holidays
Waitangi Day (NZ): 8th Feb | Labour Day (WA): 7th March | Canberra Day (ACT) & Labour Day (VIC): 14th March | Good Friday: 28th March |

Report Index

Forecast Data (Week 5 - 9)

Variety	Trays - Total	Bulk	P/Pk	All - Total
	5.5Kg Eqv	10Kg	Kg	5.5Kg Eqv

Week 5 - begin 23/01/2016

Variety	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/Pk Kg	All - Total 5.5Kg Eqv
Hass	194,157	10,713	5,000	**214,544**
Lamb Hass	4,520	200		**4,884**
Reed	8,300	500		**9,209**
Week Total	**206,977**	**11,413**	**5,000**	**228,637**

Week 6 - begin 30/01/2016

Variety	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/Pk Kg	All - Total 5.5Kg Eqv
Hass	219,873	8,843	5,000	**236,860**
Lamb Hass	4,130	288		**4,654**
Reed	8,500	575		**9,545**
Shepard	1,000			**1,000**
Week Total	**233,503**	**9,706**	**5,000**	**252,059**

Week 7 - begin 06/02/2016

Variety	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/Pk Kg	All - Total 5.5Kg Eqv
Hass	215,760	6,176	5,000	**227,898**
Lamb Hass	6,000	234		**6,425**
Reed	8,300	555		**9,309**
Week Total	**230,060**	**6,965**	**5,000**	**243,633**

Week 8 - begin 13/02/2016

Variety	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/Pk Kg	All - Total 5.5Kg Eqv
Hass	136,990	5,668	5,000	**148,204**
Lamb Hass	400	20		**436**
Reed	8,000	500		**8,909**
Shepard	1,000			**1,000**
Week Total	**146,390**	**6,188**	**5,000**	**158,550**

Week 9 - begin 20/02/2016

Variety	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/Pk Kg	All - Total 5.5Kg Eqv
Hass	100,771	4,159	5,000	**109,242**
Week Total	**100,771**	**4,159**	**5,000**	**109,242**

Dispatch Data (Week 5 - begin 23/01/2016)

Variety	Trays 5.5Kg Eqv	Bulk 10Kg	P/PK Kg	5.5Kg Eqv Total Trays
Hass	212,940	6,832	605	**225,472**
Lamb Hass	5,174	158		**5,461**
Reed	15,520	124		**15,745**
Total	**233,634**	**7,114**	**605**	**246,679**

Dispatch vs weekly forecast - all varieties and all packs
(5th September 2015 to 26th February 2016)

New Zealand Avocado Exports—Forecast v Actual Infocado/Export Statistics (5.5kg eqv trays) July 2015 - March 2016

Export Destination	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total to Date
NZ-Aus - Pre Season Forecast[1]	17,160	109,680	384,240	330,990	378,100	496,690	463,096	232,050	3,520	**2,415,526**
NZ-Aus - Disp + Mthly Forecast[2]	16,725	80,567	191,340	420,417	324,356	388,566	311,881	35,260	0	**1,769,112**
Australia (from ABS)	27,589	107,037	232,868	444,023	373,317	526,550				**1,711,384**
USA[3]	0	0	0	0	0	0	0			**0**
Japan[3]	0	0	4,212	20,473	26,484	10,728	5,413			**67,310**
Other Asia[3]	973	6,951	28,265	61,567	63,798	52,651	33,235			**247,440**
Total Dispatch (Infocado 2 + 3)	17,698	87,518	223,817	502,457	414,637	451,945	350,528	0	0	**2,144,476**

1 Source: Infocado AAL, Seasonal Forecast provided at start of season
2 Source: Infocado AAL, Mthly Dispatch + Updated Mthly Seasonal Forecast (dispatch is updated at the end of each month or calculated from the Total Dispatch row at bottom of table)
3 Source: Infoshare NZ, statistics adjusted for freight time from NZ to destination port

2

Industry Dispatches By Origin Region and Count Size : 23rd January - 29th January 2016 (Wk 5)

Origin Region	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	Trays - Total	Bulk	P/PK	5.5Kg Eqv Trays All
	<16	16	18	20	23	25	28	28+	5.5Kg Eqv	10Kg	Kg	Total
Central NSW		728	700	2,133	792	337	608		5,298	897		6,929
New Zealand		4,167	8,935	19,334	17,983	24,308	9,616	24,415	108,758			108,758
Tri State	378	708	993	353	136	80	25		2,673	112		2,877
WA/NT	11,636	17,778	18,031	23,330	18,546	14,648	10,606	2,330	116,905	6,105	605	128,115
	12,014	23,381	28,659	45,150	37,457	39,373	20,855	26,745	233,634	7,114	605	246,679

Origin of Avocado ⬆   ⬇ **Destination of Avocado**

Industry Dispatches By Destination State and Count Size : 23rd January - 29th January 2016 (Wk 5)

Dest. State	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	5.5kg	Trays - Total	Bulk	P/PK	5.5Kg Eqv Trays All
	<16	16	18	20	23	25	28	28+	5.5Kg Eqv	10Kg	Kg	Total
EXP	100		17					753	870	1,005		2,697
NSW	3,767	8,574	10,432	17,619	15,725	17,912	7,955	14,720	96,704	2,701		101,615
QLD	5,685	9,434	9,678	9,687	6,194	6,221	2,256	5,282	54,437	288		54,961
SA / NT	160	160	160	2,216	2,680	5,689	1,108	160	12,333	672		13,555
TAS					760	456	304		1,520			1,520
VIC	2,142	4,783	7,700	14,653	10,226	7,963	3,750	5,677	56,894	2,233		60,954
WA	160	430	672	975	1,872	1,132	5,482	153	10,876	215	605	11,377
Total	12,014	23,381	28,659	45,150	37,457	39,373	20,855	26,745	233,634	7,114	605	246,679

Throughput Australian & NZ avocados by destination state
Throughput 1st January 2016 to date = 980,272 5.5kg tray eqv
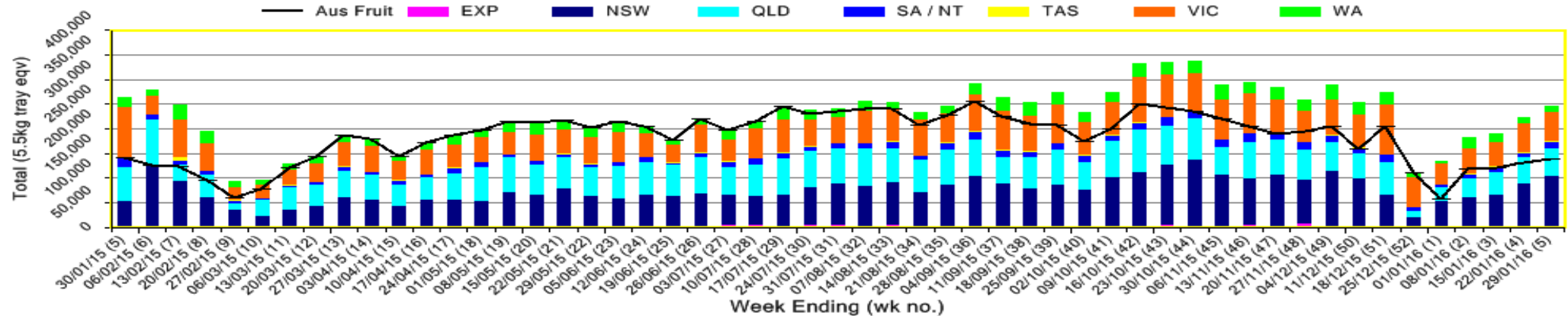
Legend: Aus Fruit — EXP — NSW — QLD — SA / NT — TAS — VIC — WA

Y-axis: Total (5.5kg tray eqv)
X-axis: Week Ending (wk no.)

NB: The graph below utilises the seasonal forecast data (without adjustment). The total of each bar in the below graph is a result of; Total Monthly Dispatches to date plus the remaining Seasonal Forecast which can be updated monthly by contributors.

Percentage dispatched by region (Based on seasonal forecast – 2016)

Legend: 12 month relative regional forecast — Dispatch for season so far as a proportion of regional forecast — Forecast volume at season start

Regions (top to bottom): CNSW, Tristate, WA/NT, NZ, NQ, CQ, Scoast, SQ, T/NR

2015 Season / 2016 Season

X-axis: Total (5.5kg tray eqv)
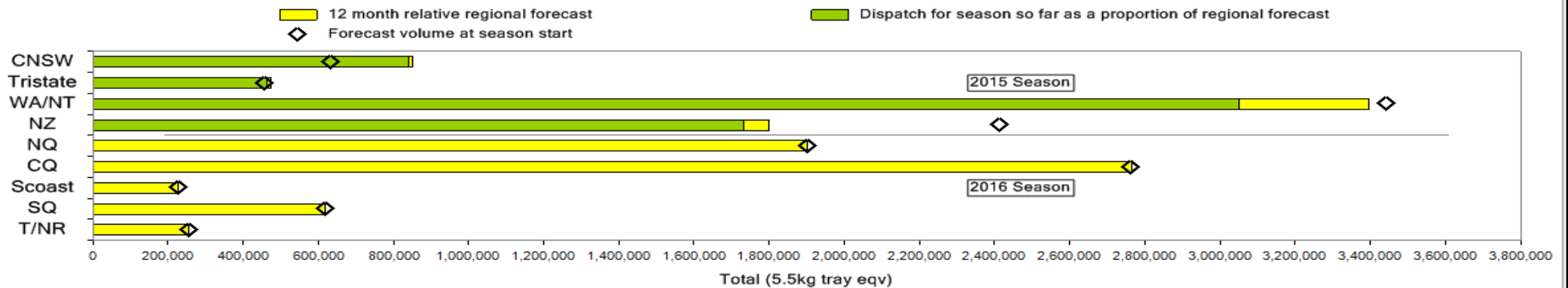
Week 5 Contributors - Packhouses		Week 5 Contributors - Wholesalers	
Sunfresh (Consolidator)	VP & EA Farrell (WA)	C & S Ponte Produce Pty Ltd (Melbourne)	Sinclair & Antico (Aust) Pty Ltd (Sydney)
The Avolution (Consolidator)	Mariners Rest (WA)	Costa Farms (Adelaide)	Southern Cross Produce Pty Ltd (Sydney)
		Costa Farms (Brisbane)	The La Manna Group (Adelaide)
Avocado Industry Council (NZAGA)	Delroy Orchards (WA)	Costa Farms (Melbourne)	The La Manna Group (Brisbane)
		De Luca Banana Marketing Pty Ltd (Brisbane)	The La Manna Group (Melbourne)
Willow Creek (WA)	Advance Packing & Marketing Services P/L (WA)	Etherington (Perth)	United Fresh (Adelaide)
Avonova (WA)	CNSW: Less than 3 contributors	Exotic Fruit Traders (Sydney)	VB Sculli (Melbourne)
		Fresh Choice WA Pty Ltd (Perth)	WA Farm Direct (Perth)
Golden Hill Avocados (WA)	TRI: Less than 3 contributors	Murray Bros (Brisbane)	

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Sales Report including Direct Sales from Packhouses, Wholesale Sales and Stock on Hand at Wholesale Level

	Trays 5.5kg eqv (incl. Mod6 & P84)				Bulk 10Kg Cartons					Pre-Pack Kg					Total (5.5Kg Eqv)			
	Hass	Shepard	Other	Total	Hass	Shepard	Other	Total	5.5Kg Eqv	Hass	Shepard	Other	Total	5.5Kg Eqv	Hass	Shepard	Other	Total
NSW																		
Total supermarket sales	36,786			**36,786**	286			286	**520**						37,306			**37,306**
Total non supermarket sales	3,876		879	**4,755**	480		100	580	**1,055**						4,749		1,061	**5,810**
Total exports																		
Total sales	40,662		879	**41,541**	766		100	866	**1,575**						42,055		1,061	**43,116**
Total Stock on Hand	**76**			**76**	88			88	**160**						236			**236**
QLD																		
Total supermarket sales	32,912			**32,912**	96			96	**175**						33,087			**33,087**
Total non supermarket sales	2,337		90	**2,427**	88			88	**160**						2,497		90	**2,587**
Total exports																		
Total sales	35,249		90	**35,339**	184			184	**335**						35,584		90	**35,674**
Total Stock on Hand	12,521	4,000	70	**16,591**		91		91	**165**						12,521	4,165	70	**16,756**
SA & TAS																		
Total supermarket sales	10,773			**10,773**	288			288	**524**						11,297			**11,297**
Total non supermarket sales	5,216		1,142	**6,358**	200		242	442	**804**						5,580		1,582	**7,162**
Total exports																		
Total sales	15,989		1,142	**17,131**	488		242	730	**1,327**						16,876		1,582	**18,458**
Total Stock on Hand	7,201		1,962	**9,163**	201		131	332	**604**						7,566		2,200	**9,767**
VIC																		
Total supermarket sales	25,778		2,206	**27,984**	465		112	577	**1,049**						26,623		2,410	**29,033**
Total non supermarket sales	5,435	43	1,878	**7,356**	647		432	1,079	**1,962**						6,611	43	2,663	**9,318**
Total exports																		
Total sales	31,213	43	4,084	**35,340**	1,112		544	1,656	**3,011**						33,235	43	5,073	**38,351**
Total Stock on Hand	3,911	357	2,442	**6,710**	105	1		106	**193**						4,102	359	2,442	**6,903**
WA																		
Total supermarket sales	6,214			**6,214**	155			155	**282**						6,496			**6,496**
Total non supermarket sales	2,376			**2,376**	336			336	**611**						2,987			**2,987**
Total exports	710			**710**	249			249	**453**						1,163			**1,163**
Total sales	9,300			**9,300**	740			740	**1,345**						10,645			**10,645**
Total Stock on Hand	3,378			**3,378**	7			7	**13**						3,391			**3,391**
Total																		
Total supermarket sales	112,463		2,206	**114,669**	1,290		112	1,402	**2,549**						114,808		2,410	**117,218**
Total non supermarket sales	19,240	43	3,989	**23,272**	1,751		774	2,525	**4,591**						22,424	43	5,396	**27,863**
Total exports	710			**710**	249			249	**453**						1,163			**1,163**
Total sales	132,413	43	6,195	**138,651**	3,290		886	4,176	**7,593**						138,395	43	7,806	**146,244**
Total Stock on Hand	27,087	4,357	4,474	**35,918**	401	92	131	624	**1,135**						27,816	4,524	4,712	**37,053**

Weekly National Sales

Legend: Total supermarket sales, Total non supermarket sales, Total exports, Total closing stock

y-axis: 5.5kg tray eqv (0, 100,000, 200,000, 300,000)

x-axis (Week Ending): 07/08/15, 14/08/15, 21/08/15, 28/08/15, 04/09/15, 11/09/15, 18/09/15, 25/09/15, 02/10/15, 09/10/15, 16/10/15, 23/10/15, 30/10/15, 06/11/15, 13/11/15, 20/11/15, 27/11/15, 04/12/15, 11/12/15, 18/12/15, 25/12/15, 01/01/16, 08/01/16, 15/01/16, 22/01/16, 29/01/16

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INFOCADO WEEKLY REPORT: 30th January—5th February 2016 (Week 6)

Comments

- The weekly dispatch volume (270,984 trays) was slightly higher than the week's forecast by about 18,925 trays (7%) (refer P 2).

- The four weekly forecast continues to indicate declining volumes through February with WA and NZ finishing their harvest and NQ nearing the start of theirs. NQ packers are reminded to carefully monitor fruit maturity as the harvest season approaches, to ensure consumer satisfaction which drives future purchases (refer P 2).

- NQ Infocado packhouse contributors are reminded to update their four week forecast a month before they start harvesting (refer P 2).

- The largest volume of dispatches in week 5 originated from Western Australia (155,788 tray eqv.). The Sydney market received the highest volume (88,146 tray eqv.), size 20 was the dominant size (47,724 tray eqv.) (refer P 3).

- Strong contributions have been received from the wholesale sector for the past week, AAL would like to thank all for providing their data

Marketing Update: Avo e-newsletters kick off on Australia Day

The first of Hort Innovations' monthly Avocado Lovers e-newsletters was distributed this year to celebrate Australia Day. The content included 7 of the 'Aussiest' avocado recipes including avos on the BBQ; chicken and avo damper; a bloody mary with an avocado twist; chilli con Kanga (yep chilli con carn with kangaroo and avocado); avocados stuffed with prawns; avo ice-cream; and the most Aussie of the them all ... avocado and vegemite toast.

Hort Innovation will be launching its next social media project showcasing the matching of avocados with other tastes. Called Perfect Match, the project will feature four short films to delight avocado lovers. These will be launched on Facebook on Valentine's day.

Click here to learn How to conduct Dry Matter tests at home

Click here to for a refresher on how to contribute to Infocado

Click here for tips for using and interpreting Infocado Reports

Click here to download avocado supply chain education materials

Upcoming Holidays
Labour Day (WA): 7th March | Canberra Day (ACT) & Labour Day (VIC): 14th March | Good Friday: 25th March | Easter Monday: 28th March |

Report Index

Forecast Data (Week 6 - 10)

Variety	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/Pk Kg	All - Total 5.5Kg Eqv
Week 6 - begin 30/01/2016				
Hass	219,873	8,843	5,000	**236,860**
Lamb Hass	4,130	288		**4,654**
Reed	8,500	575		**9,545**
Shepard	1,000			**1,000**
Week Total	**233,503**	**9,706**	**5,000**	**252,059**
Week 7 - begin 06/02/2016				
Hass	188,402	6,186	5,000	**200,558**
Lamb Hass	7,300	338		**7,915**
Reed	18,300	1,255		**20,582**
Week Total	**214,002**	**7,779**	**5,000**	**229,055**
Week 8 - begin 13/02/2016				
Hass	156,480	5,668	5,000	**167,694**
Lamb Hass	900	30		**955**
Reed	8,300	540		**9,282**
Shepard	1,000			**1,000**
Week Total	**166,680**	**6,238**	**5,000**	**178,931**
Week 9 - begin 20/02/2016				
Hass	109,771	4,149	5,000	**118,224**
Lamb Hass	1,000	10		**1,018**
Reed	18,000	1,200		**20,182**
Week Total	**128,771**	**5,359**	**5,000**	**139,424**
Week 10 - begin 27/02/2016				
Hass	77,201	3,049	5,000	**83,654**
Lamb Hass	1,000	10		**1,018**
Shepard	2,500			**2,500**
Week Total	**80,701**	**3,059**	**5,000**	**87,172**

Dispatch Data (Week 6 - begin 30/01/2016)

Variety	Trays 5.5Kg Eqv	Bulk 10Kg	P/PK Kg	Other Kg	5.5Kg Eqv Total Trays
Hass	246,367	9,900	864	8	**264,525**
Lamb Hass	4,426	161			**4,719**
Reed	236				**236**
Shepard	1,492	7			**1,505**
Total	**252,521**	**10,068**	**864**	**8**	**270,984**

Dispatch vs weekly forecast - all varieties and all packs
(12th September 2015 to 4th March 2016)

New Zealand Avocado Exports—Forecast v Actual Infocado/Export Statistics (5.5kg eqv trays) July 2015 - March 2016

Export Destination	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total to Date
NZ-Aus - Pre Season Forecast[1]	17,160	109,680	384,240	330,990	378,100	496,690	463,096	232,050	3,520	**2,415,526**
NZ-Aus - Disp + Mthly Forecast[2]	16,725	80,567	191,340	420,417	324,356	388,566	311,881	263,307	2000	**1,999,159**
Australia (from ABS)	27,589	107,037	232,868	444,023	373,317	526,550				**1,711,384**
USA[3]	0	0	0	0	0	0	0			**0**
Japan[3]	0	0	4,212	20,473	26,484	10,728	5,413			**67,310**
Other Asia[3]	973	6,951	28,265	61,567	63,798	52,651	33,235			**247,440**
Total Dispatch (Infocado 2 + 3)	17,698	87,518	223,817	502,457	414,637	451,945	350,528	102,281	0	**2,150,881**

1 Source: Infocado AAL, Seasonal Forecast provided at start of season
2 Source: Infocado AAL, Mthly Dispatch + Updated Mthly Seasonal Forecast (dispatch is updated at the end of each month or calculated from the Total Dispatch row at bottom of table)
3 Source: Infoshare NZ, statistics adjusted for freight time from NZ to destination port

Industry Dispatches By Origin Region and Count Size : 30th January - 5th February 2016 (Wk 6)

Origin Region	5.5kg <16	5.5kg 16	5.5kg 18	5.5kg 20	5.5kg 22	5.5kg 23	5.5kg 25	5.5kg 28	5.5kg 28+	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/PK Kg	Other Kg	5.5Kg Eqv Trays All Total
Central NSW	34	578	563	1,724		671	295	473		4,338	751			5,703
New Zealand		3,917	8,403	18,182		16,914	22,861	9,043	22,961	102,281				102,281
North Qld			269	337	638	248				1,492	7			1,505
Tri State	576	1,035	2,258	1,078		271	104	47	27	5,396	171			5,707
WA/NT	9,122	22,305	28,481	26,403		28,181	17,293	5,364	1,865	139,014	9,139	864	8	155,788
	9,732	27,835	39,974	47,724	638	46,285	40,553	14,927	24,853	252,521	10,068	864	8	270,984

Origin of Avocado ⬆ | ⬇ Destination of Avocado

Industry Dispatches By Destination State and Count Size : 30th January - 5th February 2016 (Wk 6)

Dest. State	5.5kg <16	5.5kg 16	5.5kg 18	5.5kg 20	5.5kg 22	5.5kg 23	5.5kg 25	5.5kg 28	5.5kg 28+	Trays - Total 5.5Kg Eqv	Bulk 10Kg	P/PK Kg	Other Kg	5.5Kg Eqv Trays All Total
EXP	100		17						1,651	1,768	923			3,446
NSW	2,235	7,945	11,373	13,832		15,337	13,060	4,807	11,827	80,416	4,251		8	88,146
QLD	5,478	14,710	17,530	13,950	638	10,118	8,280	3,030	6,881	80,615	1,415			83,188
SA / NT	153	743	752	3,615		5,078	1,713	549		12,603	280			13,112
TAS						152	608			760				760
VIC	1,766	4,023	9,740	14,594		11,666	10,184	4,332	4,443	60,748	3,008			66,217
WA		414	562	1,733		3,934	6,708	2,209	51	15,611	191	864		16,115
Total	9,732	27,835	39,974	47,724	638	46,285	40,553	14,927	24,853	252,521	10,068	864	8	270,984

Throughput Australian & NZ avocados by destination state
Throughput 1st January 2016 to date = 1,251,256 5.5kg tray eqv
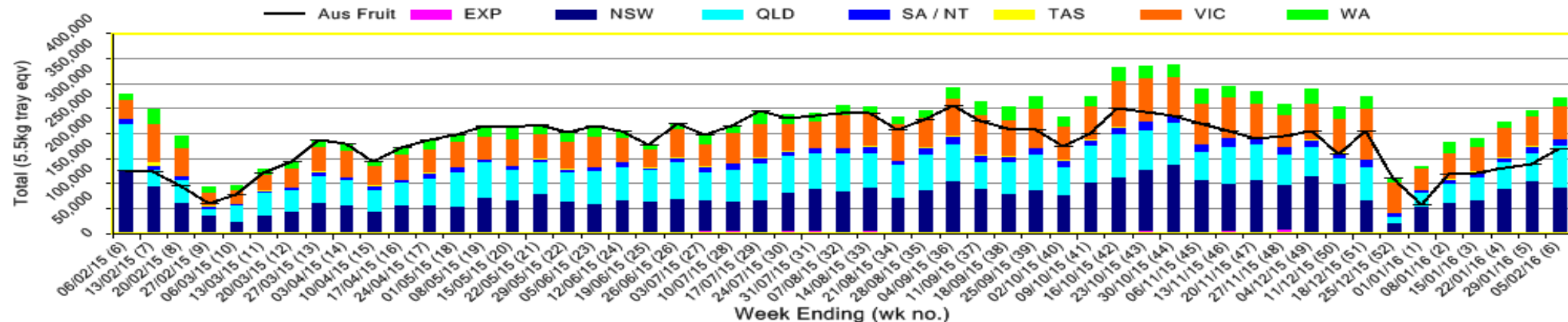
NB: The graph below utilises the seasonal forecast data (without adjustment). The total of each bar in the below graph is a result of; Total Monthly Dispatches to date plus the remaining Seasonal Forecast which can be updated monthly by contributors.

Percentage dispatched by region (Based on seasonal forecast – 2016)
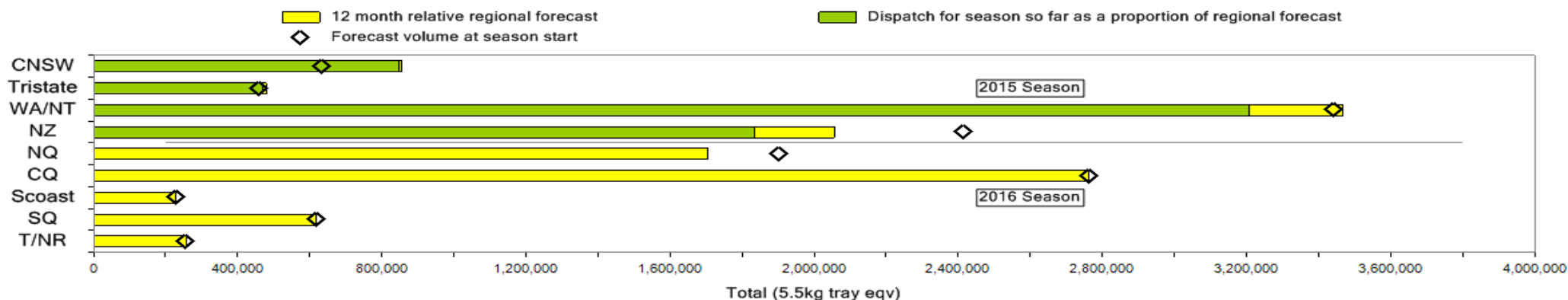
Week 6 Contributors - Packhouses		Week 6 Contributors - Wholesalers	
Sunfresh (Consolidator)	Avonova (WA)	Allcrops Pty Ltd (Sydney)	Murray Bros (Brisbane)
The Avolution (Consolidator)	Advance Packing & Marketing Services P/L (WA)	C & S Ponte Produce Pty Ltd (Melbourne)	Sinclair & Antico (Aust) Pty Ltd (Sydney)
Avocado Industry Council (NZAGA)	Golden Hill Avocados (WA)	Costa Farms (Adelaide)	The La Manna Group (Adelaide)
Golden Hill Packing Pty Ltd (TRI)	Delroy Orchards (WA)	Costa Farms (Brisbane)	The La Manna Group (Brisbane)
Chinoola Orchards (TRI)	VP & EA Farrell (WA)	Costa Farms (Melbourne)	The La Manna Group (Melbourne)
Klingbiel Family Trust (TRI)	CNSW: Less than 3 contributors	De Luca Banana Marketing Pty Ltd (Brisbane)	United Fresh (Adelaide)
Willow Creek (WA)	NQ: Less than 3 contributors	Etherington (Perth)	VB Sculli (Melbourne)
		Exotic Fruit Traders (Sydney)	WA Farm Direct (Perth)
		Fresh Choice WA Pty Ltd (Perth)	

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Sales Report including Direct Sales from Packhouses, Wholesale Sales and Stock on Hand at Wholesale Level

	Trays 5.5kg eqv (incl. Mod6 & P84)				Bulk 10Kg Cartons					Pre-Pack Kg					Total (5.5Kg Eqv)			
	Hass	Shepard	Other	Total	Hass	Shepard	Other	Total	5.5Kg Eqv	Hass	Shepard	Other	Total	5.5Kg Eqv	Hass	Shepard	Other	Total
NSW																		
Total supermarket sales	39,282			39,282	1,847			1,847	3,358						42,640			42,640
Total non supermarket sales	6,652		1,740	8,392	128		155	283	515						6,885		2,022	8,907
Total exports																		
Total sales	45,934		1,740	47,674	1,975		155	2,130	3,873						49,525		2,022	51,547
Total Stock on Hand	1,876		1,727	3,603			96	96	175						1,876		1,902	3,778
QLD																		
Total supermarket sales	61,731	3,524		65,255	1,408			1,408	2,560						64,291	3,524		67,815
Total non supermarket sales	2,103		72	2,175	62			62	113						2,216		72	2,288
Total exports																		
Total sales	63,834	3,524	72	67,430	1,470			1,470	2,673						66,507	3,524	72	70,103
Total Stock on Hand	17,805	3,712	3,518	25,035	188			188	342						18,147	3,712	3,518	25,377
SA & TAS																		
Total supermarket sales	10,324			10,324	192			192	349						10,673			10,673
Total non supermarket sales	2,452	579	905	3,936	431		213	644	1,171						3,236	579	1,292	5,107
Total exports																		
Total sales	12,776	579	905	14,260	623		213	836	1,520						13,909	579	1,292	15,780
Total Stock on Hand	15,526	967	3,870	20,363	1,083		249	1,332	2,422						17,495	967	4,323	22,785
VIC																		
Total supermarket sales	29,385			29,385	1,436			1,436	2,611						31,996			31,996
Total non supermarket sales	2,682	327	3,812	6,821	525			525	955						3,636	327	3,812	7,776
Total exports																		
Total sales	32,067	327	3,812	36,206	1,961			1,961	3,565						35,632	327	3,812	39,772
Total Stock on Hand	10,869	365	5,747	16,981	282			282	513						11,382	365	5,747	17,494
WA																		
Total supermarket sales	8,222			8,222	207			207	376	864			864	157	8,755			8,755
Total non supermarket sales	2,760			2,760	353			353	642						3,402			3,402
Total exports	1,768			1,768	923			923	1,678						3,446			3,446
Total sales	12,750			12,750	1,483			1,483	2,696	864			864	157	15,603			15,603
Total Stock on Hand	4,216			4,216	52			52	95						4,311			4,311
Total																		
Total supermarket sales	148,944	3,524		152,468	5,090			5,090	9,255	864			864	157	158,356	3,524		161,880
Total non supermarket sales	16,649	906	6,529	24,084	1,499		368	1,867	3,395						19,374	906	7,198	27,479
Total exports	1,768			1,768	923			923	1,678						3,446			3,446
Total sales	167,361	4,430	6,529	178,320	7,512		368	7,880	14,327	864			864	157	181,176	4,430	7,198	192,804
Total Stock on Hand	50,292	5,044	14,862	70,198	1,605		345	1,950	3,545						53,210	5,044	15,489	73,743

Weekly National Sales

Legend: Total supermarket sales, Total non supermarket sales, Total exports, Total closing stock

5.5kg tray eqv (y-axis: 0, 100,000, 200,000, 300,000)

Week Ending (x-axis): 14/08/15, 21/08/15, 28/08/15, 04/09/15, 11/09/15, 18/09/15, 25/09/15, 02/10/15, 09/10/15, 16/10/15, 23/10/15, 30/10/15, 06/11/15, 13/11/15, 20/11/15, 27/11/15, 04/12/15, 11/12/15, 18/12/15, 25/12/15, 01/01/16, 08/01/16, 15/01/16, 22/01/16, 29/01/16, 05/02/16

Appendix 12: Quarterly Infocado report (example)

INFOCADO CROP FORECAST
Quarterly Infocado Report — January 2016

Avocados Australia

Horticulture Innovation Australia

Welcome to the <u>Quarterly</u> Infocado Report. This report is released in the months January, April, July and October. Each report shows the previous 12 month's dispatch figures and the future 12 month's forecast figures including both Australian and New Zealand data.

Australian Avocados Forecast Jan 15 to Dec 15 (5.5 kg eqv trays)

	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15	12 Mth Total
Hass	330,441	155,563	74,227	339,016	926,757	991,606	951,159	980,394	919,702	955,240	908,715	767,765	8,300,585
Shepard	6,386	253,102	860,241	502,146	57,768	2,145	0	0	0	0	0	0	1,681,788
Other	14,394	4,761	34,119	29,671	57,947	55,101	79,172	103,135	32,558	23,154	11,531	10,102	455,645
Total	351,221	413,426	968,587	870,833	1,042,472	1,048,852	1,030,331	1,083,529	952,260	978,394	920,246	777,867	10,438,018

Australian Avocados Dispatches Jan 15 to Dec 15 (5.5 kg eqv trays)

	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15	12 Mth Total
Hass	569,451	366,282	65,707	168,975	1,227,519	1,000,347	1,200,414	1,001,435	1,057,775	1,197,729	892,709	718,881	9,467,224
Shepard	0	29,974	652,529	814,487	155,649	0	0	0	0	0	0	0	1,652,639
Other	27,398	11,555	7,592	41,290	33,878	35,949	51,684	75,824	30,193	21,066	20,915	39,482	396,826
Total	596,849	407,811	725,828	1,024,752	1,417,046	1,036,296	1,252,098	1,077,259	1,087,968	1,218,795	913,624	758,363	11,516,689

Australian Avocados Forecast Jan 16 to Dec 16 (5.5 kg eqv trays)

	Jan 16	Feb 16	Mar 16	Apr 16	May 16	Jun 16	Jul 16	Aug 16	Sep 16	Oct 16	Nov 16	Dec 16	12 Mth Total
Hass	685,434	261,708	61,489	483,032	1,261,354	1,365,898	1,038,113	1,161,415	1,028,373	757,713	511,683	502,257	9,118,469
Shepard	1,000	143,476	868,792	692,112	81,548	0	0	0	0	0	0	0	1,793,797
Other	14,300	5,601	6,202	33,520	47,528	36,121	59,772	35,142	13,084	12,257	12,880	11,000	280,538
Total	700,734	410,785	936,483	1,208,664	1,390,430	1,402,019	1,097,885	1,196,557	1,041,457	769,970	524,563	513,257	11,192,804

Australian & New Zealand Avocados : Jan 15 to Dec 15 Dispatch / Jan 16 to Dec 16 Forecast
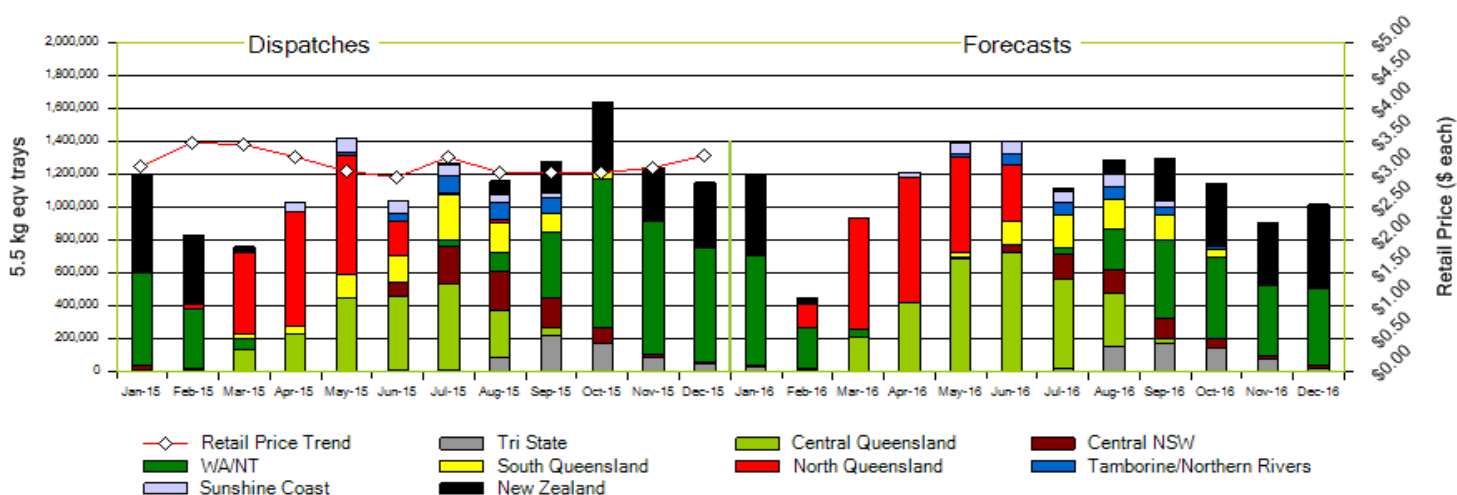
Jan 15 to Dec 15 Dispatches & Jan 16 to Dec 16 Avocado Production Estimates 5.5kg eqv trays

Region	Jan15 to Dec15	Jan16 to Dec16
North Queensland	2,181,229	2,499,125
Central Queensland	2,106,280	2,924,037
Sunshine Coast	361,356	377,221
Southern Queensland	1,008,173	758,039
Tamb/Northern Rivers	365,429	306,748
Central NSW	902,553	608,003
Tri State	635,750	602,804
WA	3,955,919	3,116,827
Aust. Sub Total	11,516,689	11,192,804
New Zealand	2,470,533	2,130,692
Total	13,987,222	13,323,496

Please Note: *The monthly forecast and dispatch figures in the Quarterly Infocado Report incorporate an allowance (which varies by region) to allow for the production forecasts and dispatches that are not inputted into the Infocado system. This production (dispatch and forecast) data is not inputted for various reasons including some packhouse's unwillingness to engage with industry and/or lack of computer access. For this reason it is not possible to extrapolate the figures from the Weekly Infocado Report to come up with either the dispatch and/or forecast figures in the Quarterly Infocado Report. At any time the Weekly Infocado Report incorporates around 85% of total production and forecasts however this does vary depending on time of year (as a result of the fruit coming from different regions with different levels of packhouse input). It is not functionally possible to incorporate allowances for missing data into the Weekly Infocado Report hence the variance between it and the Quarterly Infocado Report.*

Comments from the Infocado Team

Over the last couple of weeks the industry has struggled to meet consumer demand for avocados. This has resulted in record farmgate prices per tray for some growers with reports stating trays are selling around $80 each.

The above scenario has been created due to a variety of factors. Dispatches reduced over the Christmas break which was then followed by WA bushfires and rain that halted harvests in WA and NZ. The January forecast above was prepared before these events so it shows higher forecast volumes than will be dispatched. We would expect this to be reflected in higher February dispatch data due to the delays. Many reports from NQ growers have indicated that Shepard avocados will probably not reach maturity until mid to late February.

Overall 2015 was a strong year for the avocado industry in relation to Australian industry dispatches with 1,078,671 more 5.5kg tray eqv. being dispatched compared with the latest 2015 seasonal forecast. The 2015 Shepard forecast was quite accurate (diff. 29,149 trays above) whilst the Hass forecast saw the biggest discrepancy (diff. 1,166,639 trays below).

The current outlook for 2016 forecast looks positive with a slight reduction from the 2015 actuals. This reduction has been forecast across a number of regions with NQ, CQ & SC being the exceptions.

Fruit maturity and quality remains the key factors affecting repeat purchases by consumers. Do-it-yourself video clips about dry matter testing are now available on the BPR under Packhouse > Maturity. The BPR also has extensive information on recommended storage time for harvested avocados. All growers looking to begin harvesting are encouraged to make use of this valuable resource.

AV15004, a new 12 month Hort Innovation project has been awarded to AAL which will provide funding for the Infocado, OrchardInfo and Qualicado programs in 2016.

1

New Zealand Avocados - Dispatch and Forecast

Legend: Seasonal Forecast (NZ estimate) | Import Data (Customs) | Dispatch (Infocado)

Y-axis: 5.5kg trays (0 to 800,000)

X-axis: Jul-14, Aug-14, Sep-14, Oct-14, Nov-14, Dec-14, Jan-15, Feb-15, Mar-15, Apr-15, May-15, Jun-15, Jul-15, Aug-15, Sep-15, Oct-15, Nov-15, Dec-15, Jan-16, Feb-16, Mar-16, Apr-16, May-16, Jun-16, Jul-16, Aug-16, Sep-16, Oct-16, Nov-16, Dec-16, Jan-17, Feb-17, Mar-17
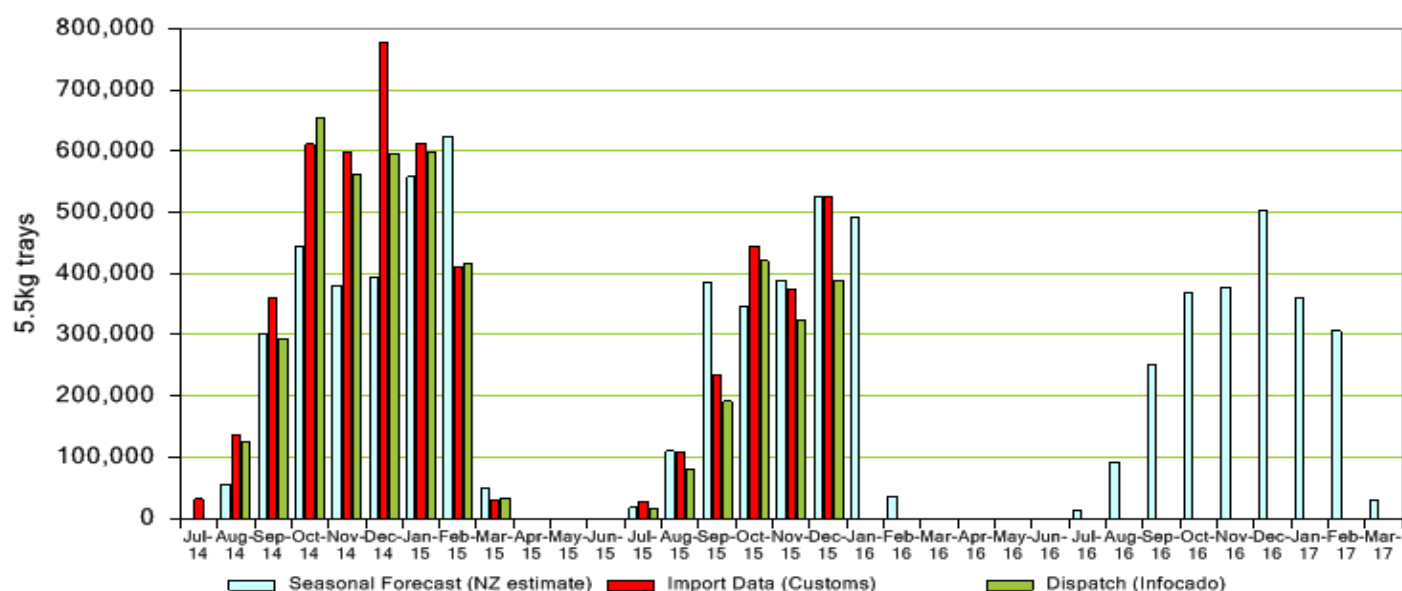
Jan 15 to Dec 15 Dispatches & Jan 16 to Dec 16 Forecasts
Avocados by Variety
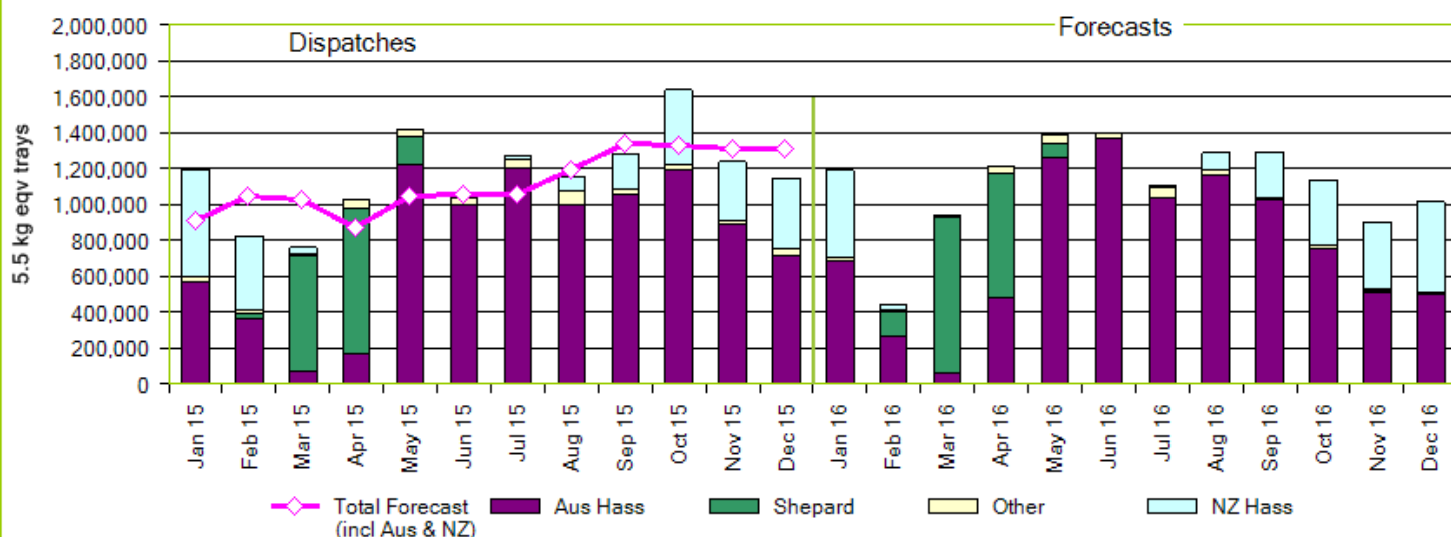
Dispatches | Forecasts

Y-axis: 5.5 kg eqv trays (0 to 2,000,000)

X-axis: Jan 15 – Dec 16

Legend: Total Forecast (incl Aus & NZ) | Aus Hass | Shepard | Other | NZ Hass

NB: NZ Dispatch figures in this graph are from Infocado and Customs data, the total forecast line (pink line) above displays the most up to date forecasts.

Seasonal Forecast Contributors

Central NSW
Coastal Avocados
I & A Tolson
Midcoast Avocados
Central Qld
BT & RG Pegg
De Paoli Orchards
Donovan Family Investment Trust
Lava Valley Produce
Simpson Farms Pty Ltd
Sunny Bluff Produce Pty Ltd
SuperPak/Avocado Ridge
New Zealand
Avocado Industry Council (NZAGA)
North Qld
Avocado Estates
Avocados with Altitude
Battistin Orchards Pty Ltd

Cobra Hill Orchards
Gunnado Farm
Hilltop Mareeba
Koci Avocado's
Lakeshore Pty Ltd
Rockridge Farming Pty Ltd
Tinaroo Falls Avocado Trust
Tropicado Avocados
South Qld
Balmoral Orchard
G & J Krenske
Googa Farms
Green Nugget Orchards
Mountain Fresh
One Harvest
Perseverance Farming Co
Sunnyspot Packhouse Pty Ltd
Touchwood Farming

Wodonga Park Fruit and Nuts
Sunshine Coast
G & C Christensen
Natures Fruit Company
Sunfresh
Tamborine / Northern Rivers
Aussie Orchards Growers & Packers
JB & CM Culross
Summerland House With No Steps
T W Silver
WJ Row
Tristate
Chinoola Orchards
Chislett Farms Pty Ltd
Golden Hill Packing Pty Ltd
Justin Loffler
Klingbiel Family Trust
KV & JM Lehmann

Marrbiz Pty Ltd
Mildura Fruit Company
Schirripa Orchards
Sunvale Produce Pty Ltd
Vitor Marketing Pty Ltd
Western Australia
Advance Packing & Marketing Services P/L
Avonova
Avowest
Delroy Orchards
Golden Hill Avocados
Green Pear Avocado
Mariners Rest
The Avocado Grove
VP & EA Farrell
West Aussie Avos
Willow Creek

For more detailed reports please go to www.avocado.org.au and login to Infocado. Instructions on accessing reports are available at www.avocado.org.au by clicking on the Industry tab and then looking under services.

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For further assistance please contact: Nathan Symonds, Ph: 07 3846 6566, Email: infocado@avocado.org.au

INFOCADO CROP FORECAST
Quarterly Infocado Report — October 2015

Welcome to the _Quarterly_ Infocado Report. This report is released in the months January, April, July and October. Each report shows the previous 12 month's dispatch figures and the future 12 month's forecast figures including both Australian and New Zealand data.

Australian Avocados Forecast Oct 14 to Sep 15 (5.5 kg eqv trays)

	Oct 14	Nov 14	Dec 14	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	12 Mth Total
Hass	729,101	880,842	815,348	330,441	155,563	74,227	339,016	926,757	991,606	951,159	980,394	919,702	8,094,156
Shepard	0	0	0	6,386	253,102	860,241	502,146	57,768	2,145	0	0	0	1,681,788
Other	31,882	7,883	18,012	14,394	4,761	34,119	29,671	57,947	55,101	79,172	103,135	32,558	468,635
Total	760,983	888,725	833,360	351,221	413,426	968,587	870,833	1,042,472	1,048,852	1,030,331	1,083,529	952,260	10,244,579

Australian Avocados Dispatches Oct 14 to Sep 15 (5.5 kg eqv trays)

	Oct 14	Nov 14	Dec 14	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	12 Mth Total
Hass	1,109,500	717,892	561,559	569,451	366,282	65,707	168,975	1,227,519	1,000,347	1,200,414	1,001,435	1,057,775	9,046,856
Shepard	0	0	0	0	29,974	652,529	814,487	155,649	0	0	0	0	1,652,639
Other	30,638	20,682	18,112	27,398	11,555	7,592	41,290	33,878	35,949	51,684	75,824	30,193	384,795
Total	1,140,138	738,574	579,671	596,849	407,811	725,828	1,024,752	1,417,046	1,036,296	1,252,098	1,077,259	1,087,968	11,084,290

Australian Avocados Forecast Oct 15 to Sep 16 (5.5 kg eqv trays)

	Oct 15	Nov 15	Dec 15	Jan 16	Feb 16	Mar 16	Apr 16	May 16	Jun 16	Jul 16	Aug 16	Sep 16	12 Mth Total
Hass	955,240	906,258	767,317	636,822	255,414	61,136	436,336	1,143,756	1,314,237	1,036,994	1,059,837	954,772	9,528,119
Shepard	0	0	0	0	148,360	767,284	633,475	80,108	0	0	0	0	1,629,227
Other	23,154	10,948	9,602	15,133	4,046	6,434	33,883	43,254	36,201	59,663	40,982	12,299	295,599
Total	978,394	917,206	776,919	651,955	407,820	834,854	1,103,694	1,267,118	1,350,438	1,096,657	1,100,819	967,071	11,452,945

Australian & New Zealand Avocados : Oct 14 to Sep 15 Dispatch / Oct 15 to Sep 16 Forecast
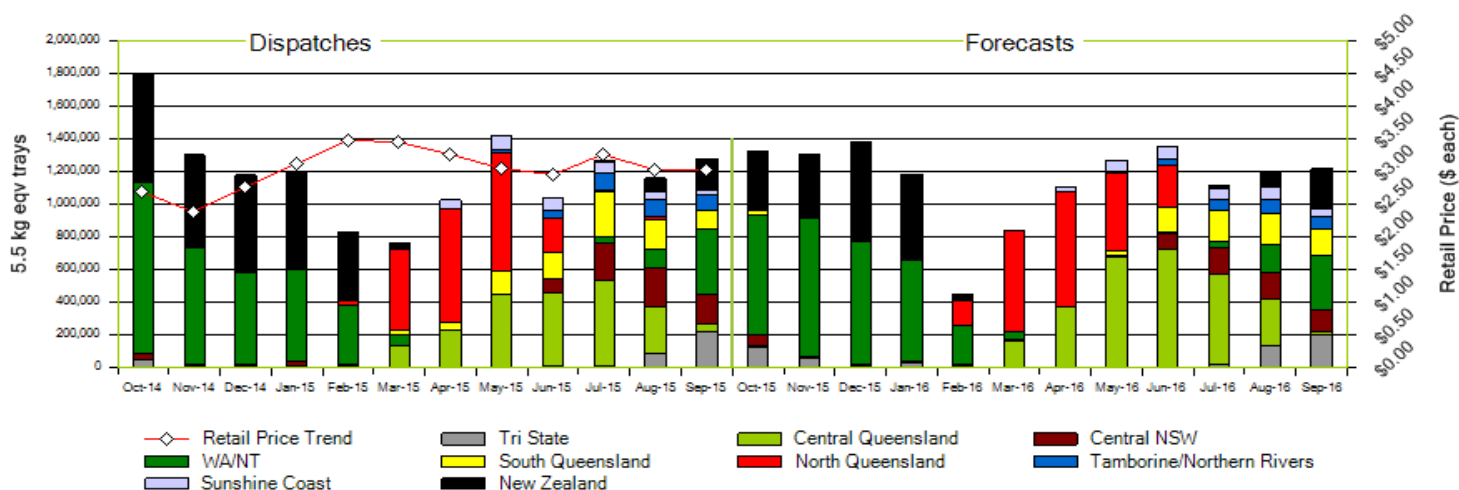
Oct 14 to Sep 15 Dispatches & Oct 15 to Sep 16 Avocado Production Estimates 5.5kg eqv trays

Region	Oct14 to Sep15	Oct15 to Sep16
North Queensland	2,181,229	2,210,098
Central Queensland	2,107,025	2,802,421
Sunshine Coast	360,735	370,723
Southern Queensland	966,043	753,110
Tamb/Northern Rivers	368,619	284,596
Central NSW	835,582	668,922
Tri State	400,245	571,986
WA	3,864,812	3,791,089
Aust. Sub Total	11,084,290	11,452,945
New Zealand	3,147,389	2,270,888
Total	14,231,679	13,723,833

Please Note: *The monthly forecast and dispatch figures in the Quarterly Infocado Report incorporate an allowance (which varies by region) to allow for the production forecasts and dispatches that are not inputted into the Infocado system. This production (dispatch and forecast) data is not inputted for various reasons including some packhouse's unwillingness to engage with industry and/or lack of computer access. For this reason it is not possible to extrapolate the figures from the Weekly Infocado Report to come up with either the dispatch and/or forecast figures in the Quarterly Infocado Report. At any time the Weekly Infocado Report incorporates around 85% of total production and forecasts however this does vary depending on time of year (as a result of the fruit coming from different regions with different levels of packhouse input). It is not functionally possible to incorporate allowances for missing data into the Weekly Infocado Report hence the variance between it and the Quarterly Infocado Report.*

Comments from the Infocado Team

Fruit maturity has resulted in dispatch volumes lagging by about a month compared to this time last year. However, due to the consistency throughout the regions, this has not disadvantaged the industry.

Dispatches over the last 12 month period are higher than forecasted by approximately 840,000 5.5kg trays (8% increase). The forecast for the coming 12 month period from October 2014-September 2015 suggests dispatches will increase by 368,655 5.5kg trays (3% increase). Due to the high number of plantings in the last seven years, avocado volumes are expected to continue increasing.

An important note is the low supply forecast for February 2016 compared with last year though the forecast shows steady supply from April to September 2016.

Fruit maturity is a key factor affecting flavour and therefore repeat purchases by consumers. Do-it-yourself video clips about dry matter testing will be available on the BPR by the end of November. Keep an eye out for this valuable resource.

The levy funded marketing campaign will continue during 2015-16 in line with the three year marketing strategy. HIA is about to commence planning for the next three year strategy

A new HIA project proposal has been submitted by AAL that, if successful, will replace the Qualicado program in 2016. The new project will include an extension component and will be aimed at improving internal quality and productivity through management practices in both the growing and wholesale sectors.

AAL is continuing to deliver retailer training in Brisbane, Sydney, Melbourne and Perth to educate retailers about how best to handle avocados to deliver a quality product.

1

New Zealand Avocados - Dispatch and Forecast

5.5kg trays

800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0

Jul-14, Aug-14, Sep-14, Oct-14, Nov-14, Dec-14, Jan-15, Feb-15, Mar-15, Apr-15, May-15, Jun-15, Jul-15, Aug-15, Sep-15, Oct-15, Nov-15, Dec-15, Jan-16, Feb-16, Mar-16, Apr-16, May-16, Jun-16, Jul-16, Aug-16, Sep-16, Oct-16, Nov-16, Dec-16

Legend: Seasonal Forecast (NZ estimate) ■ Import Data (Customs) ■ Dispatch (Infocado)

Oct 14 to Sep 15 Dispatches & Oct 15 to Sep 16 Forecasts
Avocados by Variety

Dispatches — Forecasts

5.5 kg eqv trays

2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0

Oct 14, Nov 14, Dec 14, Jan 15, Feb 15, Mar 15, Apr 15, May 15, Jun 15, Jul 15, Aug 15, Sep 15, Oct 15, Nov 15, Dec 15, Jan 16, Feb 16, Mar 16, Apr 16, May 16, Jun 16, Jul 16, Aug 16, Sep 16

Legend: Total Forecast (incl Aus & NZ), Aus Hass, Shepard, Other, NZ Hass

NB: NZ Dispatch figures in this graph are from Infocado and Customs data, the total forecast line (pink line) above displays the most up to date forecasts.

Seasonal Forecast Contributors

Central NSW	Cobra Hill Orchards	Touchwood Farming	KV & JM Lehmann
Coastal Avocados	Gunnado Farm	Wodonga Park Fruit and Nuts	Marrbiz Pty Ltd
I & A Tolson	Hilltop Mareeba	**Sunshine Coast**	Mildura Fruit Company
Midcoast Avocados	Koci Avocado's	G & C Christensen	Schirripa Orchards
Central Qld	Lakeshore Pty Ltd	Natures Fruit Company	Sunvale Produce Pty Ltd
BT & RG Pegg	R & M Waterman	Sunfresh	Vitor Marketing Pty Ltd
De Paoli Orchards	Rockridge Farming Pty Ltd	**Tamborine / Northern Rivers**	**Western Australia**
Donovan Family Investment Trust	Tinaroo Falls Avocado Trust	Aussie Orchards Growers & Packers	Advance Packing & Marketing Services P/L
Lava Valley Produce	Tropicado Avocados	JB & CM Culross	Avonova
Simpson Farms Pty Ltd	**South Qld**	Summerland House With No Steps	Avowest
Sunny Bluff Produce Pty Ltd	Balmoral Orchard	T W Silver	Box Organics
SuperPak/Avocado Ridge	G & J Krenske	WJ Row	Delroy Orchards
New Zealand	Googa Farms	**Tristate**	Green Pear Avocado
Avocado Industry Council (NZAGA)	Green Nugget Orchards	Chinoola Orchards	Mariners Rest
North Qld	Mountain Fresh	Chislett Farms Pty Ltd	The Avocado Grove
Avocado Estates	One Harvest	Golden Hill Packing Pty Ltd	VP & EA Farrell
Avocados with Altitude	Perseverance Farming Co	Justin Loffler	West Aussie Avos
Battistin Orchards Pty Ltd	Sunnyspot Packhouse Pty Ltd	Klingbiel Family Trust	Willow Creek

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For further assistance please contact: Nathan Symonds, Ph: 07 3846 6566, Email: infocado@avocado.org.au

Appendix 13: OrchardInfo report (example)

ANNUAL ORCHARDINFO REPORT
CQ Jan 2013 - Dec 2013 Season

Horticulture Innovation Australia

Avocados Australia

Table 1: Central Qld Summary Report - All Contributors										
Variety	**Tree numbers**				**Hectares**			**Trees/ha**		
	0 to 5 yrs	6 yrs+	Total	%	0 to 5 yrs	6 yrs+	Total	0 to 5 yrs	6 yrs+	Wt Ave.
Fuerte	-	498	498	0.16%	-	3.4	3.4	-	145	145
Hass	48,210	172,161	220,371	72.78%	252.0	902.4	1,154.4	191	191	191
Lamb Hass	-	8,611	8,611	2.84%	-	37.0	37.0	-	233	233
Other	3,100	13,123	16,223	5.36%	15.5	69.6	85.1	200	189	191
Sharwil	1,251	1,399	2,650	0.88%	8.2	6.3	14.4	153	224	184
Shepard	10,592	36,120	46,712	15.43%	60.1	188.2	248.4	176	192	188
Wurtz	2,657	5,075	7,732	2.55%	8.2	23.1	31.3	323	220	247
Total	65,810	236,987	302,797	100%	344.0	1,230.0	1,574.0			
Yield Contributors	*32,033*	*204,073*	*236,106*	*77.98%*						

Table 2: Central Qld Summary Report Yield Contributors Only *										
Variety	**Mkt Yield (t)**				**Mkt Yield/Ha (t)**			**Yield/Tree (kg)**		
	0 to 5 yrs	6 yrs+	Total	%	0 to 5 yrs	6 yrs+	Wt Ave.	0 to 5 yrs	6 yrs+	Wt Ave.
Fuerte	-	6.5	6.5	0.07%	-	2.9	2.9	-	23.4	23.4
Hass	454.5	5,930.0	6,384.5	68.60%	3.9	7.6	7.1	20.0	39.7	37.1
Lamb Hass	-	552.6	552.6	5.94%	-	18.3	18.3	-	77.9	77.9
Other	4.8	367.2	372.0	4.00%	0.3	6.3	5.1	1.6	33.7	26.7
Sharwil	3.5	40.0	43.5	0.47%	0.9	10.2	5.5	6.3	51.0	32.4
Shepard	277.4	1,451.0	1,728.4	18.57%	9.1	8.7	8.8	47.8	46.3	46.5
Wurtz	-	219.2	219.2	2.36%	-	10.7	10.7	-	50.4	50.4
Total	740.2	8,566.5	9,306.7	100%						
(a) Est. prod'n based on ave yield	1,520.7	9,948.2	11,935.5							
(b) Infocado Production 2013			13,295.7	*Yield data based on extrapolation from yield contributors 77.98% of trees!*						
(a) as prop'n of (b)			90%							

Fig 1a: Central Qld Tree Numbers
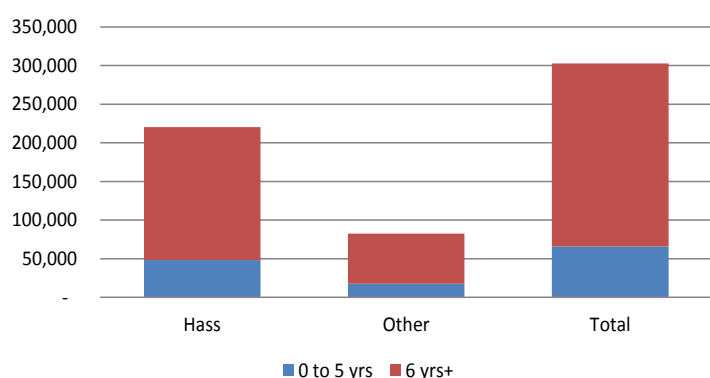
Fig 1b: Central Qld "Other" Tree Number
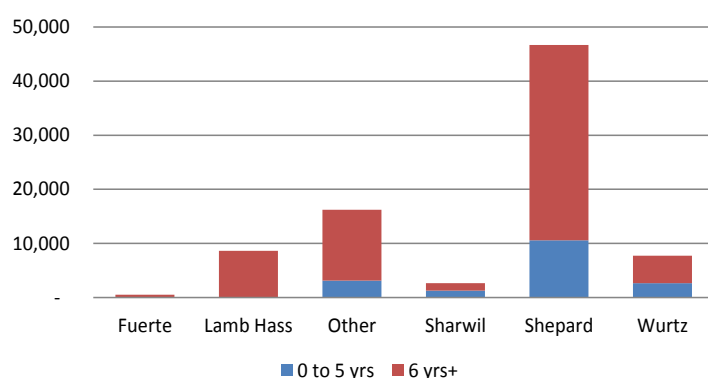
Fig 2a: Central Qld Hectares
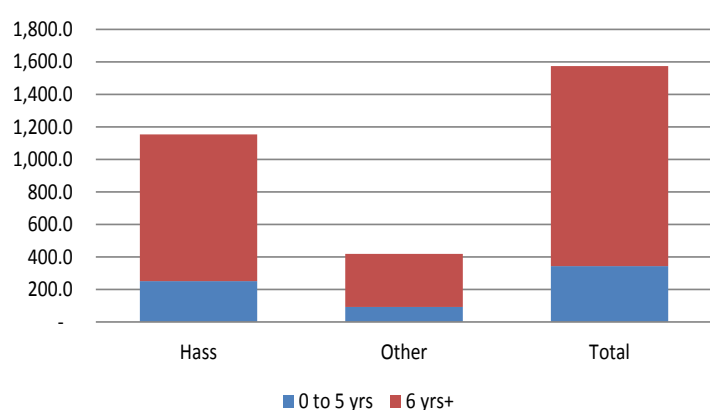
Fig 2b: Central Qld "Other" Hectares
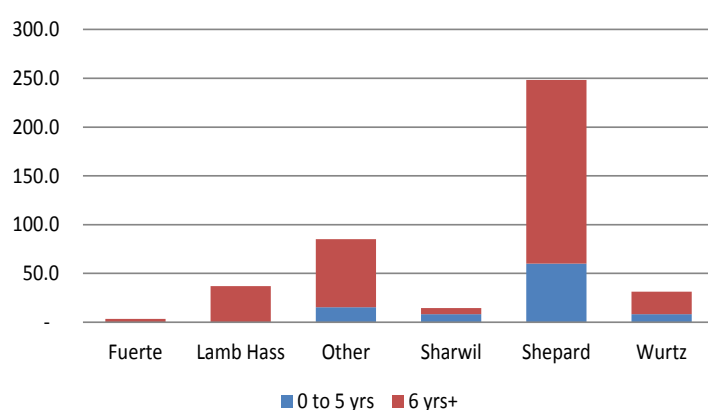
Fig 3a: Central Qld Mkt Yield (t)
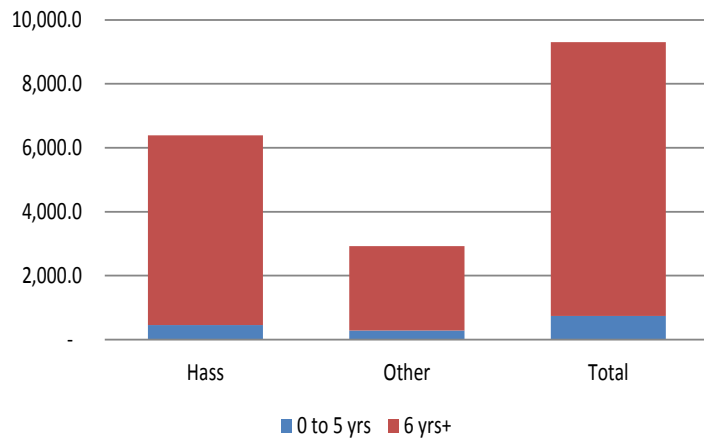
Fig 3b: Central Qld "Other" Mkt Yield (t)
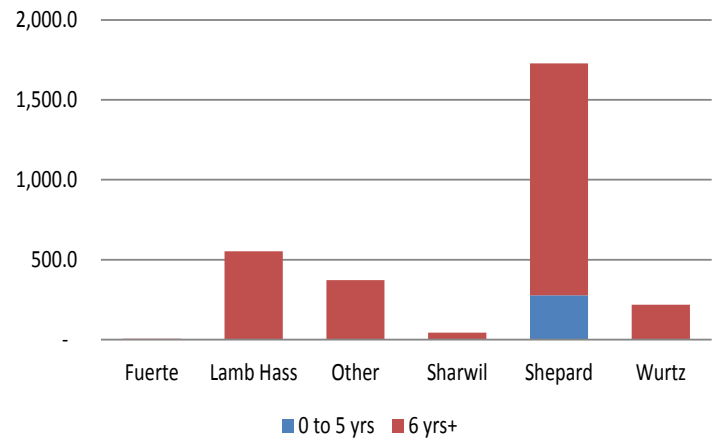
Table 3: National Summary Report - All Contributors										
Variety	Tree numbers				Hectares			Trees/ha		
	0 to 5 yrs	6 yrs+	Total	%	0 to 5 yrs	6 yrs+	Total	0 to 5 yrs	6 yrs+	Wt Ave.
Bacon	24	400	424	0.04%	0.0	1.5	1.5	800	268	279
Fuerte	758	4,012	4,770	0.46%	3.5	24.6	28.1	216	163	170
Gem	5,045	-	5,045	0.49%	25.5	-	25.5	198	-	198
Gwen	80	4,693	4,773	0.46%	0.1	13.5	13.6	727	348	351
Hass	184,689	602,968	787,657	76.58%	883.7	2,732.8	3,616.5	209	221	218
Lamb Hass	2,782	16,546	19,328	1.88%	7.7	72.0	79.7	364	230	243
Other	1,003	1,055	2,058	0.20%	4.3	5.4	9.6	235	196	213
Pinkerton	214	1,826	2,040	0.20%	1.0	8.7	9.8	206	209	209
Reed	16,298	27,608	43,906	4.27%	36.8	111.4	148.2	443	248	296
Ryan	444	239	683	0.07%	1.3	0.9	2.3	334	254	301
Sharwil	1,326	3,628	4,954	0.48%	8.3	19.2	27.5	160	189	180
Shepard	35,422	99,616	135,038	13.13%	221.9	577.5	799.4	160	172	169
Turner Hass	7,421	-	7,421	0.72%	49.4	-	49.4	150	-	150
Wurtz	3,644	6,745	10,389	1.01%	13.9	32.7	46.5	263	207	223
Zutano	-	50	50	0.00%	-	0.3	0.3	-	161	161
Grand Total	259,150	769,386	1,028,536	100.00%	1,257.4	3,600.5	4,857.9			
Yield Contributors	*95,587*	*386,361*	*481,948*	*46.86%*						
ABS Stats 2012-13	345,156	1,137,387	1,482,543							
ABS Stats 2013-14	296,875	1,195,884	1,492,759							
OrchardInfo as a % of ABS	81%	66%	69%							

Table 4: National Summary Report Yield Contributors Only *										
Variety	Mkt Yield (t)				Mkt Yield/Ha (t)			Mkt Yield/Tree (kg)		
	0 to 5 yrs	6 yrs+	Total	%	0 to 5 yrs	6 yrs+	Wt Ave.	0 to 5 yrs	6 yrs+	Wt Ave.
Bacon	-	8.7	8.7	0%	-	21.8	21.8	-	60.4	60.4
Fuerte	1.1	85.2	86.3	0%	0.5	8.7	7.2	2.4	62.3	47.4
Gem	4.8	-	4.8	0%	0.3	-	0.3	1.6	-	1.6
Gwen	-	181.4	181.4	1%	-	16.7	16.7	-	46.7	46.7
Hass	1,033.5	12,797.4	13,830.9	76%	3.4	8.5	7.6	15.9	42.0	37.4
Lamb Hass	17.3	711.3	728.6	4%	7.2	17.0	16.5	13.9	72.9	66.2
Other	1.3	8.2	9.5	0%	1.3	14.1	6.0	8.1	52.9	30.2
Pinkerton	-	19.5	19.5	0%	-	12.8	12.8	-	68.2	68.2
Reed	133.7	469.1	602.8	3%	4.0	5.9	5.3	8.9	24.4	17.6
Ryan	-	4.2	4.2	0%	-	5.1	5.1	-	19.6	19.6
Sharwil	4.4	57.3	61.7	0%	1.1	8.8	5.8	7.0	48.1	33.9
Shepard	481.9	2,029.2	2,511.1	14%	8.7	9.2	9.1	47.9	49.9	49.5
Turner Hass	-	-	-	0%	-	-	-	-	-	-
Wurtz	-	250.1	250.1	1%	-	11.1	11.1	-	52.2	52.2
Zutano	-	-	-	0%	-	-	-	-	-	-
Grand Total	1,678.0	16,621.6	18,299.6	100%						
(a) Est. prod'n based on ave yield	4,549.3	33,099.7	39,053.6							
(b) Infocado Production 2013			55,524.8							
(a) as prop'n of (b)			70%	** Yield data based on extrapolation from yield contributors 46.86% of trees!*						
ABS Stats 2012-13			52,982.4							
ABS Stats 2013-14			43,969.2							

2

Fig 4a: National Tree Numbers
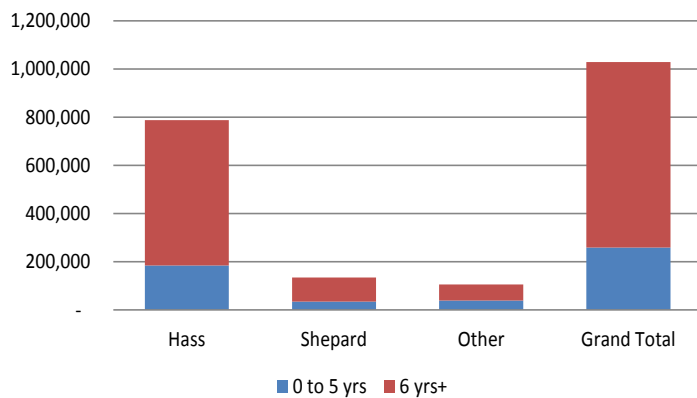
Fig 4b: National "Other" Tree Numbers
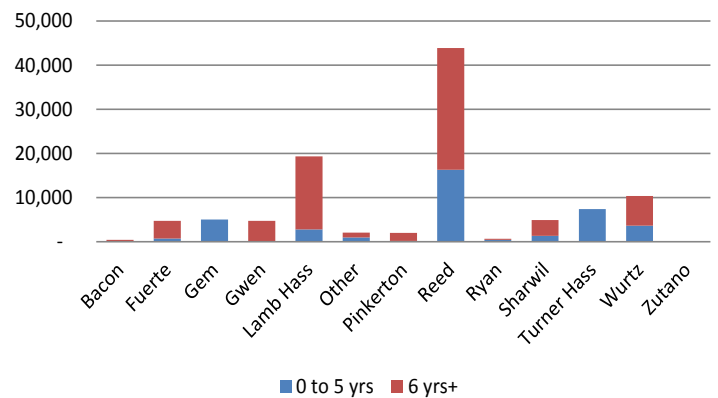
Fig 5a: National Hectares
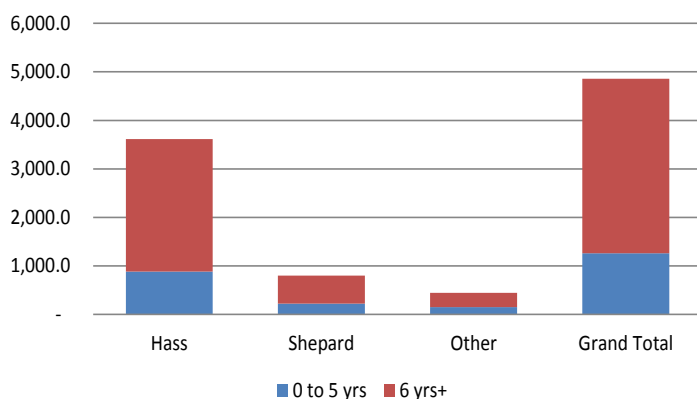
Fig 5b: National "Other" Hectares
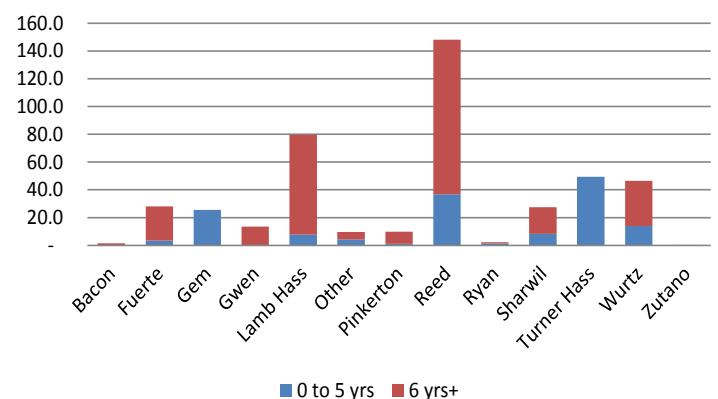
Fig 6a: National Mkt Yield (t)
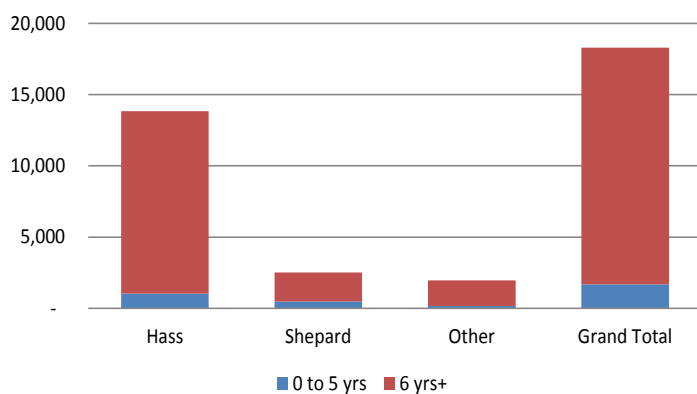
Fig 6b: National "Other" Mkt Yield (t)
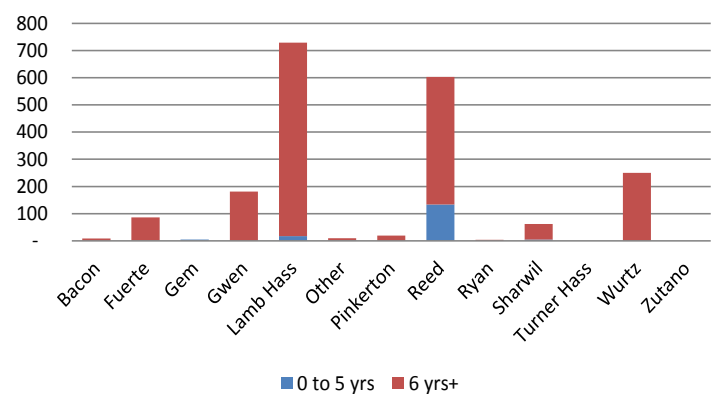
Comments

All data within this report represents a snap shot in time. Only data collected for the 2013 season is included and obviously as further data is gathered and published more meaningful comparisons and conclusions can be made. Not all growers were able to provide reliable yield data by block. The marketable yield, yield/ha and yield/tree information included in tables 2 and 4 have been calculated from the data provided by those growers who did provide yield information. All contributors provided tree number data. Therefore to get a better indication of overall production across all contributors the yield data (provided by some contributors) has been extrapolated across the tree numbers (provided by all contributors). See tables 2 and 4, row *(a) Est. prod'n based on ave yield*.

- The total production from CQ in the 2013 season is shown in tables 2 & 4, sourced from 2014 January Quarterly Infocado Report (QIR).
- The QIR and Annual 2012/13 & 2013/14 ABS Commodity Statistical figures have been used to present the National Summary information shown on pages 2 & 3.
- Page 4 gives an indication of the OrchardInfo program participation.
- Based on the ABS statistics for tree numbers, OrchardInfo accounts for approx. 69% of all avocado trees in the ground in the 2013 season (see table 3). Tables 3 & 4 illustrates the ABS production figures for the two years from July 2012 to June 2014.
- *OrchardInfo as a % of ABS* is calculated by using an average from the 2 years of ABS data. The reason being that all information collected per region originates from different time periods in a year. This may contribute to the variance between data sets.
- Any varieties with fewer than 3 separate contributors have been grouped under "other".
- 22 CQ growers contributed data to the OrchardInfo program for the 2013 season, an increase from the 2012 season. AAL would like to thank everyone who provided data.

3

OrchardInfo Contributors

Central NSW
Ansonton Pty Ltd
Avolicious Pty Ltd
Coastal Avocados
D Williams
David Reeve & Tristan Murray
Den Organics
DG & CJ Kafer
Francis Plantations
GB & RJ Hannaford
GJ & MM Burch
GM & SV Britten
Graham Bilbe
I & A Tolson
Janelle Lendrum
JD Croad
KS & TK KhunKhun
Kulnura Ambrosia Avocados
L & F Spagnolo
L Spagnolo
M Bonanno Avocados
Meliora Farm
Midcoast Avocados
NT & MA Schenken
PC & GD Lindsay
PL Woods
S Wyllie
Sandy Hills Premium Avocados
Stephen & Sharon Peruch
Steve Smith
Still Waters
Tideman Partnership
Tuckerflora
W & M Serjeant

Central Qld
AG & BS Butcher
D.P. Lines and J.K. Radel
Donovan Family Investment Trust
Dorrian Farms
Electra Farmlands Pty Ltd
Erik Mijlemans & Caroline Travers
F Ekin
G.J. Sullivan
Goodlife Orchards
Groves Grown Tropical Fruits
Lava Valley Produce
M & E Hydro Tomato Growers
Ochelen Pty Ltd
Peirson Memorial Trust
Prime Orchards
Red Town Orchard
RS & RD Beer
Saltbush Bananas
Simpson Farms Pty Ltd
Sunny Bluff Produce Pty Ltd
Superpak / Avocado Ridge
The I & R Philpott Family Trust

North Qld
A & L Piagno Pty Ltd
Adil Farming
Alvise Brazzale
Avocados with Altitude
Avogreen Orchards
Balurga Trading
Battistin Orchards Pty Ltd
Bellview Orchards Pty Ltd
BI & IM Westwood
Blue Sky Produce
Blushing Acres Pty Ltd
Cadorin Orchards Pty Ltd
Cobra Hill Orchards
E Feltrin Trust
Golden Triangle Avocados

Gorge Creek Orchards
Green Dragon Fruit Pty Ltd
Hilltop Mareeba
J.F & J. L Burness
Jennings Family Trust
Lakeshore Pty Ltd
Lavers Orchards
Leadwood Pty Ltd
Lone Gum Avocados
M Ivicevic
Mountain Side Avocados
Muccignat Farming
Nyleta Park
P & L Blundell Family Trust
Plozza, S & L
R & M Waterman
Rockridge Farming Pty Ltd (Walkamin)
RT & AL McGregor
S & K Bilic
The Jonsson Family Trust
Tinaroo Falls Avocado Trust
Toohey Farming
Tropicado Avocados
V & R Krleza
Wilfrid Ronald and Rosemary Blundell
Willbi Pty Ltd

South Qld
Avosun
B & M Trousdell
Firrell Enterprises
Francis Family Trust
From Partnership
G & J Krenske
Googa Outdoor Education Centre
Green Nugget Orchards
Janet Gray Pty Ltd
Jimmara
Kathryn M Erbacher
Kluck's Electrical Pty Ltd
K-Sun Fruit Pty Ltd
Lakeview Produce
Lean Hotel Pty Ltd
Mountain Fresh
Perseverance Farming Co
R.J. & J.A. Dugdell
Rangely Orchard Pty Ltd
RG Sewell
Smok Contracting Pty Ltd
Sunnyspot Packhouse Pty Ltd
Touchwood Farming
Wodonga Park Fruit and Nuts

Sunshine Coast
BH & SA McLaren
Bluegum Creek Produce Pty Ltd
D Aird
EA Noble
G & C Christensen
GE Taylor
Jahade Farms Pty Ltd
NJ & JK Donovan
PM & TC French
Price Partners
Pringle Road Farms
Prosser Partners
Pub World
R & C Maywald
Smerdon Enterprises Pty Ltd
Top of the Range Avocados

Tamborine/Northern Rivers
AA Bordin & D Zanette
AW Davis
B & B Bartle

Baclisin Pty Ltd
C & E Perkins
Cipta Citra Family Trust
Crescent Plateau Holdings
GS Reason
I & M Adar
Iain Saul
J & T Zanette
J Youngman
J. Morrow
JA & PD Davidson
JB & CM Culross
Jirel Holdings
Kris Farm
Lammal Investments
LL Tracey
M & J Dover
Martin & Sue Stevens
Michael Vass
Mountain Top Magic Orchard
P & A Molenaar
Pirl Fruit
PR Connor
Rainbow Ridge
RR & DR Bartle
Summerland House With No Steps
T W Silver
Tam Mountain Farm Management
Tilbamont T/A Uralba Orchard
TM & EM Martin
Warren & Lynda Rixon
WJ Row

Tristate
Agriexchange Pty Ltd
AJ & WE McCracken Pty Ltd
Barham Avocados
Belair Orchards
Bonyaricall Vineyards
Boreray Pty Ltd
C F Fechner
Carey Property Trust
Chinoola Orchards
Chislett Farms Pty Ltd
Coolibah Boyanda Farm
Crux Farm Operations Pty Ltd
G Cupper
GB Fulwood & Co
GMP Farms
Golden Hill Packing Pty Ltd
Goldup Farms
H Hope
Ian Pope Pty Ltd
J & G Stamopoulos Pty Ltd
Justin Loffler
KV & JM Lehmann
LD & PM Burns
Manna Farms
Marrbiz Pty Ltd
Mitchell River Avocados
Nankivell Partners
NPA & DL Willmott
Palinyewah Producers
Peter & Joel Brockhoff
PL & VM Jones
PW & DF Ward
R.C. Howie
Redlynch Pty Ltd
RJ & SD Ward
RWL Shaw
Wacanca Pty Ltd
Wingara Wine Group

Western Australia
A & A Arena

A Cheetham
A. Church
Alban Coolstores
Ambrosia Orchard
Avodale
Avonova
Avowest
Avwan
BJ Dunnet - Flybrook Farm
Box Organics
BR & JJ Beetson
C.T. Blakers Farming
Canterbury
Capel Farms Pty Ltd
Capel Fruit Co
Collier & Son
D & D Favero
D & L Henderson
Delroy Orchards
Dorfus
DP Lawe Davies
DR & DJ Roche
Eastbrook Enterprises
Edwards Farm Pty Ltd
Fonty's Pool Farm Pty Ltd
French's Group 89 P/L
Green Pear Avocado
Half Moon Farms Pty Ltd
Hawke Brook Chalets
Healbeerley Farm
IDA Holdings Pty Ltd
JA Patton Family Trust
Jarnadup Investments Pty Ltd
Jasper Farms
Jilba Enterprises
Joe Bendotti & Co.
JR & SM Heslop
KA & RD Spencer
Karri Glade Chalets
King River Avocado
KL & HM Anderson
KO & JA Luzny
M & L Blee
Mariners Rest
Mayfield Park Farms
Moonlight Forest
Mystery Creek Avos
N Kok
NR Love & VJ Roche
Peerabeelup Farm
Podargus
PR & JK Scott
Premium Choice Produce
Priddis & Priddis
R & S Bamess
R'Angee Park
RD & FA Dossor
Roma Spiccia & Son
Runnymeade Orchard
Settlers Plantation
Shiron Grove
T & C Luzny
Tantemaggie Vineyard
Terracept Orchards
The Avocado Grove
The Berry Farm
The Durif Trust
VP & EA Farrell
West Aussie Avos
West Pemberton Avocados
Willow Creek
Willyung Farms & Mt Willyung Avocados
Winterbrook Avocados
WJ Slater
Yaldon

This report has been authorised by John Tyas, CEO Avocados Australia on the 31 August 2015

4

Appendix 14: Crop forecasting report

Avocado Crop Forecasting

for

Avocados Australia

Presented by:	P2P Business Solutions Pty Ltd
	PO Box 3000
	Ashgrove East QLD 4060
	B: 0418 215276
	E: jmargetts@bigpond.com

Date:	January 2016

P2P Business Solutions

Designing solutions to help your business grow

CONTENTS

1   REQUIREMENT

Avocados Australia (AAL) has collected crop forecasting data from growers and packers through the Infocado and OrchardInfo programs for a number of years.

There is evidence that some growers are able to consistently and accurately forecast their crop, whilst others appear to struggle with this task. From the industry data systems that AAL have developed over the last 10 years it is possible to identify those growers/packers who consistently provide the most accurate crop forecasting data.

AAL would like to understand the approach these growers and packers use, to determine if their skills and processes are transferable and if so to document these in a series of case studies so that other growers might be able to improve their crop forecasting techniques.

2   BACKGROUND

AAL has two key industry data collection and reporting systems, Infocado and OrchardInfo, which provide the industry with information to assist with management and marketing decisions. Through Infocado, weekly grower-packer and packer dispatch and forecast supply information is collected and collated, whilst OrchardInfo is the mechanism for collecting longer term monthly forecasts from growers.

In the review project, *'AV11013: Review of avocado industry and market information systems'*, a series of recommendations related to the accuracy of data provided to the industry data collection systems were provided. One of the recommendations was for the industry to develop guidelines and processes to assist growers and packers in developing crop forecasting figures taking account of fruit numbers and size (count) throughout the season.

A review of different crop forecasting approaches within the avocado (domestically and internationally) and other Australian horticultural industries was undertaken in 2001. Additionally it is also known that other international industries have advanced different approaches to forecasting marketable crop yield.

3   APPROACH

The following approach was adopted for this project:

1. A previous crop forecasting project (*AV01013: Development of a Crop Prediction System for Avocados (Piccone & Woolcock)* was undertaken by the Australian avocado industry fifteen years ago. A review of this project was undertaken to ascertain if there were relevant findings that could be applied in today's environment.
2. A review of the Avocado Crop Estimating (ACE) System used by the Californian Avocado Commission (CAC) to forecast production within the State of California was also completed.
3. During visits and attendance at the World Avocado Conference (Peru, September 2015) information was sought from a number of larger international operations as to their approach to crop forecasting.
4. A short report on AV01013 and its relevance to the current industry situation and a commentary on the relevance of approaches other international industries / companies have adopted to the Australian situation was written (this report).
5. In conjunction with AAL, grower-packers who have a good record of accurately forecasting their crop were identified. These grower-packers were then contacted to ascertain their interest in providing information to assist with developing a picture of the different forecasting techniques used in the industry.
6. For each interview a short case study was written which includes:
   o A short narrative incorporating the description of the grower and production operation i.e. how long growing, production locality, area planted, varieties grown, and any other

relevant production / geographic / climatic information and its relevance to crop forecasting.

- o An outline of what crop forecasting tasks and when (in relation to time and crop cycle) the grower undertakes these to begin formulating the crop forecast for the coming season; and as the crop develops what additional tasks are undertaken to refine the forecast.

7. The draft case studies were then forwarded to the grower and AAL for checking and then AAL for checking. Once this process was completed a final formatted version was developed.

4 FINDINGS

4.1 REVIEW OF PREVIOUS PROJECTS

The previous Australian avocado industry crop forecasting project (*AV01013: Development of a Crop Prediction System for Avocados (Piccone & Woolcock, 2003)*) and the Avocado Crop Estimating (ACE) System used by the Californian Avocado Commission (CAC) was reviewed. A summary of the project and ACE system can be found in Appendix 1 and 2 respectively.

It is noted in the work undertaken by *Piccone & Woolcock (2003)*, that there was a range of methods engaged to forecast avocado and other fruit crops, all with varying degrees of success. There were some elements that consistently appeared in whichever process was used. These included:

- Using historical records and visually assessing performance of current crop in comparison to the previous year to derive a current season crop forecast.
- Counting fruit on individual trees in a block and extrapolating this figure to account for production of the entire block. Note: there were a range of different methods of selecting trees to be counted i.e. based on heavy, medium or light crop loads, representative tree sampling, random tree sampling, and use of systematic tree sampling and / or measuring the same trees every year.
- Using more than one person to do the crop forecast assessment or a 'moderating' committee so that a more informed crop estimate was developed.
- In mature orchards, harvesting a percentage of the block, which is representative of the entire block, prior to the main harvest period and using this figure to extrapolate expected production over entire block.

For packers and marketers, there was a heavy reliance on use of historical records.

At an industry level, some industries (e.g. the Californian avocado industry and the Australian citrus industry) are using aerial photography to ascertain areas of plantings and extrapolating crop volume representative production per hectare figures.

The CAC ACE model provided a prescriptive method for growers to estimate their crop forecast, and can be summarized as follows[1]:

- Use historical records to inform decisions.
- Choose a minimum of 10 avocado trees in the lightest, medium and heaviest producing areas in the block.
- Estimate the total number of fruit per tree and use visual assessment and historical records to estimate fruit size. Calculate the average number of equivalent lugs [cartons] per tree, expected in each area.

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[1] *Note: the detailed process provided to Californian avocado growers in outlined in Appendix 1.*

- Multiply the average lugs [cartons] per tree, by the number of trees in the block, to generate an estimate of the total number of lugs [cartons] per block.

4.2 REVIEW OF CURRENT INTERNATIONAL CROP FORECASTING PRACTICES

At the recent World Avocado Conference (WAC) in Peru (September 2015), there was an opportunity to speak with a number of large South American based avocado producers and also growers, packers, marketers and industry representatives from other parts of the world regarding the forecasting practices used in their operations:

The commonly used practices across these operations included:

- Use of historical data to inform current season's forecasts. This was especially so in mature orchards, where growers could consistently rely on tree performance.
- Counting fruit on individual trees and extrapolation of this information to determine production per block. For example, at one establishment, Grupo Rocio, in Northern Peru, 30 trees per 3 acre block (or 10 trees per acre) were counted to derive the crop forecast.
- Tagging and counting the same trees each year. Selection of trees was often based on a systematic sampling technique. One large producer visited in Chile used this technique. In addition to this, because of the difficulty to count trees on steep terrain and for efficiency, he also ensured there were two people undertaking the counting process together - counting a quarter of the tree each from different sides. These figures were then extrapolated to provide a crop forecast for each block.
- Commencing counting fruit on a monthly basis after flowering, although frequency may be increased towards harvest date. At this time, the size of fruit was also measured to determine range and average size of fruit expected at harvest.
- At one operation visited, all trees had been geotagged, their performance monitored (fruit number and fruit size) and rated as high, medium or low performing trees. A selection of these trees (stratified sample) from each of these performance categories was counted and the overall production forecast derived. This process also allowed for very high performing trees to be identified and monitored and their genetics exploited for use in future plantings.

Other considerations regarding crop management and forecasting in Peru that are relevant include:

- The lower degree of variability within blocks (than is often experienced in Australian orchards), as the crop is grown in desert sand and hence effectively hydroponically grown. Therefore variability related to soil nutrition and condition is significantly reduced.
- Maintenance of mature tree height at 4-5 metres, means it is easier to count fruit in trees, therefore providing more accurate figures related to fruit load.
- (for interest only) The monitoring of calcium levels in the fruit after flowering (from marble size) is undertaken to ensure there are sufficient levels to safeguard against poor postharvest outcomes.

It should be noted that the larger operations visited in Peru invest significant resources into collecting and monitoring forecast data in a systematic and methodical way. As labour is cheap, time can be allocated to undertake data collection and monitoring activities in the field. Additionally these businesses have invested in enterprise software which facilitates the forecasting data collection and analysis processes.

A number of packers and marketers from different countries attending the WAC also indicated they used a mix of historical information, feedback from the growers on current crop performance and in some cases use field representatives that assisted with the forecasting process, to obtain an indication of expected seasonal intake.

4.3 Summary of Australian crop forecasting practices

The interviews conducted and case studies developed as part of this project outline as range of techniques employed by Australian production and packing businesses for crop forecasting (see Appendix 4). These techniques are consistent with the findings of the work undertaken by *Piccone & Woolcock (2003)* and those employed by international businesses.

A summary of techniques and practices used is summarized below:

- Use historical records and visually assess performance of the current crop in relation to the previous year to derive a current season crop forecast to estimate the number of trays.
- Make initial estimates just after flowering, keeping in mind historical performance of the crop.
- Once flowering begins do regular checks of the orchard. This will help establish is the fruit set is light, medium or heavy and if different parts of the block are performing differently.
- Count fruit on individual trees in a block and extrapolate this figure to account for production of the entire block. A range of different methods can be used to select trees to be counted. For example it may be based on selecting different trees in a block that are:
    - Representative of heavy, medium or light cropping trees in a block
    - Representative of average trees in a block
    - Randomly selected
    - Systematically selected
    - The same trees every year.

    The information collected is then extrapolated appropriately.
- Focus on fruit counts after major orchard events, such as fruit drop and pre-harvest.
- Adjust forecast as the season progresses. More effort is needed as the crop gets closer to harvest to ensure the figures are as accurate as possible.
- Factor in wastage when developing a forecast (i.e. fruit that will not be marketed). Anecdotal evidence suggest that a number of growers use a figure around 10%.
- At the end of the season forecasts are compared with actuals and historic records and a record kept of what happened in individual blocks.
- Use more than one person to do the crop forecast assessment so that a more informed / considered crop estimate was developed.

Other considerations:

- It is important to 'know the block'. Growers that have been forecasting for a long time get 'a feel' for how a block should be performing from year to year.
- If setting up or replanting blocks try to keep blocks a similar size or trees/block. This assist with developing systems and processes to help with forecasting.
- The 'art' of forecasting seems to be something that some have and others don't.

4.4 Other considerations

The role of carbohydrates and crop prediction

The report suggests a number of techniques should be investigated further including the Israeli avocado orchard crop estimation technique, pre-flowering carbohydrate as an indicator of yield (Tony Whiley) and the early harvest technique.

Dr Tony Whiley authored a paper *'Avocado crop prediction – usefulness and methods' (1995)* commented carbohydrate levels in the tree prior to flowering and the potential correlation with yield, and opportunity for this to be used as a leading indicator of yield potential for the coming season. In the review by *Piccone & Woolcock (2003)* it was suggested that this approach should be investigated further, however for various reasons the work by Whiley appears not to have been progressed.

Currently, the New Zealand avocado industry is undertaking research work to better understand the role of carbohydrates in the flowering / pollination process and the impact on productivity[2].

Additionally the Australian macadamia industry are also undertaking a HIA research project looking at the role of carbohydrates in the tree and their impact on production.

In the Bundaberg region, Hortus Technical Services has since 2014 provided trunk carbohydrate (total non-structural carbohydrate) testing for tree crop growers. Although originally developed for the macadamia growers this service is being adopted by avocado and mango growers in the region. As part of a package with soil and dry tissue (leaf) testing, this information allows growers to assess soil and plant nutrition levels, then see the implications to stored carbohydrate levels in the trees throughout the year. More information on carbohydrate testing is provided in Appendix 3.

Other crop prediction models

Underpinning the citrus industry's crop modelling efforts are two key pieces of research: citrus heat until modelling by Ron Hutton and fruit sizing research undertaken by Ken Bevington. It is noted in the review by *Piccone & Woolcock (2003)* that these two projects may be good reference points for the Australian avocado industry.

Fruit sizing in the apple industry

The apple industry has for a number of decades used fruitlet size testing as an indicator of final fruit size of crop. This has been supported by international research and progressed by various commercial entities.

Currently AgFirst (www.agfirst.co.nz), a group of commercial horticultural consultants, offer a service in Australia which they have developed for apple growers to monitor fruit size for quality and crop forecasting (fruit size) purposes. After thinning, a minimum of 20 tagged fruit per hectare are measured on a weekly or fortnightly basis to ascertain their growth profile in respect to known growth models which have been developed for different varieties. Based on this information, growers are able to see how their crop is performing and develop a fruit size harvest profile.

New approaches

In 2015, HIA, on behalf of a number of the horticultural industries, including avocados, commissioned the National Tree Project, which looks at multi-scale monitoring tools for managing Australian tree crops. This project brings together a number of academic institutions, industry groups and commercial partners to look at solutions that will provide:

- The capability to undertake a national audit identifying the location, area and tree population of every commercial avocado, mango and macadamia orchard in Australia; and
- A farm-level decision support tool utilising satellite image data streams and novel on-ground sensor systems, including machine vision and spectro-radiometric sensors, and robotic platforms for mapping fruit yield and quality, tree health and inflorescence counts. Data will assist yield forecasting and optimisation, harvest segregation based on quality and fruit size, tree health monitoring including early detection of pest and disease outbreaks, support product traceability (tree-to-plate), and reducing input costs through judicious management of water, fertiliser and pesticides, and genotype evaluation.

In the medium to long term this project may provide the additional capacity for growers and industry to collect and collate required data in a more effective and efficient manner.

More details on this project can be found at: http://www.une.edu.au/about-une/academic-schools/school-of-science-and-technology/research/precision-agriculture/research-areas-and-current-projects/national-tree-project

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[2] *H. Boldingh et al, 2015, "The potential for the production of "successful" fruit on 'Hass' avocado (Persea americana Mill.) trees is reflected by the carbohydrate content of the style", Abstract from World Avocado Conference, Peru 2105.*

5 CONCLUSIONS & RECOMMENDATIONS

Although there are a range of different techniques that different industries and growers are using to assist with crop forecasting, there are common elements that are evident. These include:

- Maintenance and use of historical records to assist with decision making
- Assessment of the orchard from flowering and then at critical periods up to harvest, including post-fruit drop periods – crop forecasts are adjusted as the season progresses.
- Counting fruit on individual trees in a block and extrapolating this figure to account for production of the entire block, although a range of different methods are used to select trees to be counted.

Growers should be encouraged to adopt these techniques as a minimum when doing their crop forecasts. Extension of different forecasting techniques could be included in grower workshops.

The industry should also investigate whether developing fruit sizing models and measuring fruit development (size) over the season, as the apple industry has done, would assist in predicting the size of fruit for the coming season.

Further research should be undertaken to understand the relationship between carbohydrate levels and production levels and whether carbohydrate levels could be used as a leading indicator for future production (crop forecasting).

APPENDIX 1: REVIEW OF AV01013: DEVELOPMENT OF A CROP PREDICTION SYSTEM FOR AVOCADOS

Marie Piccone, PHC & Rod Woolcock, GRM International, 2003, 'AV01013: Development of a Crop Prediction System for Avocados', Horticulture Australia, Sydney.

The aim of this project was to determine if it was possible to develop a crop forecasting system whereby the size of the crop at an orchard, regional and national level was possible[3].

The AV01013 report was undertaken in 3 parts:

1) A review of the then current crop forecasting systems in avocados and comparison with systems in other crops
2) An options paper detailing recommendations and conclusions on possible models including details of analysis
3) A proposed crop forecasting system, strategic plans of action, relevant background information and a proposed strategy for future development.

Terminology used

- Crop estimation – for next production season
- Crop forecasting – longer term prediction of yield 2- 10 year timeframe
- Crop prediction – covers both long and short term methodologies

Overview

This review was extensively researched and there was broad consultation with industry stakeholders including: growers, marketers, packers, industry groups, international stakeholders, industry consultants and researchers (Australian and international).

Individual growers / packers

Techniques identified that were used by individual producers / packhouses and marketers [4] were identified:

1) Sunraysia: After fruit set, count fruit on representative trees (e.g. 20 trees of each of heavy, medium and light load). Size and size range of fruit in block is also assessed. All trees in block designated heavy, medium or light (by 2 people walking and agreeing status) and yield calculated.
   Results of prediction method – variable.
   Grower has also moved to a system of identification and designation of yield to every tree. Results of this method not provided.
2) Temperate Production area / Hass only: Harvest 3% of orchard which is representative, at maturity and 4 weeks before planned harvest. Then multiples up. Four (4) weeks later the fruit size will have jumped 1 size. Note: All trees are mature.
   Results of prediction – very good (2 – 5% variance).
3) Atherton Tablelands / Hass & Shepard: Visual assessment of trees and comparison with crop and harvest data in previous year. Three people undertake individual assessments and these are compared.
   Results of prediction method – variable (30 – 50% variance).
4) Mature Hass: Using a 2% sample (2% of 4,500 trees = 90 trees). Forecasts yield prior to fruit set based on historical records, corrects again after fruit set, again after fruit drop and finally prior to

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[3] *AV01013: Development of a Crop Prediction System for Avocados, p.5*
[4] *AV01013: Development of a Crop Prediction System for Avocados, p.7 - 10*

harvest. Trees in the orchard are randomly selected and 1/3 of the tree is counted and total tree fruit is calculated. The selections of tree sample area is varied.
Results of prediction – reasonably good (15-20% variance).
Young Hass: Similar to above. Greater than 2% sample and whole tree counted rather than just 1/3 of the tree.

5) Young trees: Counts 30 trees per block and multiplies out
   Mature tree: Too difficult to count and therefore uses historical records.
6) Packhouse (SA): Gut feel
7) Packhouse (QLD): Gets growers to provide estimates throughout season, but mainly relies on historical records.
   Results of prediction – reasonable (20% variance).
8) Large producer: Uses historical records then visually assesses trees to assess if crop is larger or smaller. *Results of prediction are variable.*
9) Marketing company: Uses historical records and staff to check and assess crop. Also uses one grower to check all crops in region. Have reduced forecast variance significantly using this method – from 50% to 20%.

Statistical information available to the Australian industry

A review of other sources of related data from which the industry may be able to use to collate a broad picture of industry performance was compiled. This included:

- Various databases held by then State Associations and Avoman[5]
- ABS data
- Market Information Services – Wholesale Markets (including throughput, price, variety and source)
- Australian Avocado Growers Federation (AAGF) national census
- Sales figures from ANVAS nurseries
- Levy collection figures
- Data from State Departments
- Transport figures in some areas
- Collection from packhouses.

Other historical data sources are also listed in the report, but these sources are no longer relevant to the current market.

It is concluded through review of all the above data sets and consultation that data is not easily analysed and is fragmented. The gap that remains centres on the ability to capture, compile and organise data into usable form.

Crop Estimation Research in Avocados

- Avi Crane (Californian Avocado Commission) presented a paper at the Second World Avocado Congress titled 'Estimating Californian Avocado Production' (summary provide below)
- Tony Whiley authored a paper '*Avocado crop prediction – usefulness and methods'(1995),* which looked at the role of carbohydrate prior to flowering and its correlation with yield, particularly in subtropical regions where there is consistent management and cultural practices, consistent yield from year to year and no 'Acts of God'.
- Unpublished papers – Hebrew University & the Fruit Board of Israel.

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[5] *AvoMan was developed by DAF QLD and is now no longer resourced as a tool for industry*.

Crop Estimation in Other Australian Crops

Below is a summary of techniques used in other crops / countries:

Apples & Pears

No crop forecasting in place in Australia[6]. South Africa – has crop forecasting and / or crop estimation model in place.

Macadamia

DAFQ maintain a production modelling system for macadamia based on tree numbers, variety and age of tree. Early predictions lacked accuracy.[7] Since the publication of this paper accuracy has been improved, however this is moderated by local consultants' knowledge and the Macadamia Handlers' data collection and aggregation data (based off Infocado).

Citrus

The citrus industry has made significant investments over the last two+ decades to develop systems for crop estimates and forecasting. This is driven by requirements of export markets (also the driver in other industries). Different jurisdiction (States) have different models. However methods include:

- Annual census through mail out to growers
- IDOs doing fruit density and sizing counts across the region (same blocks and trees each year) and then formulas used to extrapolate this data. This data is then moderated by individuals on a national committee. At the end of the season actuals are compared to forecasts. It is a very costly system with sometimes variable results.
- Australian Citrus Growers (ACG) also looked at aerial photography to develop better data and integrated this with broader community initiatives (whole farm planning /environmental management etc.)
- Underpinning the industry's crop modelling efforts are two key pieces of research: citrus heat until modelling by Ron Hutton and fruit sizing research undertaken by Ken Bevington. It is noted that these two projects may be good reference points for the Australian avocado industry.

Crop Estimation in Avocados - International

California

Research work through the 1980-90s and earlier led to the development of the current system used by the Californian Avocado Commission (CAC) – the ACE program (reviewed separately in Appendix 2).

- Survey all growers 2 x per year (mail out) - 40% participation
- Use of field officers to verify randomly (ground truth)
- Fly over every 4 years
- Crop estimate committee reviews processes and data and compares to historical data.
- Provides good results. Aims to be $\pm$ 5% accurate but varies between 0 – 9% accuracy.

Israel

- After fruit drop sample 20 trees per block (a block is usually 2 -4 hectares or 520 – 1040 trees) on grid row method.
- Count fruit on tree then multiply out. On large tree count a section of the tree and multiply out.
- Accuracy quite good $\pm$ 10% but can vary greatly in light or heavy years.

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[6] *The industry now collects and aggregates volumes in store and also undertakes a tree and production census.*

[7] *Since the publication of this paper accuracy has of the crop forecasting system been improved. The model now includes moderation incorporating local consultants' knowledge and aggregated data from the Macadamia handlers.*

New Zealand

- Get information from packhouses on volumes following harvest (historical information) and then update next season's forecast monthly, based on historical information and 'gut feel'.
- These figures are then analysed and reviewed by committee.
- Use predictive model to determine fruit size by measuring fruit 67-70 days after fruit set (NZ)[8].

South Africa

- Obtain figures from packers – based on historical figures and 'gut feel' for coming season.

<u>Developing recommendations</u>

In developing the recommendations the author looked at conditions of the industry and needs of stakeholders and identified the need for growers to have systems to be able to better forecast.

Priorities were set by an Industry Steering Committee:

- Industry database for estimates and forecasting
- Volume of crop by region
- Accuracy to 10-20%
- Opening season estimates
- % fruit size determined and reported by region.
- Provision of data to support supply chain management

Reviewing the possible approaches the Californian ACE system was considered most relevant, however there were elements of the others that might have applicability.

System components considered necessary include:

- Statistical database [9]
- Field testing of known crop estimation methods
- Long range forecasting system (is this capacity built into Infocado?)

The report suggests a number of techniques should be investigated further including the Israeli avocado orchard crop estimation technique, pre-flowering carbohydrate as an indicator of yield (Tony Whiley) and the early harvest technique.

The consultant offered three options:

- Option 1: Consider yield variation on previous year at production level, using trained estimators in each region – may be growers, consultants, DPI etc.
- Option 2: Based on Californian ACE system/ Citrus system: Mail out to growers. Train relevant people (growers) in field estimation techniques.
- Option 3: Use packhouses/ large producers/ local associations to provide data from each region to gain a representative indication. The principles of the Californian ACE system underpin this solutions, but rather than growers providing information directly the businesses outlined act as aggregators/ hosts.

Option 2 and 3 were preferred by the consultant.

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[8] *The use of this predictive modelling was followed up with NZ Avocado Growers Association (pers. comm. Phillip West, November 2015) and appears to be no longer used by the industry.*

[9] *Through Infocado and OrchardInfo, Avocados Australia has kept an industry database of crop predictions and actual marketed fruit volumes since 2005.*

APPENDIX 2: ACE – AVOCADO CROP ESTIMATING PROGRAM – CALIFORNIAN AVOCADO COMMISSION

Crane, A, 1992. Proceedings of the Second World Avocado Congress: Estimating Californian Avocado Production.

Relevant website material at http://www.californiaavocadogrowers.com/industry/crop-projections-and-estimates (November 2015)

The ACE or Avocado Crop Estimating program was launched in 1986 by the Californian Avocado Commission in response to an over estimation of the crop in 1985 which led to significant losses to growers and the supply chain. It is a computer based model which assists in predicting the annual production of Californian avocados by tabulating and analyzing grower production data. Although initially focused on current season yield, its intent is to use this data to build a long term predictive model.

The model uses weather records and average yield in different production divisions identified by postcode (but representative of different soils and production conditions).

To ensure the data was collected efficiently the following approach was adopted:

- Field Team (large growers and advisors) were engaged - to be able to ensure a significant area of production was included and to be able to do update estimates quickly in the case of 'weather events'.
- Survey Team engaged – to provide small growers with surveys as these growers grow the majority of production.
- Use of 'bellwether' avocado groves where the previous 5 years yield data was available to model and compare crop predictions.

Growers are asked (by the Survey Team) to complete a crop estimate form which provides place of production, variety and yield per hectare. Initially this is sent August 1st and then mid-September and the crop estimate is formulated in mid-October. Large growers were contacted separately by the Field Team.

A suitable database was developed to record and analyse the data. As a result the homogeneity of data within each postcode was able to be assessed. If large variation existed then this was investigated.

It was noted that it was also important to distinguish between new growers and seasoned growers with historical records, noting the latter were more reliable in their data. Hence the importance of historical data in developing crop estimates.

The method adopted provided a significant improvement in predicting the crop and refinements have been made from year to year as the system was developed.

By way of explanation, the Californian Avocado Commission via the Avocado Marketing research Information Center (AMRIC) system, collects daily information from each packhouse regarding inventory, shipments and price data to facilitate a more stable market. The ACE program and AMRIC system are closely linked.

Update on system (2015)

Source: *http://www.californiaavocadogrowers.com/industry/crop-projections-and-estimates* (November 2015)

The ACE system now uses:

- Aerial acreage surveys – to determine production by postcode area.
  Showing: newly planted; top worked; abandoned; bearing and non-bearing acreage.
- Grower crop estimate survey – mailed September for pre-season estimate, then January and April to allow for adjustments. Historically about 50% of all avocado acreage is represented in the returned grower crop estimate survey.
- Ground truthing field surveys – CAC staff undertake estimates to verify data
- Variety distribution adjustments

- AMRIC stats – Historical AMRIC statistics are used to predict crop movement throughout the season.

The above information is grouped by postcode, growing area, county and variety. Using the aerial survey acreage and the grower's estimates, the estimated crop volume by growing area is calculated through a computer forecasting system. Market factors, weather, and grove conditions are assessed before the estimated crop volume is translated into a final crop/shipment projection.

ACE Forms and Instructions (from website)

Below is a copy of the crop estimation form that growers are asked to complete online and the corresponding instructions for estimating the avocado crop
(source: www.californianavocadogrowers.com (November 2015)).

Crop Estimate Form

Step-by-Step Instructions for Estimating Avocado Crop:

1. Collect all previous crop estimate records, and compare them to the actual volume you harvested annually, as provided by your handler. Previous avocado harvest records will assist you in fine-tuning your estimating skills. Keep a notepad handy, and record all information as you go; this will eliminate the possibility of having to start over.

2. Do a preliminary walk through your grove(s) to get a sense of crop distribution within each block. Then choose a minimum of 10 avocado trees (the more trees, the better) in your lightest, medium and heaviest producing areas, per block. Estimate the production (total number of fruit), per tree. Some avocado growers prefer using hand counters, which are available from most agricultural supply stores.

3. Calculate the average number of equivalent lugs, per tree, expected in each area, by dividing the total number of fruit per tree, by the average fruit size. For example, a tree with 300-size 60 fruit will be carrying five lugs, per tree (300 ÷ 60 = 5).

4. Estimate your average fruit size based on past records and your current crop. For example, a light crop may average around size 40 at harvest; a heavier crop around 60.

5. Multiply the average lugs, per tree, by the number of trees in the block, and you will generate an estimate of the total number of fruit lugs, per block.

6. If you don't know how many trees are in your grove, you can calculate such by multiplying the spacing (for example, 16 feet × 20 feet = 320) and dividing this number into 43,560 (the number of square feet in an acre). In this example, the calculation is 43,560 / 320 = 136.1250 - or about 136 trees, per acre. Take into consideration roads, ditches or other obstacles. Tree count is important for an accurate estimate. If all else fails, manually count each tree in your grove. Remember to keep your tree count filed and updated.

7. A standard lug of fruit weighs 25 pounds; therefore, you can calculate the number of pounds of fruit, per block, by multiplying the number of lugs by 25. For example, a block with 500 lugs of fruit on the trees will produce 12,500 lbs of fruit.

8. Add up the totals for all blocks sampled, to determine your total-estimated avocado production in pounds.

2014-15 Mid-Season Crop Estimate

Below are the results of the 2014-15 Mid-Season Grower Crop Estimate Survey - May 2015

2014-15 Crop Estimate Survey Results By Variety

Variety	Bearing Acres	Estimated Yield		Response %
		Lbs/Acre	Lbs (MM)	
Hass	49,023	5,511	270.2	51%
Lamb-Hass	1,612	6,276	10.1	47%
Other	843	3,513	3.0	41%
Total	**51,478**	**5,503**	**283.3**	**50%**

2014-15 Crop Estimate Survey Results By County

County	Hass Only			All Varieties		
	Bearing Acres	Estimated Yield		Bearing Acres	Estimated Yield	
		Lbs Per Acre	Lbs (MM)		Lbs Per Acre	Lbs (MM)
San Diego	17,405	5,920	103.0	18,439	6,015	110.9
Riverside	5,414	4,397	23.8	5,496	4,365	24.0
Orange	1,198	4,894	5.9	1,250	4,700	5.9
Ventura	15,881	6,088	96.7	16,925	5,961	100.9
Santa Barbara	4,748	5,390	25.6	4,839	5,360	25.9
San Luis Obispo	3,766	3,329	12.5	3,821	3,304	12.6
San Joaquin	143	2,947	0.4	191	2,206	0.4
Other	468	4,769	2.2	517	5,044	2.6

2014-15 Crop Estimate Survey Results Production Percentage By County
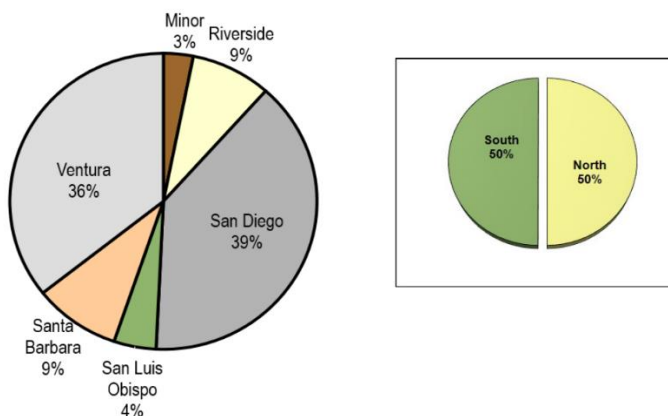
Last Five Years Mid-Season Crop Estimate Survey Results Estimated Hass Yield By County

14
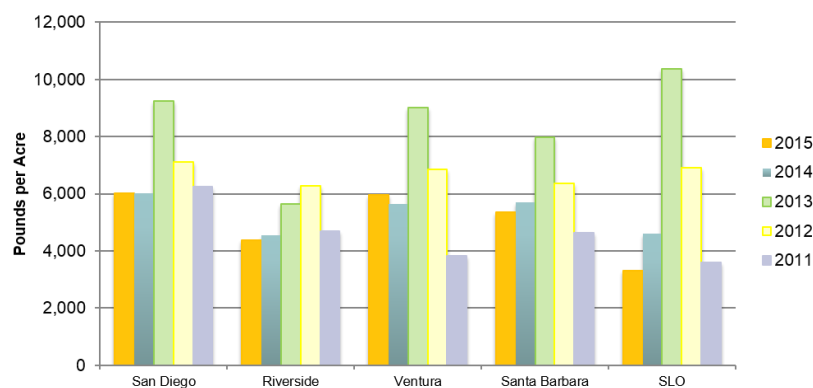
The following information is provided by Hortus Technical Services Bundaberg, Email: techservices@hortus.net.au B: Phone: 07 4132 5000

Carbohydrate Testing (Total Nonstructural Carbohydrate)

Carbohydrates (or saccharides) are a class of organic compounds in living organisms with a general formula $C_mH_{2n}O_n$ that play a number of vital structural and metabolic functions. Carbohydrates exist as simple sugars, or monosaccharides (e.g. glucose, sucrose), and larger polysaccharides (e.g. starch). Energy for growth in plants is derived from photosynthesis, which converts water and atmospheric carbon dioxide into glucose. Monosaccharides are the major source of fuel for metabolism. When not required immediately, monosaccharides are converted into polysaccharides, such as starch, for longer term energy storage. Collectively, the simple sugars and starch are known as nonstructural carbohydrates. The **total nonstructural carbohydrate (TNSC)** level gives an indication of the total energy store of a plant.

Structural carbohydrates, such as cellulose, are not considered, as these are not able to be mobilised for plant use. Carbohydrates are used for fruit setting and new wood growth. When more energy is required than can be produced by photosynthesis, the tree taps into its starch reserve. Storage carbohydrate has been identified as a factor contributing to high yields. In general, reserves are built up during the cooler winter months, and then used in spring for new growth and fruit production. Carbohydrate demand is also affected by tree pruning management.

Testing method: Total carbohydrates are determined in a two-stage process. First, soluble sugars (e.g. glucose, fructose, galactose) are extracted in hot, aqueous ethanol and analysed colorimetrically with phenol/sulphuric acid. Starch is then broken down in a second step by enzymatic hydrolysis with α-amylase and amyloglucosidase to glucose and also determined by a colorimetric method.
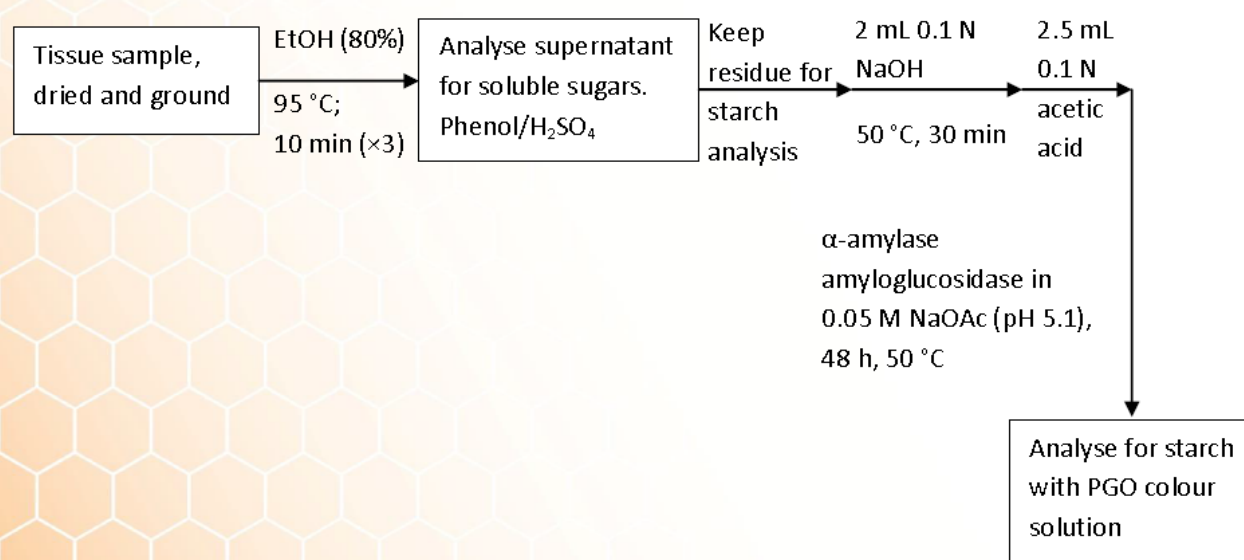
The proposed testing regime gives values for separate values for soluble sugars and starch. The sum of these is the TNSC value.

Testing considerations:

As TNSC values vary throughout the year, the time of testing will influence the results. For a complete picture of fluctuations in reserve carbohydrate levels, regular (monthly) testing will be required. Testing should be carried out at the same time each day. Samples should be submitted to the Hortus Laboratory in minimum batches of 60 samples on the first Thursday of each month.

Where and how the sample is collected is critical to results. Previous work has shown most reliable results from plugs of bark and wood tissue 30 cm above the graft line, to a ca. 5 mm depth, avoiding dead, corky bark.

There are numerous factors that affect starch levels. Anything which weakens or injures the tree, such as disease, insect attack, lack of water, or nutrient deficiency, will reduce energy reserves. Once a tree has been determined to be low in starch, the specific cause must be identified and corrected by further investigation correlating Soil, Dry Tissue, Flower and Sap nutrient levels conducted by the Hortus NATA accredited Laboratory.

For further information contact :

Dr Brendan McPherson – Senior Analyst, Hortus Technical Services P/L –

07 4132 5000 or Brendan@hortus.net.au

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APPENDIX 4: GROWER CASE STUDIES

Sunny Bluff Avocados

About…..

Tom Gorton and his family have been growing avocados in the Mullett Creek area, north of Bundaberg for nearly 20 years.

In total the Gorton family grow 13,000 Hass trees across 57 hectares of mainly red sandy loam country.

The farm is broken up into blocks of roughly equivalent size which assists with managing the orchard.

Earlier plantings on the property are on 12m x 6m spacing, whereas newer planting are on 10m x 5m spacing.

Flowering occurs in September and fruit drop usually occurs in October, December and January. The main harvest period on the farm is April to July / August.

Packing is done on-site and their product is marketed under the 'Sunny Bluff' brand.

Forecasting the crop …..

- **Forecasting starts about 4 weeks before harvest**
- **20 trees per 1000 tree planted are assessed for fruit number and expected fruit size**
- **Figures are extrapolated to work out expected number of trays per block**

The annual crop forecasting process for Tom starts in March each year, about four weeks before harvest starts. Although he spends many hours in the field, and keeps an eye on the impact that fruit drop has on potential yield for the coming season, he believes that trying to accurately forecast the crop any earlier than March in the Bundaberg region, is not a worthwhile exercise.

In March, Tom assesses every block on the farm. He selects trees - about 20 trees per 1,000 trees planted - from across an entire block. He aims to choose those that that are representative of the overall block in terms of tree health and fruit load. He then counts the number of fruit on each tree and assesses fruit size to determine if the fruit will be predominantly small (count 28+), medium (count 22- 25) or large (count 20 or less) at harvest. Tom admits with the larger trees there is an element of guess work as the fruit can be difficult to spot in the canopy.

Based on the counts he has done on the 20 trees, he averages the number of fruit per tree and based on his assessment of overall fruit size determines the number of trays he expects to pack per tree. He also adds in an allowance for wastage at field and packhouse level. For example, if fruit was predominantly in the medium sized range (count 25) he would take the average fruit per tree figure and divide it by 30 (not 25) to determine the number of trays he could expect per tree. This higher figure accounts for wastage.

The trays per tree figure is then extrapolated out to determine the expected number of trays per block.

As the season progresses the forecast figure for each block is updated, depending on how the fruit is sizing.

Tom believes that experience and firsthand knowledge of the orchard is key to being able to forecast the crop accurately. Although Tom knows how a particular block performed the previous year, he is quick to point out that every year is different, hence it is important to go through the exercise of trying to forecast the current crop accurately.

Donovan Family Investments

About…..

Annaleise & Lachlan Donovan have been have been growing avocados since 1991. Their farms are located at Childers, Isis, Bundaberg and Bellthorpe on the Sunshine Coast.

They currently have 300 ha under production, with Shepard, Hass and Lamb Hass being the major varieties.

Most of the production in the Bundaberg region is on deep red volcanic soils with average annual rainfall of approximately 1000 ml mainly occurring over the summer months.

Flowering occurs in September and fruit drop usually occurs in October, December and January. The main harvest period on the farm is April to July / August.

They also have a newly commissioned packhouse where they pack their own fruit and as well as contract packing for other growers.

Forecasting the crop …..

- **Crop foresting starts at flowering and is updated as the season progresses**
- **Comprehensive historical data is maintained to support decision making**

For the Donovan's, forecasting the crop is a process that starts in September each year with flowering. Over the flowering period, a visual assessment is made as to the extent and success of this event. Based on this assessment and historical performance, a preliminary forecast is developed for the coming season for each block.

Across the 300 hectares of production there are approximately 100 blocks. Splitting the farms in this ways allows for a more targeted approach to managing the overall crop.

From the completion of flowering up to the commencement of harvest anywhere up to another 6 visual assessments will be made of the crop load in each block – taking into account both fruit number and fruit size. This information is then used to update the crop forecast as the season progresses.

Lachlan says that he rarely uses the method of counting fruit per tree and extrapolating the result across the block – especially in larger trees. He believes this method is too unreliable as it is too difficult to see the fruit in larger trees and every tree is different.

He believes it's really about having a feel for the crop, knowing how each block performed the previous year and validating this with historical data to confirm crop forecast assessments.

Donovan's have maintained comprehensive farm records of their avocado production over the last 15 years. For each block information collected includes:

- Variety/rootstock
- Year planted/age;
- Trees/block
- Tray equivalents/block
- Tonnes/hectare.

By looking at records it is easy to see trends in the production levels of blocks (and identify issues) and this data is invaluable in helping to develop forecasts from the beginning of each season.

Aussie Orchards

About…..

Colin and Louise Foyster and their family are avocado growers and packers based in Northern NSW. They farm at Pretty Gully (Northern NSW) and Mutchilba on the Atherton Tablelands.

The Pretty Gully farm has deep red volcanic soils which are high in organic matter and an annual average rainfall in excess of 1250mm. It total there are 20,000 mature Hass trees planted over 90 hectares.

In comparison, their Mutchilba farms are predominantly granite sand with little nutritive value and in a low rainfall area. In total there are more 80 hectares of Shepard on the property which have been progressively planted since 2009. One of the biggest challenges in growing avocados in this region is the prevalence of fruit spotting bug.

Forecasting the crop …

- ***Experience and knowledge of the orchard are critical***
- ***Data is extrapolated from counting light, medium and heavy yielding trees***

Colin believes experience and knowledge of your orchard are the keys to getting each year's crop forecast right.

He believes some people have the ability to forecast well and others find the process difficult. On his properties, Colin is the key person doing the crop forecasting, however there are other key orchard staff who also undertake estimates and hence comparisons and discussions with these staff can help refine the forecast.

From flowering and fruit set there are indications of how the crop will perform and although crop estimates are done from this period, more effort is made after the last fruit drop when estimates are more reliable.

Colin identifies light, medium and heavy yielding trees in the orchard and does fruit counts on a sample of these. Estimating the percentage of trees across the orchard which fall into these categories, he then extrapolates the data to determine the expected number of trays which will be harvested. When doing forecasts Colin doesn't break the orchard into blocks, rather he treats the orchard as a whole.

Forecasting the crop at the Pretty Gully farm is made easier as the size of fruit is relatively consistent from year to year and there is less variation in production across the orchard.

Advanced Packaging & Marketing Services

About…..

Jennie and Wayne Franchesci are based in Western Australia and have a life time of experience in growing, packing, marketing and exporting avocados. Through their packing and marketing business, Advance Packing & Marketing Services (APMS) they market a range of brands including 'West N' Fresh', 'Gotta Luv 'Em' and 'Avolicious'.

They work closely with their grower suppliers and provide a range of support services to ensure the fruit they are sourcing is the best quality. They have recently developed proprietary software to assist their grower suppliers with collection and recording of key orchard data for decision purposes. This includes crop forecasting and historical production data.

Forecasting the crop …

- ***Knowing the crop and keeping good crop records is essential***
- ***Managing crop forecasts at a 'block' level assists in the process***

Being a packing and marketing business, having good crop forecast figures is critical for developing sound marketing plans.

Wayne deals with the grower suppliers throughout the season, providing advice on growing practices and crop forecasting. He encourage growers to manage and analyse their crop at the 'block' level. This includes developing crop estimates for the block, which are recorded as bins/block.

APMS request grower suppliers to provide crop forecast throughout the season, which starts at flowering in late October to early December and then continues through to harvest in the following spring/summer period. Estimates are often calculated by counting fruit (full tree) on a grid pattern and then extrapolating these figures to obtain an estimate for the block.

In addition to this Wayne will also undertake his own visual assessments of their crop through the season. Having a crop forecast from two different sources provides the opportunity to validate estimates or if there are significant discrepancies, provides a trigger for further investigation.

In addition, as APMS keep good planting and production records on their supplier's orchards, they are also able to extrapolate historical data to support the crop estimate process.

At the end of the season, APMS provide grower suppliers with comprehensive pack-out data based on production blocks, so a comparison can be made with the crop estimate and information can be retained to inform the following year's estimates.

Balmoral Orchards

About…..

Michael Flynn manages Balmoral Orchards. The business is situated at Carbarlah, north of Toowoomba on the Great Dividing Range. It grows, packs and markets fruit under the Balmoral Avocados brand. It also provides packing and marketing services for other growers.

The production side of the business was established in 1988 and now grows over 12,000 Hass avocado trees planted across 198 hectares. The orchard is situated approximately 600 metres above sea level, providing a cooler climate and later crop. Flowering occurs during September and October and harvest during late Winter and Spring.

Forecasting the crop …

- *Experience and knowing the orchard is key*
- *Select 'average' trees across the block as sample trees for counting*

Michael is responsible for completing the crop forecasts for the business. Throughout the season he is orchard, monitoring the performance of the crop – looking at flowering, fruit set and getting a feel for how the crop is progressing.

The final fruit drop usually occurs over the January/February period during the peak of Summer heat. After fruit drop, in February/March, when estimates are more reliable, Michael will complete a fruit count and develop a crop forecast.

Michael looks for 'average' trees in the block and selects a sample of these to undertake fruit counts. He will count a 1/4 of the tree, ensuring he counts different sides of the trees he is sampling to reduce sampling bias. Taking into account an expected average size of fruit, he will then extrapolate this figure out to calculate 'trays/tree' and then 'trays/block'. In calculating these figures he will usually factor in a 10% wastage figure.

As the season progresses more fruit counts are completed and the crop estimates refined up to harvest. Not every block is counted every time, particularly when blocks are known to have similar performance.

At the end of the season, Michael will compare his crop estimates for each block with the actual crop harvested. He says that most years he gets it right, but there are some years where the process just doesn't work. In those years it's always important to understand why there were discrepancies so that forecasting processes can be improved the following season.

Where fruit is supplied from others, Michael relies on those growers to provide their estimates. Although historical records are often a good indicator of the expected crop, if there has been adverse weather conditions during the season.

Appendix 15: Remote sensing research (final report)

Avocado Project AV12012

Remote Sensing Component: Final Report.

Submitted 15th September 2014

Andrew Robson   (University of New England)
Chad Simpson   (Simpson Farms)
Julie Petty   (Avocado Australia Ltd)
Daryl Joyce   (Department of Agriculture, Fisheries and Forestry Queensland (DAFF Qld)/ The University of Queensland),

Terrance Campbell   (DAFF Qld)
Jose Marques   (DAFF Qld)
Peter Hofman   (DAFF Qld)

Aim:

To assess the effectiveness of using remote sensing technologies to predominately collect tree number and tree health information.

Executive Summary:

High resolution satellite images were captured over two Hass avocado crops during 2013 and 2014. Image analysis coupled with the strategic ground truthing of trees enabled classified maps depicting a number of tree health and production parameters to be derived. Improved accuracies in tree auditing were also achieved using novel imagery, GIS and Google Earth methodologies.

Summary:

High resolution satellite imagery, Geographical Information Systems (GIS) and Google Earth were demonstrated as effective tools for tree auditing and for defining the spatial variability of tree condition across two commercial 'Hass' avocado blocks in Childers, Australia. Using a classified normalised difference vegetation index (NDVI) map derived from a WorldView2 image captured on April 19th 2013 and then repeated May 29th 2014, three replicate trees within high, mid and low growth regions were selected from each block. The annual harvest of these trees was conducted on May 21st 2013 and May 7th 2014, along with measures of leaf fluorescence and SPAD. Fruit quality measures were also conducted post-harvest. Spectral information corresponding with each of the sampled tree canopies was extracted and used to derive a number of pigment and structural based vegetation indices. These indices along with the 8 spectral band reflectance data was correlated against the measured fruit and tree parameters resulting in strong correlations with average fruit weight (g) (R= 0.86**, P=0.0001, RMSE= 14.7 gms); % commercial yield (R=0.71**, P= < 0.0001, RMSE= 13.2%); Fm/Fv (R= -0.67**, P= < 0.0001) and SPAD (R= 0.67**, P= <0.0001). Using algorithms produced from the linear relationships between the measured parameters and the derived vegetation indices, specific maps representing the spatial and temporal distribution of each of the parameters were developed. This information supports improved tree management and harvest segregation based on fruit size.

For the auditing of tree numbers, a more exact method for calculating orchard area and tree density was examined that increased the prediction accuracy of one orchard (30.3 ha) from 90.4 % to 97.3 %. The development of spatial data base that incorporated every individual tree within an orchard was also investigated. At the regional level an accurate inventory of trees supports improved handling, marketing and forward selling decisions. At the orchard level, it offers an improved method of orchard data recording and 'paddock to plate' traceability.

Introduction:

The avocado (*Persea Americana* Mill.) plant is an evergreen tree that can reach up to 20 metres in height, that when grown in close proximity will create a continuous closed canopy. The leaves are spirally arranged along branches and vary in both size and shape. The upper (adaxial) surface is waxy and lacks stomata. The underside (abaxial) surface is light green and glaucous. Leaf growth generally occurs in two 'flushes'; one in spring and the other in summer/ autumn. Within the Childers growing region of South-eastern Queensland Australia, avocado trees flower in September, with the initial fruit set occurring in October. This is followed by a fruit drop in December when the tree, based on health, determines its fruit carrying capacity until harvest, which generally begins in May.

In order to assess the health of an avocado tree, a number of on ground measures have been developed that include SPAD and chlorophyll fluorescence of individual leaves sampled from around the tree. The chlorophyll or SPAD meter measures the amount of light transmitted through the leaf in the visible red (approximately 650 nm: red LED) and infrared (peak approximately 940 nm) wavelength to obtain a measure of leaf greenness or relative chlorophyll concentration (Uddling et al 2007). The chlorophyll fluorescence of leaves provides a non-destructive measure of photosystems II (PSII) activity, which reflects plant function including photosynthetic performance and stress level (Whiley et al 1988). This is expressed as F_v/ F_m, with healthy plants exhibiting a value in the range of 0.79 to 0.84 (Maxwell and Johnson 2000). Although these instruments provide a measure of the photosynthetic potential, nutrition, etc of individual trees, the ability to undertake these measures across entire orchards to account for spatial variation would be time consuming, labour intensive and prohibitively costly. This limits the producer's ability to understand and therefore apply more spatially relevant remedial action particularly at the key growth stages where fruit yield and quality are set.

An accurate annual forecast of Avocado production is extremely difficult for agencies that supply information for national marketers such as Avocado Australia Ltd. A major limitation is not only being able to estimate yield per tree, but also accessing accurate information about the number of trees in production for a given year. Currently, information on the number of trees grown and density of trees planted is sourced by grower survey, a method that is subjective and prone to human error. An automated method for obtaining this information would ensure greater data integrity and ultimately improved confidence when formulating handling, storage and forward selling decisions.

Remotely sensed imagery in conjunction with an effective geographical information system (GIS) offers one solution for extrapolating 'point-source' measures of tree health and yield to the orchard level, as well as for improving current tree auditing techniques. The recent evolution of satellite based sensor platforms, in terms of spatial, spectral and temporal resolution has made it possible to clearly identify individual trees and extract a wider range of spectral data pertaining to tree condition. With this, comes the potential to infer a range of commercially relevant parameters.

The following report investigates the accuracies high resolution satellite imagery, GIS and Google Earth for avocado tree auditing and for the mapping avocado tree health and production variables.

Materials and Methods:

Study Site.

For this study, two 'Hass' avocado orchards were selected near the township of Childers, Queensland, Australia (152.35647° E, -25.15055° S) (Figure 1. circled in white).
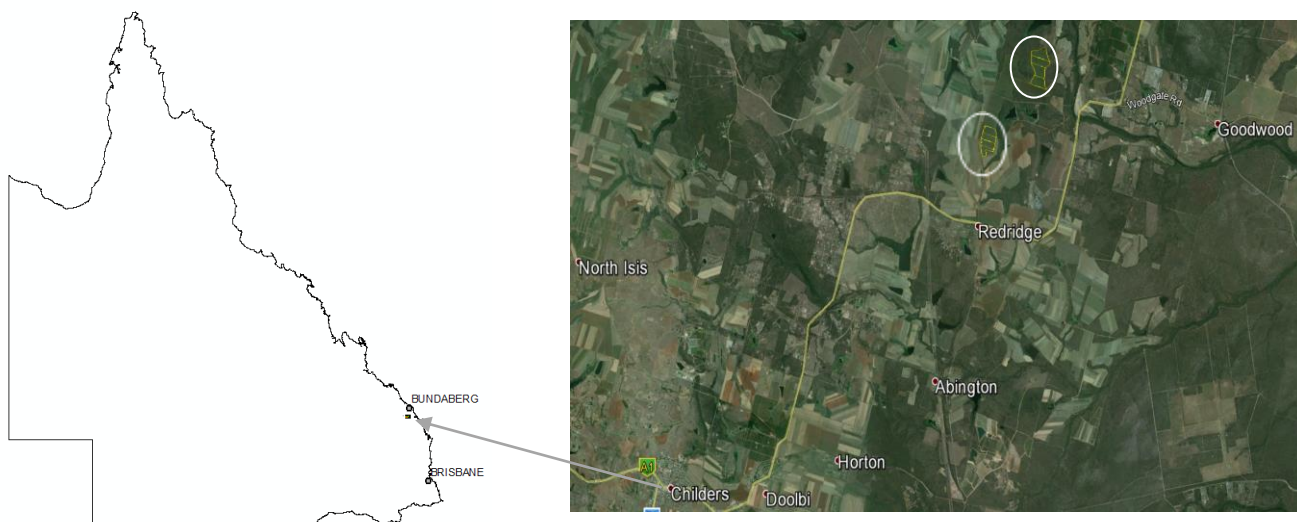
Figure 1. Location of the two Hass avocado orchards located near Goodwood, Queensland.

Figure 2. Northern Hass orchard blocks 1- 4 (left). Southern Hass orchard blocks 6- 8 (right) (Images sourced from Google Earth captured 11 April 2009).

The northern orchard (blocks 1- 4) was planted in 2005 and encompassed 30.3 ha and 5,481 trees. The southern orchard (blocks 5- 8), was planted in 2006 and encompassed 21.2 ha and 3,669 trees.

The project was repeated over two growing years 2013 and 2014 in an attempt to compensate for annual weather variation, which in this case proved to be warranted. The 2013 harvest season (1 June 2012 to 31 May 2013)

experienced substantially more rainfall than the 2014 season (1 June 2012 to 31 May 2013) (viz., 1251 mm compared to 578 mm, respectively), slightly cooler average maximum temperatures (26.9 compared to 28.2 deg C) and reduced radiation (6,689 compared to 7,087 MJ/m^2).

Satellite Imagery and Pre-processing:

A number of commercially available satellite platforms provide sub metre imagery; viz., SPOT6, Pleiades, Ikonos, QuickBird, (http://www.geoimage.com.au/satellites/satellite-overview). However, Worldview 2 (WV2) was selected for this preliminary study due to its very high spatial resolution (50 cm panchromatic) and its superior 8 band spectral resolution (coastal blue (400- 450 nm), blue (450 – 510 nm), green (510 – 580 nm), yellow (585 – 625 nm), red (630 – 690 nm), red-edge (705 – 745 nm), NIR 1 (770 – 895 nm) and NIR 2 (860 – 1040 nm)). The additional wavebands allow for a greater array of pigment and structural based vegetation indices to be derived and subsequently correlated against measured parameters.

> * Cost of each Worldview 2 image $3,244 (100km^2, 8 spectral band bundle with panchromatic) + $660 for orthorectification and pansharpening.
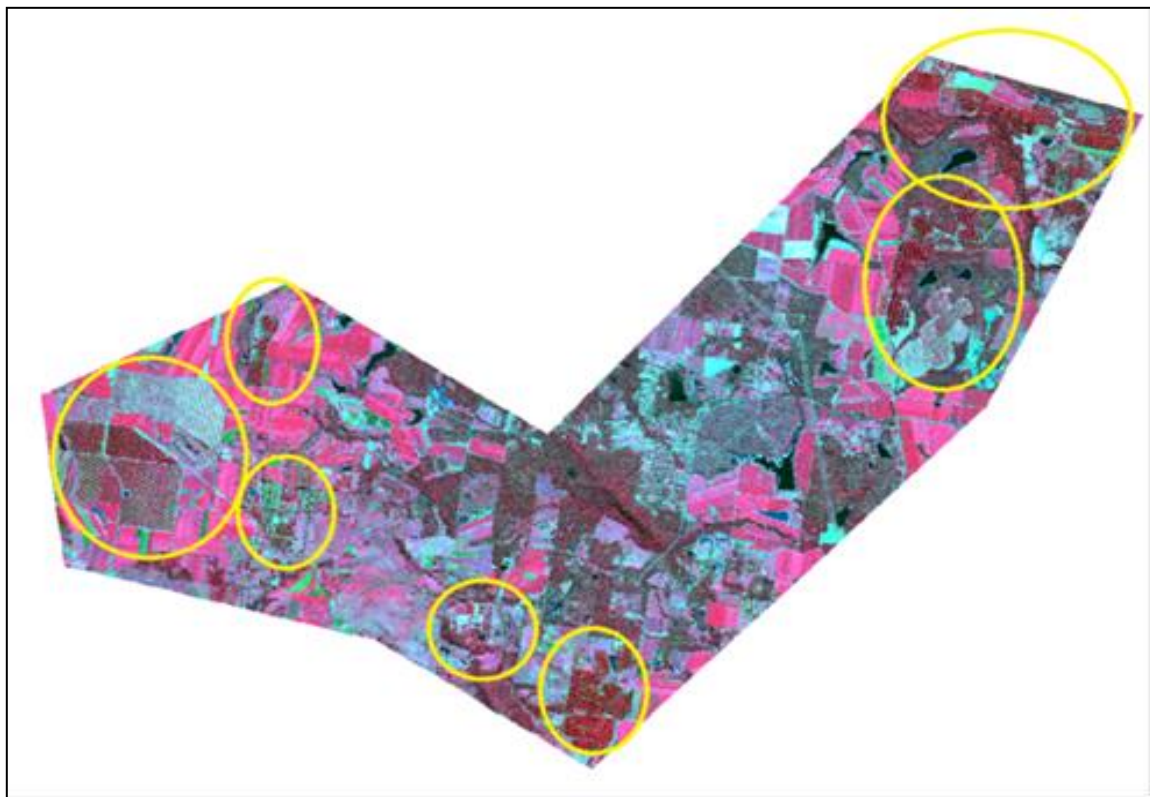
Figure 3: False colour WV2 image captured 29 May 2014. Yellow circles indicate the multiple orchards encompassed within the 100km^2 capture area.

As indicated, the minimum commercial capture area for WV2 is 100 km². Although this well exceeded the area required to encompass the two study blocks, it included six additional orchards. This equates to around $570 per orchard, which is not cost prohibitive if this technology was to be commercially adopted over intensive growing areas such as this.

The two WV2 images were acquired on April 19th 2013 and May 29th 2014 to coincide with the fruit maturation period. Both images were orthorectified (WGS 84, UTM Zone 56), converted to top of atmosphere reflectance (TOA) and panchromatic sharpened before further analysis. Although the panchromatic sharpened product is not recommended for the temporal analysis of imagery data, it was used in this study as very high resolution was required for the delineation of each individual tree.

Identifying Sample Trees:

From each pre-processed image, a Normalised Difference Vegetation Index (NDVI= (NIR1- red)/ (NIR1 + red)) layer of the two orchards was derived and then classified into a 6 colour ramp image using an unsupervised classification. From the classified NDVI layers, 9 trees per orchard (3 replicate trees from within each of the high, mid and low NDVI regions) were selected, with the block, row and tree number recorded so they could be located in the field. NDVI is the most commonly used vegetation index for identifying variability in plant/ tree vigour as it incorporates both structural turgidity via NIR reflectance and chlorophyll concentration via absorption within the visible red. However, its use in the prediction of specific agronomic parameters is limited as it is influenced by most abiotic or biotic constraints. For this study the classified NDVI images were used only to identify general variability in tree vigour and therefore guide the location of the replicate trees to be sampled.
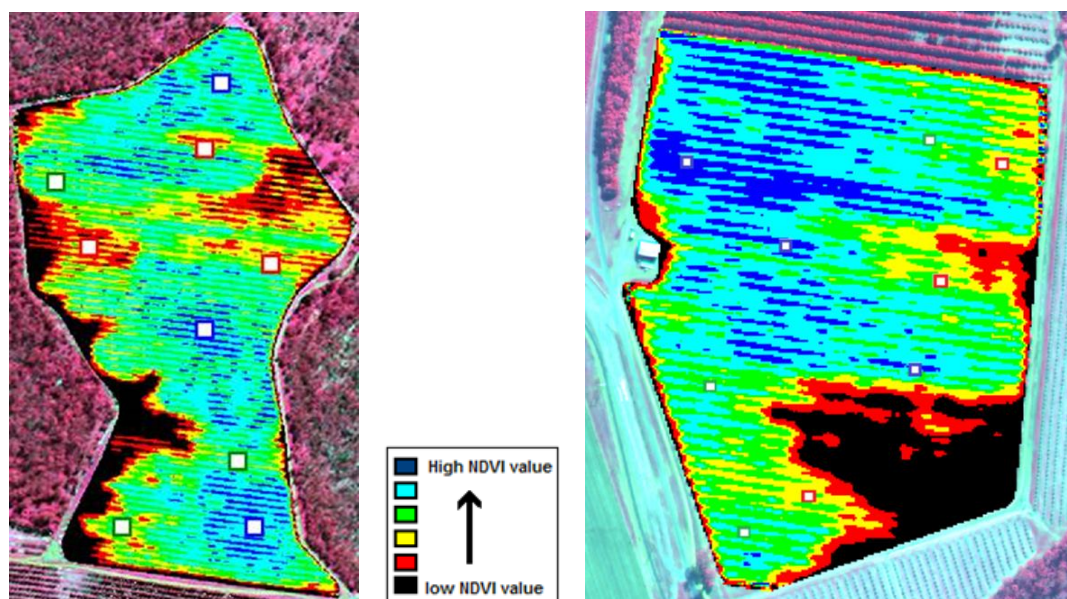
Figure 4. Classified NDVI images of the northern and southern Hass orchards. The colour coded markers indicate the replicate tree sampling locations.

17 of the 18 trees sampled in 2013 were re- sampled in 2014, with the location of the remaining 1 being moved, due to limb removal on the original tree, to another tree less than 20 metres away, but still within the same NDVI class.

Obtaining Measures of Tree Health and Fruit Quality:

The manual harvest of the selected 18 trees was conducted on May 21st 2013 and then again on May 7th 2014 (n = 18 + 18 = 36), with the total weight of fruit per tree recorded. The fruit were then separated by size, and re-weighed to obtain a proportion (%) of commercial weight. A sub sample of 40 commercial sized fruit per tree were collected and later assessed for a range of quality parameters including average fruit weight (g), days to ripen, skin colour, dry matter (%), total rots (%), bruising (%), acceptable fruit (%) and acceptable fruit including bruising (%). To obtain a surrogate indicator of tree health, leaf fluorescence (OptiSciences OS-30p, Opti-Sciences Inc.) and SPAD (SPAD 502 chlorophyll meter, Spectrum Technologies Inc.) measurements were undertaken on multiple leaves around the base of each tree. Soil samples (10 cm depth) were also collected around the base of each tree, bulked to create one sample per tree, and sent for a full chemical analysis.

Development of Parameter Specific Algorithms:

A point source GIS data layer defining the location of each sample tree was developed within ArcGIS (*Environmental Systems Research Institute. Redlands, CA*). A 3 metre buffer was applied to each point so that the resultant polygon (28.1 m^2) encompassed the majority of an individual tree's canopy reflectance without the inclusion of shading or inter-row vegetation. Using the software STARSPAN GUI (Rueda et al. 2005), the 8 band TOA reflectance data of each sample tree was extracted from both WV2 images. A number of structural and pigment based vegetation indices (Table 1) were derived from the extracted data and correlated against each of the measured parameters. Vegetation indices or band rationing reduces the degree of spectral 'noise' such as that associated with atmospheric attenuation. Structural based indices predominantly incorporate the reflectance properties of a canopy within NIR (700 – 1000 nm) as these indicate cell structure, turgidity, etc. Pigment based indices focus on the absorption characteristics within the visible wave lengths (400 – 690 nm) as these indicate the concentration of various photosynthetic pigments. The linear algorithms derived from those vegetation indices with strongest correlations were retained for the further image analysis.

Table 1: Indices investigated.

Normalised Difference Vegetation Index (NDVI)	$R_{NIR} - R_{Red} / R_{NIR} + R_{Red}$
GreenNDVI	$R_{NIR} - R_{Green} / R_{NIR} + R_{Green}$
MidIRNDVI	$R_{MIR} - R_{Red} / R_{MIR} - R_{Red}$
Plant Cell Density (PCD)	R_{NIR} / R_{Red}
MidIRPCD	R_{MIR} / R_{Red}
MidIRNDVIPCD	$MidIRNDVI / R_{Red}$
Transformed chlorophyll absorption reflectance index (TCARI)	$-3*(R_{Red} - R_{Green}) - 0.2*(R_{Red} - R_{Green}) *(R_{Red} / R_{NIR} + Red))$
Two-band Enhance Vegetation Index (EVI_2)	$2.5*((R_{NIR} - R_{Red})/(R_{NIR} +(2.4* R_{Red})+1))$
Structure insensitive pigment index (SIPI)	$R_{NIR} - R_{Blue} / R_{NIR} - R_{Red}$
Modified Simple Ratio (MSR)	$(R_{NIR}/ R_{Red)}- 1)/(SQRT(R_{NIR}/ R_{Red})+ 1)$
REGNDVI	$R_{Red-edge} - R_{Green} / R_{Red-edge} + R_{Green}$
N1RENDVI	$R_{NIR} - R_{Red-edge} / R_{NIR} + R_{Red-edge}$
N2RENDVI	$R_{MIR} - R_{Red-edge} / R_{MIR} + R_{Red-edge}$
N1/Red/RENDVI	$R_{NIR} - R_{Red} / R_{NIR} + R_{Red-edge}$

*R indicates the spectral values measured in the accompanying band width.

Development and Distribution of Tree health and Production Specific Maps:

In order to extrapolate the point source measures to all trees in the orchard, a number of approaches were investigated. The first used the orchard boundary vector file to subset the orchard specific reflectance data from the WV2 images, whilst the second method removed all non- canopy specific data including tree shading and inter-row vegetation. To achieve this, a GIS point grid layer was developed in the GIS software Geospatial Modelling Environment (GME) and then refined in ArcGIS, to ensure each point aligned with each tree centre. The 3 m buffer was again applied to all points, creating a 28.1 m^2 polygon for each tree (Figure 5). Using ENVI *(Exelis Visual Information Solutions, Boulder, Colorado)* software the relevant vegetation index and linear algorithm for each measured parameter was applied to the sub-setted images, before being classified using an 8 colour ramp density slice. The resultant maps were produced in a number of formats including digital hard copies, Geotifs, and as Google Earth kmz files.
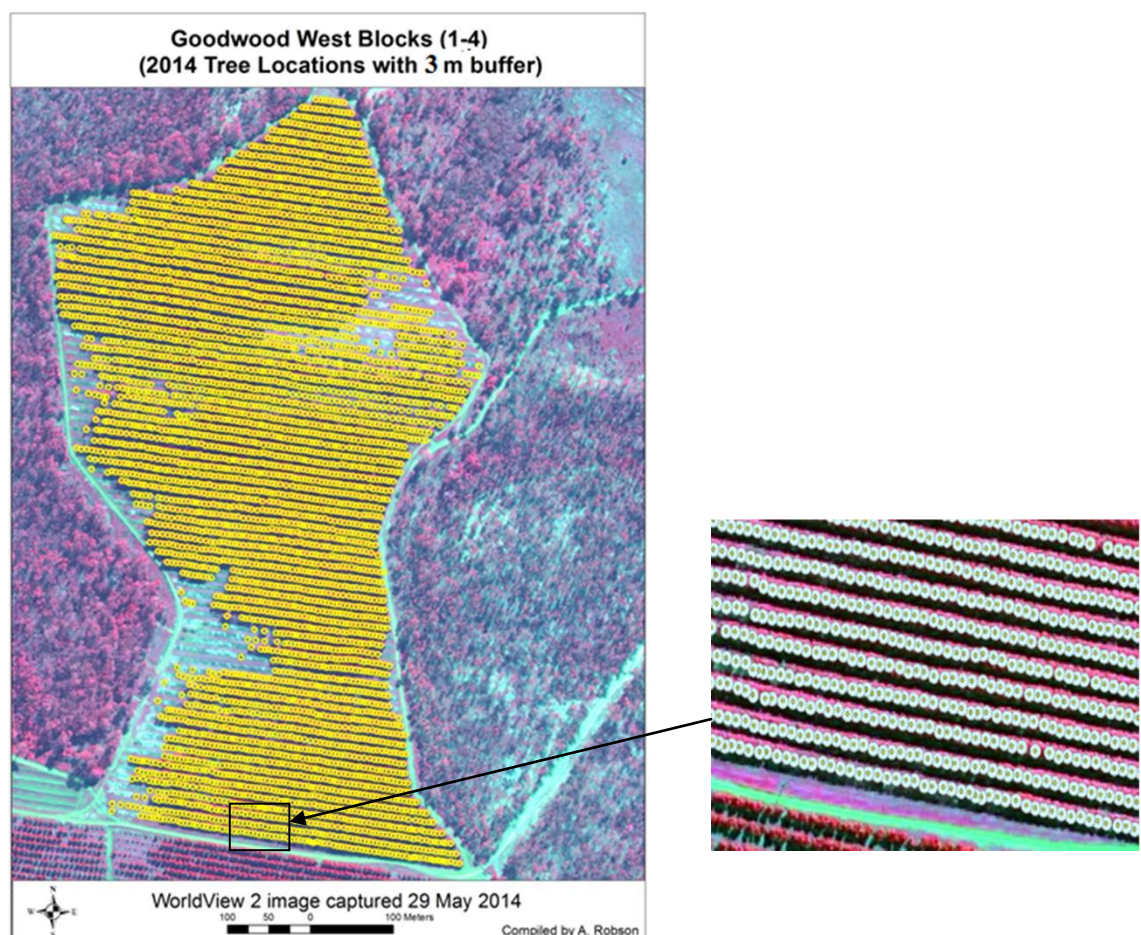
Figure 5. GIS polygon layer of the northern Hass orchard developed from 3 m buffers (28.1 m^2) being applied around the central point of each tree.

Tree Auditing:

As this was a preliminary study, the evaluation of novel tree auditing methodologies over large growing areas was not feasible. As such a test case scenario was established for the northern avocado orchard. Initially, an 'area/ tree density calculation' was investigated where the area of the orchard and tree spacing information was provided by the grower:

Tree number = orchard area / area per tree

The second method looked at refining the grower information by obtaining an accurate measure of the area of growing trees within the orchard rather than using the external boundary. This was achieved by manually measuring the extent of actively growing tree with the ArcGIS 'measure tool' using the 2014 WV2 image as a guide. For determining actual tree spacing, a similar approach was adopted. However, this could only be applied to smaller trees where the individual canopies could be differentiated. For the larger trees with a continuous canopy, the Google Earth 'historical imagery' option was used to access archive imagery of the trees at a younger age. A direct measure of tree spacing using the Google Earth 'show ruler' tool was undertaken on selected trees. 836 trees were also manually 'geo-tagged' using the 'add place mark' option and exported into ArcGIS to establish an average tree density. Although time consuming, the 'geo-tagging' method provided a database of each individual tree and their location.

Results and Discussion:

Correlation of Imagery to Tree Health and Productivity:

The use of classified NDVI maps for directing sampling locations (Figure 4) proved effective for selecting trees of different size and vigour (Figure 6). This ensured that all subsequent sampling and analysis encompassed a large extent of variability actually occurring within the orchard and therefore did not produce biased or non- representative results.
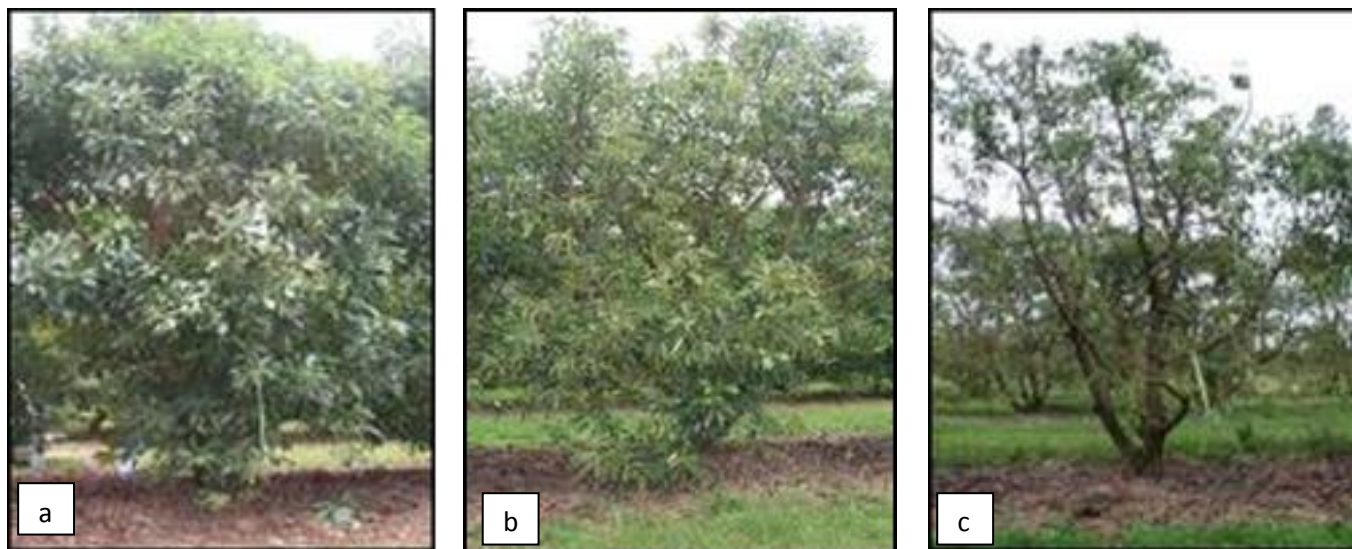
Figure 6. Visible variation in tree size and vigour within high (a), medium (b) and low (c) NDVI regions.

The further extraction of spectral information specific to each sampled tree identified some strong correlations between derived vegetation indices and a number of measured parameters (Table 2). These included:

- Average fruit weight (gms) (R= 0.86**, P=0.0001, (n=36, RMSE= 14.7 gms);
- % commercial yield   (R=0.71**, P= < 0.0001), (n=36, RMSE= 13.2%);
- Fm/Fv   (R= -0.67**, P= < 0.0001) (n= 36);
- SPAD   (R= 0.67**, P= <0.0001), (n=36).

Table 2: Correlation matrix between individual band widths and vegetation indices to each of the measured parameters.

	Total yld (Kg)	Com. yld (Kg)	% com. yld	Av. fruit wt (g)	Fruit dry matter (%)	Fo (min)	Fm (max)	Fv/Fm value	CI SPAD	Days to ripe	Skin colour (1-6)	Total rots (%)	Bruising (%)	% accep fruit	% accep fruit incl bruising	Number of fruit
Coastal Blue	0.259577	0.313976	0.152628	-0.30591	-0.44434	-0.20458	-0.32545	-0.39016	0.443645	-0.16195	-0.35262	-0.4312	-0.20577	0.396858	0.617935	0.331178
Blue	-0.01321	-0.00471	-0.14875	-0.57199	-0.1287	-0.22683	-0.49803	-0.56213	0.135223	-0.06594	-0.19894	-0.30735	-0.18841	0.294781	0.434878	0.139753
Green	-0.28006	-0.37349	-0.61882	-0.79651	0.223773	-0.23827	-0.69958	-0.67049	-0.47052	0.216925	0.209279	-0.12986	-0.16127	0.118727	0.213822	-0.06844
Yellow	-0.20816	-0.28391	-0.52329	-0.81122	0.127266	-0.36504	-0.73906	-0.6081	-0.39283	0.118874	0.085092	-0.23014	-0.18559	0.21184	0.321422	0.004979
Red	-0.24262	-0.30219	-0.51186	-0.82661	0.167634	-0.35288	-0.7095	-0.6135	-0.34046	0.058877	0.022442	-0.26786	-0.2073	0.244042	0.336706	-0.0333
Red-Edge	-0.27491	-0.34805	-0.34421	0.052387	0.333758	0.124382	-0.06152	-0.08145	-0.4099	0.232026	0.329997	0.328323	0.217205	-0.29425	-0.39231	-0.26502
NIR1	0.119696	0.180391	0.404843	0.790666	-0.17299	0.393516	0.649099	0.449179	0.336368	0.02678	-0.00396	0.283098	0.31181	-0.28372	-0.34752	-0.05958
NIR2	0.078952	0.123967	0.337192	0.735446	-0.09786	0.346867	0.585593	0.445332	0.240365	0.045129	0.075871	0.277034	0.306402	-0.28619	-0.36201	-0.0838
RENDVI	0.081605	0.095497	0.262406	0.725342	0.002849	0.370822	0.579962	0.472828	0.089087	0.062111	0.137179	0.383975	0.306116	-0.35247	-0.47526	-0.087
N1/RE NDVI	0.313613	0.395339	0.589645	0.8536	-0.33936	0.373779	0.737762	0.566512	0.506324	-0.05273	-0.07185	0.186079	0.227877	-0.19268	-0.22907	0.107852
N1/ N2NDVI	0.197631	0.215986	0.348097	0.703477	-0.08524	0.282478	0.566499	0.553955	0.157033	0.041308	0.191372	0.255982	0.234193	-0.25495	-0.35092	0.033739
TCARI	0.026591	-0.10219	-0.53729	-0.62066	-0.01791	-0.07688	-0.45387	-0.47656	-0.3995	0.303541	0.444328	-0.19355	-0.19496	0.16651	0.326584	0.185579
SIPI	0.096826	0.091693	0.177376	0.635764	-0.03638	0.312117	0.537488	0.482468	0.021098	0.125853	0.232072	0.297945	0.282987	-0.29889	-0.39591	-0.0474
NIR1GNDVI	0.232728	0.299684	0.50502	0.84489	-0.23562	0.367569	0.704684	0.558787	0.400074	-0.03515	-0.02593	0.246985	0.280207	-0.24531	-0.31735	0.032932
MSR	0.179674	0.251755	0.498892	0.860602	-0.19016	0.386759	0.722586	0.560835	0.370771	-0.0347	-0.06153	0.283129	0.292125	-0.27571	-0.36235	-0.02569
NIR1PCD	0.15564	0.234514	0.502998	0.863574	-0.183	0.382101	0.726096	0.559755	0.377953	-0.04825	-0.0994	0.28048	0.301525	-0.27419	-0.36581	-0.05053
N1NDVI	0.238852	0.290103	0.467131	0.825044	-0.20714	0.384649	0.688377	0.544947	0.338572	0.005146	0.039747	0.282303	0.265504	-0.27148	-0.34451	0.043189
N2NDVI	0.225079	0.273291	0.455768	0.819269	-0.18204	0.368205	0.680739	0.563291	0.307204	0.008548	0.05901	0.280172	0.268165	-0.27232	-0.35443	0.030973
N1RENDVI	0.370334	0.484283	0.694033	0.811208	-0.46354	0.322455	0.727586	0.540852	0.667548	-0.1238	-0.21057	0.056327	0.162725	-0.08341	-0.07307	0.170955
N2RENDVI	0.384436	0.499904	0.712118	0.796674	-0.46274	0.271301	0.717378	0.588951	0.661158	-0.1373	-0.18873	-0.0012	0.137659	-0.04249	-0.03261	0.187757
CB SIPI	0.065217	0.065233	0.155249	0.582771	-0.04979	0.333526	0.492974	0.365292	0.062279	0.138598	0.205608	0.309048	0.31558	-0.30953	-0.3975	-0.05222

* values in blue are those with the highest correlation coefficients for each parameter.

To identify if seasonal variability was influencing the relationship between the derived indices and measured parameters, a scatter plot was derived for those with a high correlation coefficient (Figure 7).
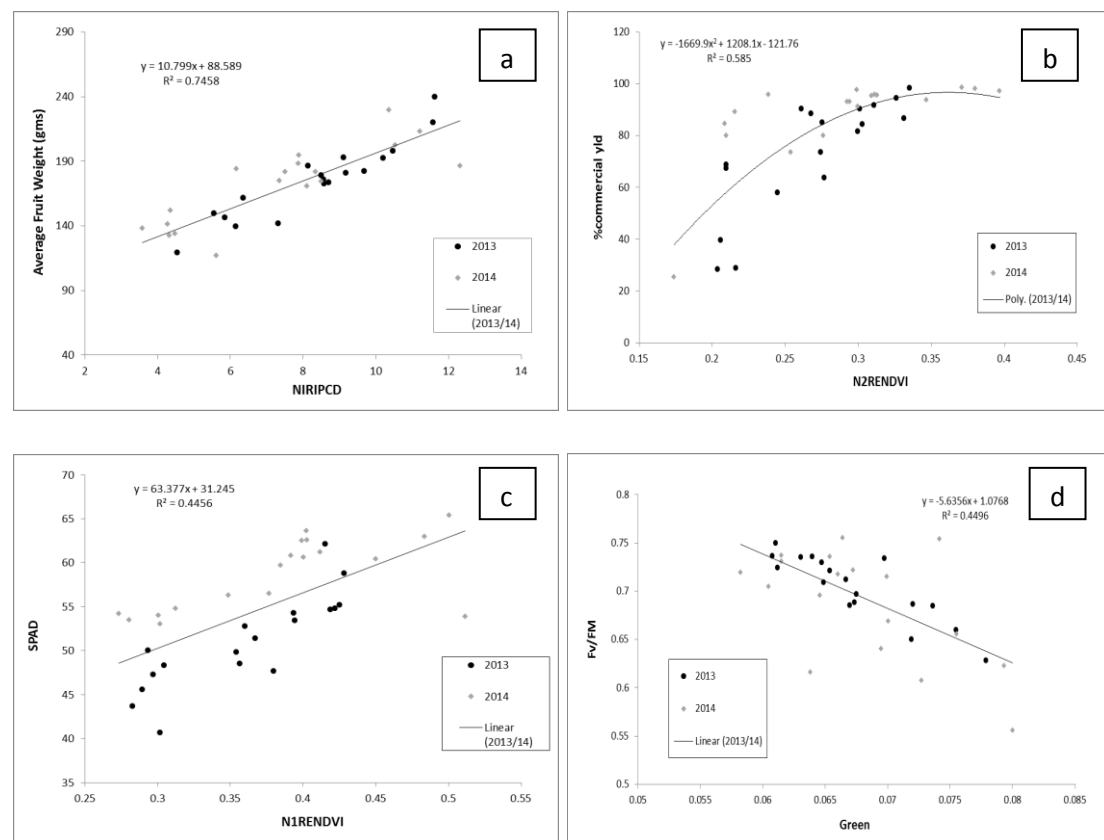
Figure 7. Scatter plots of vegetation indices (VI) derived from WV2 imagery captured 19th April 2013 and 29th May 2014 and corresponding 2013 and 2014 in-field measures of (a) Average fruit weight (b) Percentage commercial yield; (c) SPAD; and (d) leaf florescence (Fv/Fm).

The most encouraging result from this study was the strong linear relationship between the extracted spectral data and the average fruit weight of commercially sized fruit (Figure 7a). This is particularly encouraging considering the highly variable weather conditions experienced between 2013 and 2014. The strong correlation is hypothesised to be the result of the vegetation index used, the timing of imagery capture and the relationship between tree health and fruit filling capacity. Trees under stress have reduced photosynthetic ability to fix CO_2. They therefore develop relatively lower photo-assimilate reserves and so provide less CHO to maturing fruit, resulting in smaller fruit at harvest. The relationship between the spectral data and % commercial yield (Figure 7b) is also encouraging as it represents the proportion of fruit per tree that is of commercial grade.

Although strong correlations were identified between the imagery data and the yield parameters 'average fruit weight' and '% commercial fruit weight', there was little correlation to actual tree yield (R= 0.3844) (Table 2). It is hypothesized that this poor correlation was due to an inability to predict fruit number. From Figure 8, no relationship between average fruit weight and fruit number per tree was identified from the 36 trees sampled. In terms of explaining commercial yield per tree, fruit number was of much greater influence (R= 0.913) than was average commercial fruit weight (R= 0.367).
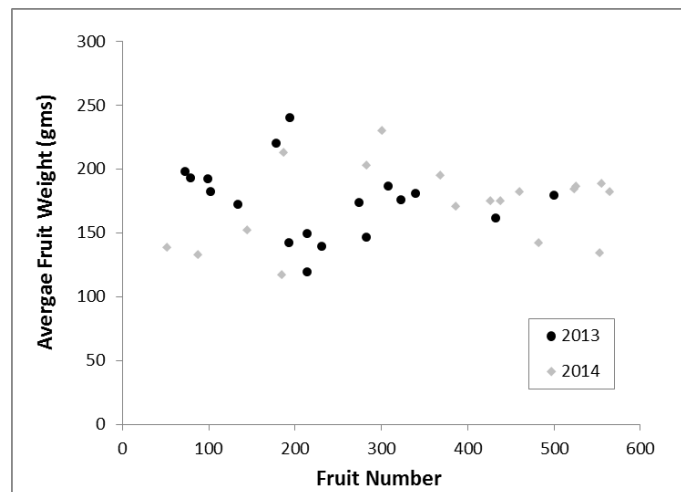
Figure 8. Scatter plot of the relationship between average fruit weight and fruit number per tree collected from the 36 sampled trees in 2013 and 2014.

Therefore, to be able to predict tree yield, some correlation to fruit number needs to be established. It is suggested that an additional image should be captured during the 'fruit set' growth stage during October / November. This information may enable some correlation between tree health and fruit setting potential. Together with the prediction of average fruit weight in April/ May image, an improved yield prediction may be achieved. Further research is required to test and ideally validate this hypothesis.

In terms of tree health, linear relationships were identified between the vegetation index N1RENDVI and SPAD (Figure 7c) and reflectance within the visible Green band with leaf fluorescence (Fv / Fm) (Figure 7d). The temporal separation between 2013 and 2014 data sets for SPAD indicates that annual calibrations may be required, particularly when seasonal conditions vary as much as they did in this study. These measures provide a strong indication of plant nitrogen supply and photosynthetic efficiency, both essential for avocado trees to achieve and sustain heavy fruit sets until maturity.

In terms of soil health, a negative correlation (R= -0.64424) was identified between soil zinc concentration (mg/kg) and total tree yield (kg) for the 18 trees sampled in 2013. This result was not found again in the 2014 season, possibly due to the highly variable weather conditions experienced across the two seasons. Nonetheless, the 2013 result does demonstrate the potential benefit of targeted sampling using imagery as the possible zinc toxicity may not have been identified under the standard soil sampling method of one bulked soil sample per orchard block. Identifying the spatial variability of soil health creates opportunity for implementing a variable rate strategy for orchard inputs.

Developing Spatial Layers from Point Source Measurements:

In order to extrapolate the point source measures (Figure 7) to the entire orchard, each linear regression algorithm was applied to the imagery, converting each pixel from reflectance into a scaled parameter value. An example of a derived classified map for average fruit weight is provided in Figure 9.
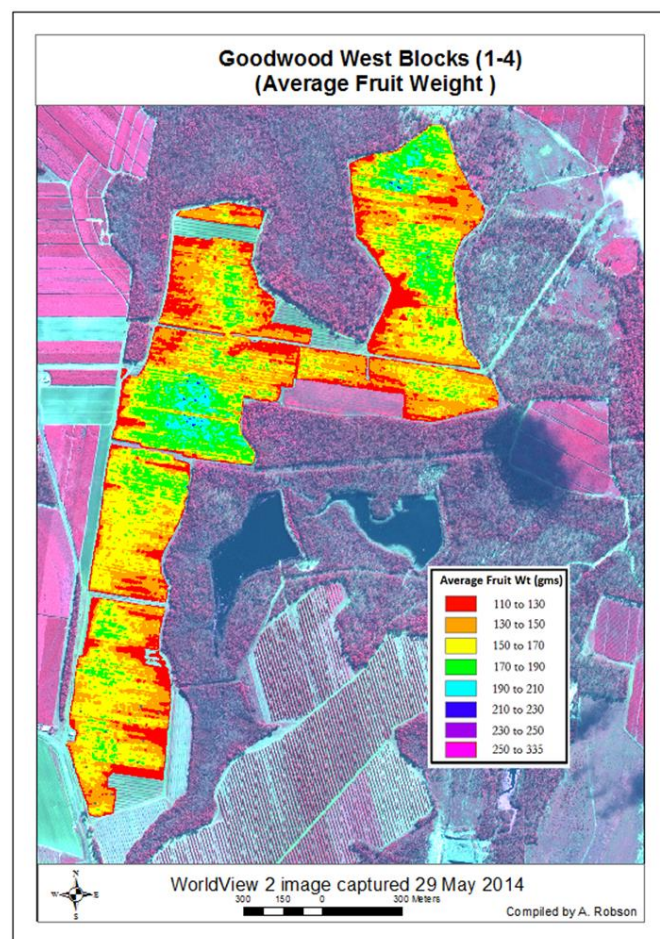
Figure 9. Derived classified map of average fruit weight for the 2014 season.

As seen in Figure 9, the spatial variability of average fruit weight across the orchard can be clearly identified. However, the exact values at the individual tree level proved to be incorrect. This was evidently attributable to non- canopy related reflectance data (i.e. between tree row vegetation and shading) influencing the classification result. This inaccuracy is apparent where stag- horned or removed trees have a predicted average fruit weight of 110 to 130 g (red colour). In order to correct this error, all non- canopy related pixels were removed using the individual tree vector file (Figure 5) and the classification analysis was repeated (Figure 10).
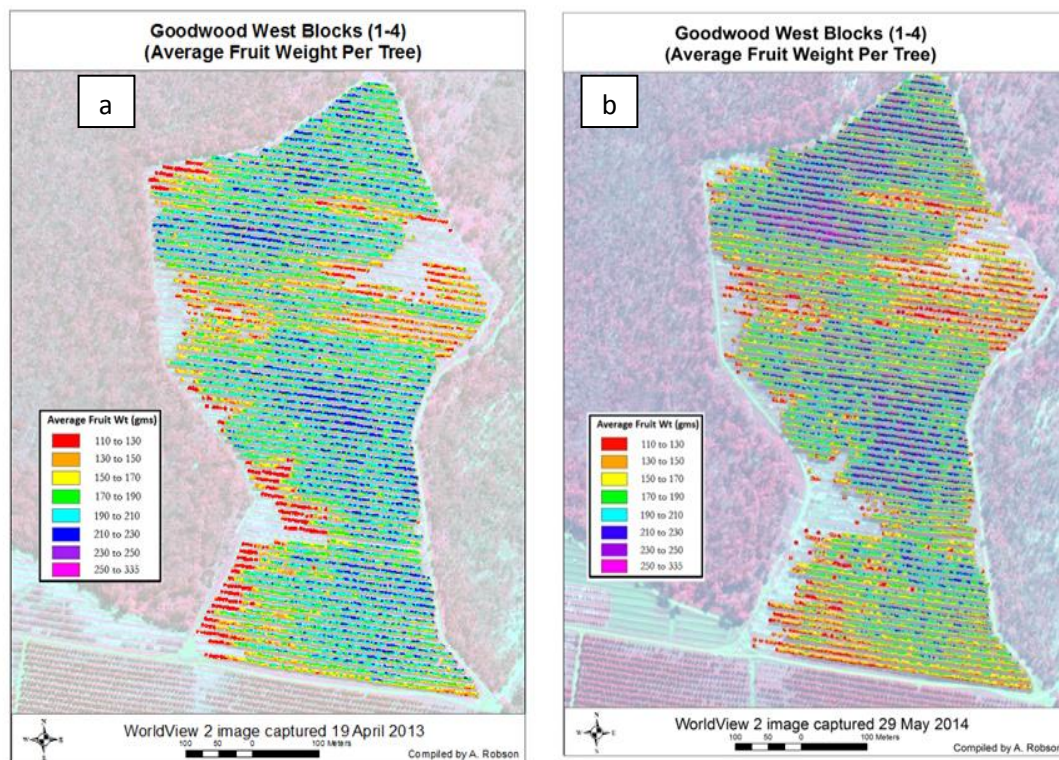
Figure 10. Classified average fruit weight maps of the northern Hass orchard for (a) 2013 and (b) 2014.

Within a growing season, the extrapolation of point source measurements to the orchard level provides an accurate map of the spatial variability of average fruit weight. This information supports improved harvest management by indicating those regions of the orchard with trees yielding larger fruit, an important consideration at the start of the harvest season when fruit prices are optimal. When derived over a number of years, a temporal comparison of trends can be undertaken. In Figure 10b, slight increase in average fruit weight from 2013 to 2014 can be identified within the optimal regions of the orchard (blue to magenta coloured regions). More importantly, an increase in areas with low average fruit weight (orange to red

colour) can also be identified, particularly in the south western corner and mid- eastern side of the orchard. This temporal change is likely to be attributed to the varying seasonal weather conditions, but it may also indicate the onset of tree disease, such as Phytophthora root rot. With this information, the orchard manager can undertake coordinated agronomic assessment of the high risk trees and implement targeted tree needling if in fact Phytophthora is present.
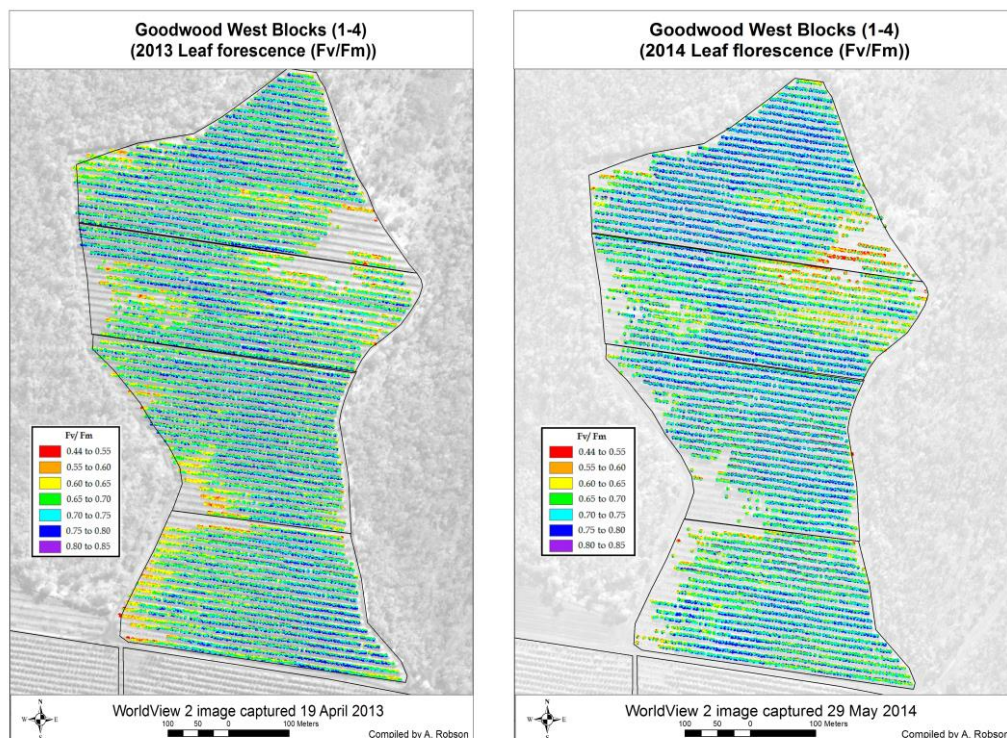
Figure 11. Classified maps of leaf florescence (Fv/Fm) for the (a) 2013 and (b) 2014 season.

The derived classified maps for leaf florescence (Fv/Fm) (Figure 11) identified a relatively consistent trend across both growing seasons as well as to that provided by average fruit weight (Figure 10). This result indicates photosynthetic potential may be a likely driver of the fruit weight. In regards to SPAD, a similar spatial variation was again identified across both growing seasons (Figure 12). However, there was an obvious increase in the overall SPAD measure from 2013 to 2014, a result again likely attributed to the varying seasonal weather conditions.
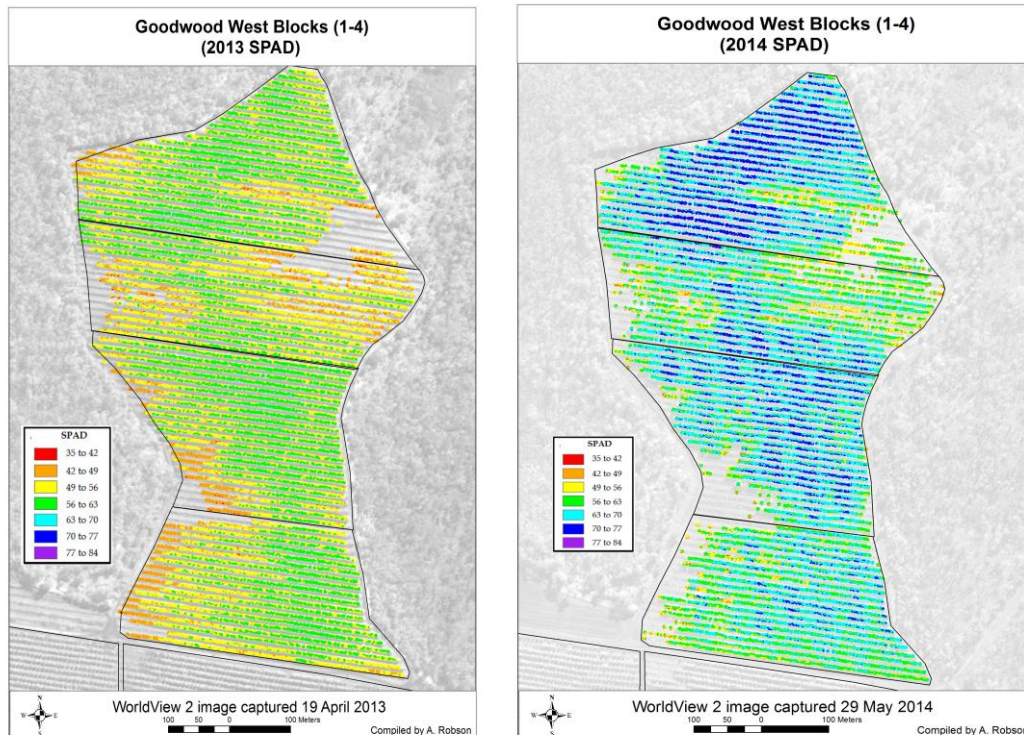
Figure 12. Classified maps of SPAD for the (a) 2013 and (b) 2014 season.

For leaf florescence and SPAD, the ability to extrapolate measures to the spatial and temporal level can again assist with the early detection of tree nutritional stress or disease and therefore support variable rate applications of orchard inputs.

Tree Auditing:

For the 2014 growing season the northern orchard had 5,481 trees in production as determined by a manual count. Using the reported area of the orchard block (defined as the yellow outline in Figure 13a; i.e. 30.3 ha), and the measured tree spacing of 10 by 5 metres or 1 tree every 50 m², the calculated tree number was 6,060.

$$\text{Tree number} = 303000 \text{ m}^2 / 50 \text{ m}^2$$
$$= 6060$$

The discrepancy of 9.6 % between the actual and calculated number of trees was the result of reported area of the orchard not reflecting tree removal and death that had occurred from the initial planting in 2005. A more precise measure of the orchard block area using the 2014 WV2 image identified an active tree growth area of 28.2 ha (Figure 13b). Repeating the tree density calculation the predicted number of trees was 5,636, an error of 2.75 %.

Although this result is specific to one orchard, it does indicate the degree of inaccuracy that can occur at the regional level using a simple area by tree density equation.
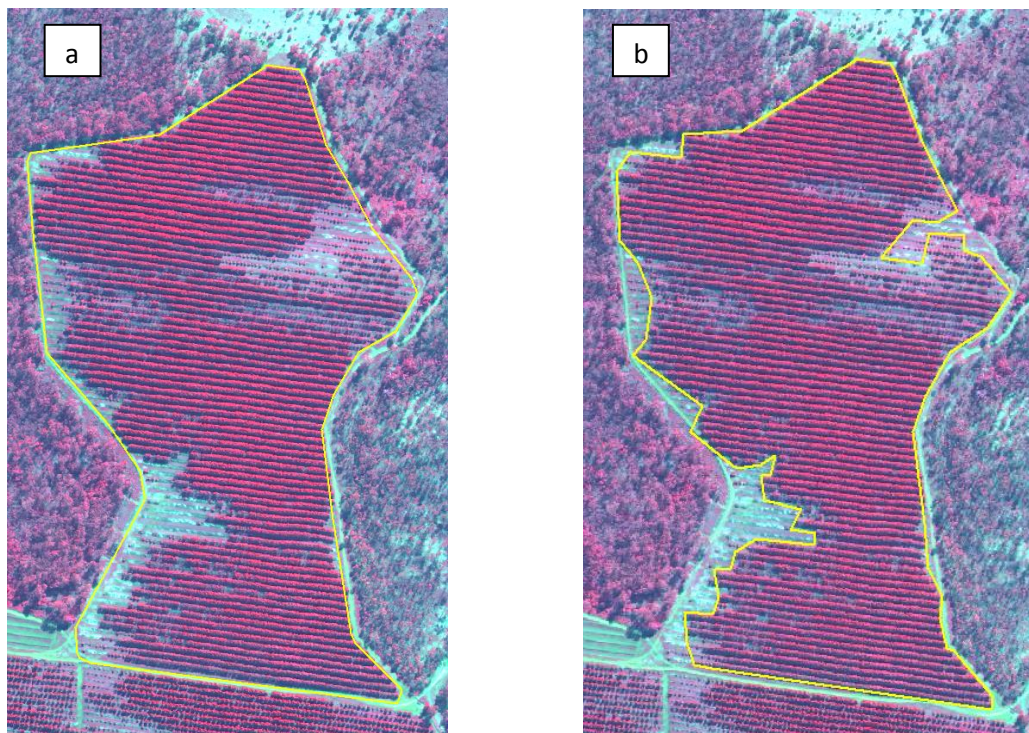
Figure 13. (a) False colour WV2 image captured 29th May 2014 with the reported area of the northern Hass avocado orchard. (b) The actual extent of fruit producing trees in 2014 is highlighted in yellow.

As seen in Figure 13, WV2 imagery is highly effective for distinguishing stag-horned or removed trees from those that are likely to produce fruit. However, the adoption of WV2 as an auditing tool at the regional scale would prove costly (~ \$40/ km^2). An alternative is to source archive imagery, where available, as it substantially discounted, or to acquire much lower resolution imagery such as SPOT 5 (10 m). Figure 14 identifies a false colour image of the same Hass orchard captured by SPOT 5 on the 24 April 2014. The area of productive tress can still be identified at a more feasible cost ~ \$1/ km^2.
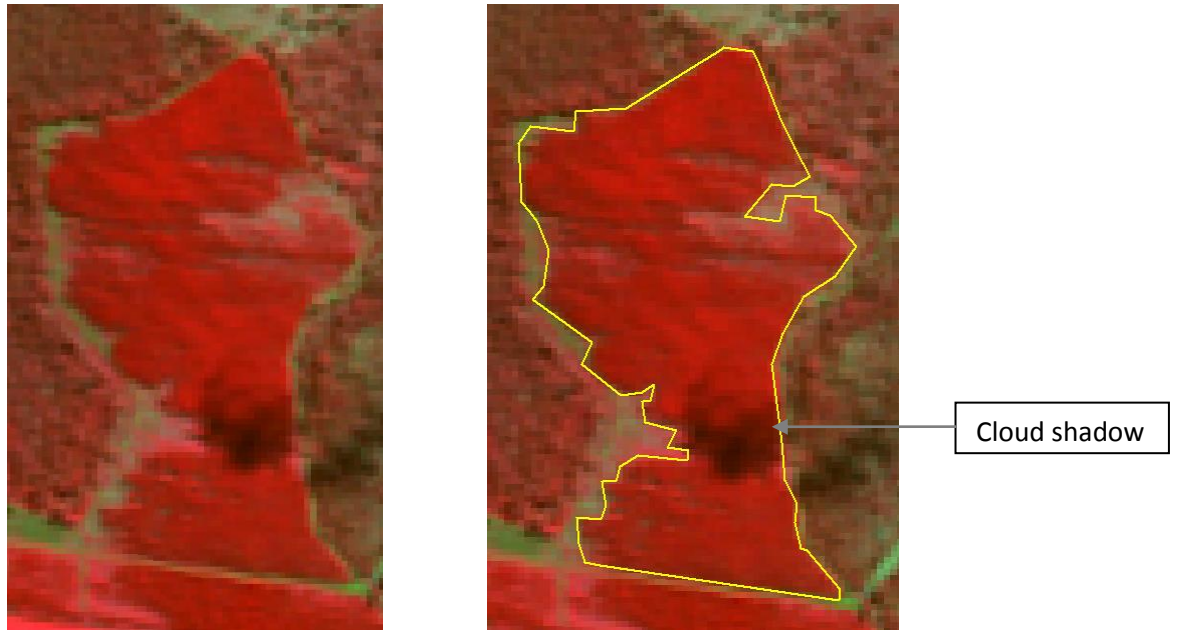
Figure 14. (a) False colour SPOT5 image of the northern Hass orchard captured 24 April 2014. (b) The yellow outline indicates the refined area of productive trees.

As demonstrated, the accuracy of predicting tree numbers within an orchard can be vastly improved by refining the area of productive trees. However, this assumes that the reported tree spacing or density is correct. In the case of the northern orchard the tree spacing was confirmed as 10 * 5 m by a physical on ground measurement. In the event that an on ground measure cannot be undertaken, the spacing between small trees can be directly measured from a WV2 imagery using the ArcGIS 'measure tool' (Figure 15).
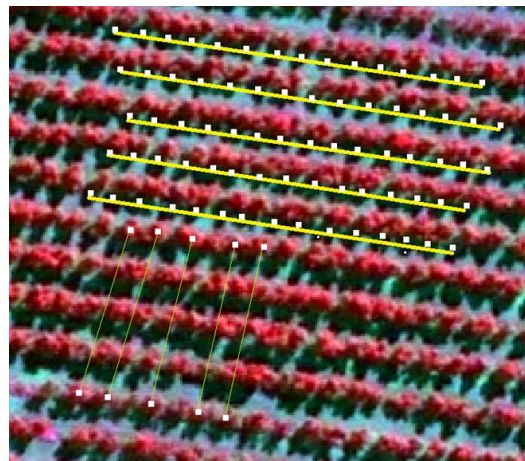
Figure 15. Using WV2 imagery and the ArcGIS 'measure tool' to determine the average tree spacing along (15 trees by 5 reps) and across (5 rows by 5 reps) the rows.

A limitation of this approach occurs when the trees are older, mechanically shaped and exhibit a continuous canopy (Figure 16 a). The use of historic imagery through Google Earth provided an effective tool for confirming tree spacing of the same trees but at a younger age (Figure 16 b).

Figure 16. (a) Example of continuous canopies displayed by mature avocado trees (image captured 2013). (b) Historic image (2009) identifying the same trees at a younger age (b).

As with the previous method, the tree spacing can then be directly measured using the Google Earth 'show ruler' tool or alternatively the manual 'geo-tagging' of individual trees can be undertaken (Figure 17).

Figure 17. Individual avocado trees 'geo- tagged' in GoogleEarth.

Although this process is labour intensive it does provide a highly accurate count of tree numbers, particularly for older orchards where tree spacing can variable. The 'geo- tagging' process also creates a data base of individual tree locations and associated names i.e. GWWB4R5T70 indicating farm name, block, row, and tree number. This data base can be exported into ArcGIS (Figure 18) and used by growers/ agronomists to record all relevant management data at the individual tree level, including disease observations. This method of data recording also has the potential to support the strict traceability requirements of some overseas markets.

GWWW_geotagging_trial

FID	Shape *	OID_	Name	FolderPath	SymbolID
0	Point ZM	0	GWWB4R1T1	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
1	Point ZM	0	GWWB4R1T2	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
2	Point ZM	0	GWWB4R1T3	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
3	Point ZM	0	GWWB4R1T4	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
4	Point ZM	0	GWWB4R1T5	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
5	Point ZM	0	GWWB4R1T6	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
6	Point ZM	0	GWWB4R1T7	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
7	Point ZM	0	GWWB4R1T8	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
8	Point ZM	0	GWWB4R1T9	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
9	Point ZM	0	GWWB4R1T10	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0
10	Point ZM	0	GWWB4R1T11	Goodwood west_TREE_POINTS_2.kmz/GWWB4R1	0

Figure 18. ArcGIS attribute table populated with information obtained through the 'geo- tagging' process in Google Earth.

An alternative to the 'geo tagging' process is the derivation of a point source grid determined by the known (or measured) tree spacing. This method is more suited to recently planted orchards where a GPS guided planting system may have been used. Figure 19 a identifies a 10 by 5 m grid overlayed on to the northern orchard; whilst Figure 19 b, shows the same grid rotated by 9 degrees to align with the tree row orientation and then sub-setted using the area of productive tree growth. This process resulted in a predicted tree number of 5,632 trees. Once alignment between the points and tree centre has been achieved, the points can be buffered and used for the extraction of satellite imagery data as detailed in Figure 5.
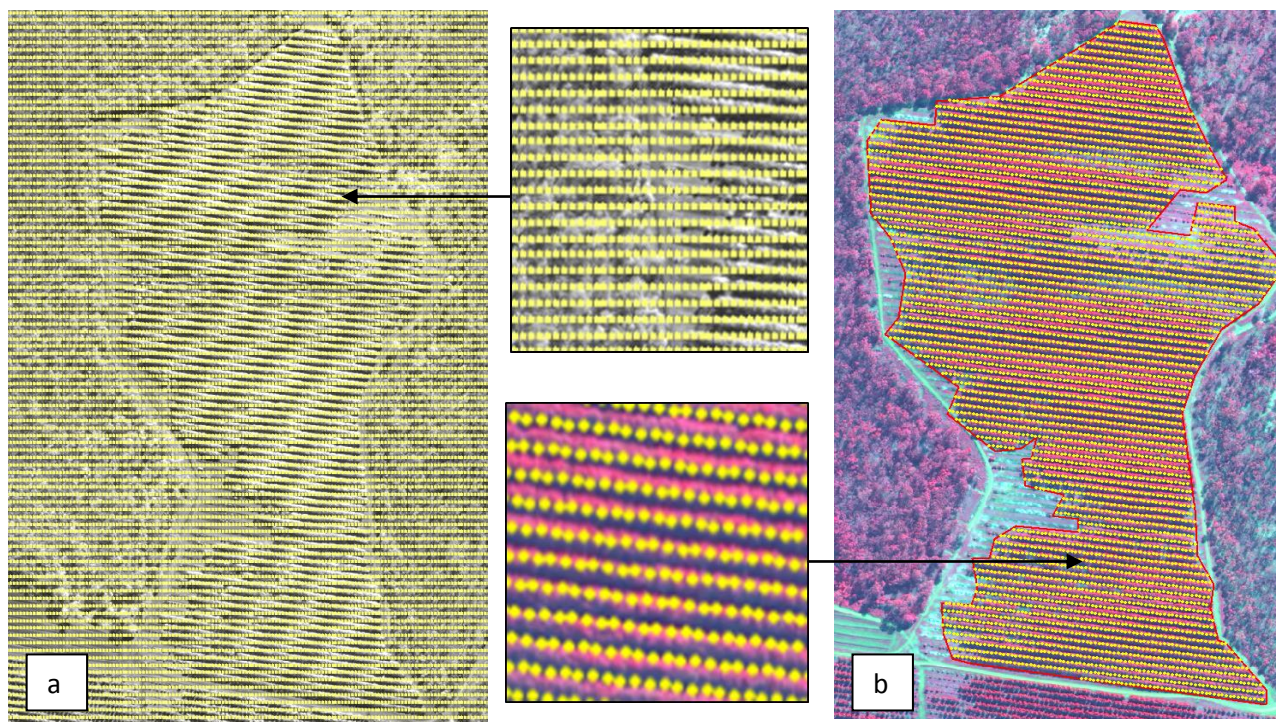
Figure 19. (a) 10 by 5 m point grid overlayed on to a false colour WV2 image. (b). Grid vector file rotated and sub- setted to align with the productive trees in the northern orchard.

Conclusion and Future Directions:

This preliminary study demonstrated that the integration of high resolution satellite imagery, GIS and ground truthing can be used to develop surrogate maps of a number of avocado tree health and yield parameters. However, additional research is required to develop and validate the linear algorithms over additional growing locations, cultivars and seasonal conditions before they can be considered robust. It is further suggested that additional image captures be evaluated around the 'fruit set' growth period in order to determine if fruit number can be predicted, and therefore tree yield. Results from the 2013 season indicated some correlation between vegetation indices and a range of fruit quality measures. Although, these results were not repeated in 2014 season, they may warrant further investigation. At the very least the mapping of tree quality variability has the potential to direct where fruit quality measures are collected thus ensuring point source measures truly reflect the variability actually occurring within the orchard.

In regard to tree auditing, this study demonstrated that high resolution imagery, together with GIS and Google Earth can improve the prediction of tree numbers at the orchard level. These results strongly suggest that the integration of these techniques with on ground surveys and grower

information can greatly improve current auditing techniques both at the farm and at the national level.

Presentation of data:

- o 2014 (17- 22 August): Presentation at 29th International Horticultural Congress 2014. Brisbane Convention and Exhibition Centre, Brisbane, Queensland, Australia.
- o 2013 (26- 28 June): Presentation at Digital Rural Futures Conference. University of New England. Armidale. NSW. http://www.une.edu.au/about-une/academic-schools/school-of-science-and-technology/news-and-events/events/digital-rural-futures-conference/presentations#! Theme 3, talk 4.
- o 2013 (13 June): Guest speaker at Precision Farming Field Day. Bundaberg, Qld.

Publications:

- o Robson, A.J., Petty, J., Joyce, D.C., Marques, J.R., and Hofman, P.J. (2014). High resolution remote sensing, GIS and Google Earth for avocado fruit quality mapping and tree number auditing. Proceedings of the 29th International Horticultural Congress 2014. Brisbane Convention and Exhibition Centre, Brisbane, Queensland, Australia.

Acknowledgments:

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Uddling, J., Gelang-Alfredsson, J., Piikki, K., Pleijel, H. (2007) Evaluating the relationship between leaf chlorophyll concentration and SPAD-502 chlorophyll meter readings. Photosynthesis Research. 91(1), 37-46.

Whiley, A. W., Saranah, J. B., Cull, B. W., & Pegg, K. G. (1988). Manage avocado tree growth cycles for productivity gains. Queensland agricultural journal, 114, 29-36.

Appendix 16: Mid-term review

Mid-term review of HAL Project AV12012 – Coordination of data management and avocado quality improvement and extension program

Jenny Margetts

P2P Business Solutions Pty Ltd

PO Box 3000

Ashgrove East QLD 4060

M: 0418 215276

E: jmargetts@bigpond.com

**Horticulture
Innovation
Australia**

Mid- term review of HAL Project AV12012 –
Coordination of data management and avocado
quality improvement and extension program

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Project Details

Project Name: Mid-term review of HAL Project *'AV12012: Coordination of data management and avocado quality improvement and extension program'*

Date submitted: December 2014

Project Purpose: This project is a mid-term review of HAL project *'AV12012: Coordination of data management and avocado quality improvement and extension program'*. Its purpose is to evaluate the management of the project against the milestone schedule; evaluate progress to date against the project outputs and outcomes; provide recommendations for the remainder of the project and future investment in quality improvement.

Project Leader: Jenny Margetts

P2P Business Solutions Pty Ltd

PO Box 3000, Ashgrove East, QLD 4060

B: 0418 215 276   E: jmargetts@bigpond.com

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Abbreviations used:

AAL - Avocados Australia Limited

BPR – Best Practice Resource – Avocados Australia's online content management system containing information about best practice management in the avocado industry

HAL – Horticulture Australia Limited

HIA Limited – Horticulture Innovation Australia Limited

Media summary

Avocados Australia (AAL) commenced a HAL Project 'AV12012: Coordination of data management and avocado quality improvement and extension program' in March 2013. The Program has two key objectives:

1. To expand on the results of an ongoing HAL project '*AV09001: National avocado quality & information management system*', and

2. Ongoing data management, specifically related to Infocado and OrchardInfo.

The Program aligns with objectives of the '*Avocado Industry Strategic Investment Plan 2011-2015*' and aims to contribute to the overall outcome to increase percentage of fruit sold at retail level meeting consumer requirements from 75% to 90%.

As part of the Program there is a requirement for an independent mid-term review, specifically to:

- Evaluate the management of the project against the milestone schedule

- Evaluate progress to date against the project outputs and outcomes

- Provide recommendations for the remainder of the project

- Provide recommendations for future investment in quality improvement.

This review addressed the above terms of reference and was undertaken in November 2014.

The quality improvement and extension component (Qualicado) of the Program has become well established in the production sector in a short period of time. This can be attributed to good planning, consultation with stakeholders, a collaborative approach with service providers, development of appropriate resources (background documentation, scorecards, report cards etc.) and execution of a strong communication plan.

Evaluations show that Qualicado workshops have been well attended and received by the production and wholesale/ripener sector. Attendees at the workshops (growers and wholesalers/ripeners) strongly indicated that they would likely use knowledge gained at these events to improve their practices. This will hopefully lead to improved fruit quality.

Avocados Australia have developed a flexible and responsive approach to the Qualicado workshops, which provides the best chance to maintain engagement with the various sectors of the supply chain and to be able to influence practice change and quality outcomes.

Infocado, the industry's crop forecasting system continues to provide valuable information to the sector on a weekly and quarterly basis. There has been considerable effort since the commencement of the Program to encourage greater participation and accuracy of data.

Promotion of OrchardInfo, which captures planting and productivity data, has seen an increase in contributions. There is still further work to be done to improve data quality and Avocados Australia through this Program have investigated the opportunity to use remote sensing technologies to gain better insight into plantings and other tree health and yield parameters.

This review has found that the Program has been well planned and, to date, overall delivery of the Program against the milestone schedule and output and outcome requirements has been very good.

1.0 Introduction

Avocado quality is recognised as one of the key factors affecting product demand. Research undertaken by Avocados Australia[1] has been able to quantify the negative impact of sub-optimal levels of maturity, ripeness and internal quality on consumer purchase behaviour.

The '*Avocado Industry Strategic Investment Plan 2011-2015*' has a strong focus on addressing quality issues and aims to contribute to the overall outcome to increase percentage of fruit sold at retail level meeting consumer requirements from 75% to 90%.

Expanding on the results from *AV09001: National avocado quality & information management system*, Avocados Australia (AAL) commenced a HAL Project '*AV12012: Coordination of data management and avocado quality improvement and extension program*' (the 'Program') in March 2013. Although the Program has a focus on quality it also recognises the need to address interrelated productivity and supply chain management issues.

The two key objectives of the Program are:

- To expand on the results of '*AV09001: National avocado quality & information management system*'

- Ongoing data management, specifically related to Infocado and OrchardInfo.

The project aligns with Strategies 1.1, 1.2 and 1.3 in the '*Avocado Industry Strategic Investment Plan 2011-2015*'.

The Program has a number of components including:

- The ongoing coordination of a suite of supply chain improvement projects that collectively form the support systems for the quality improvement and extension program

- The establishment and implementation of a quality improvement and extension sub-program (Qualicado) which aims to improve fruit quality.

- Management and improvement of Infocado

- Management and improvement of OrchardInfo.

There is a requirement to undertake an independent mid-term review of the Program to ensure it is meeting its milestone requirements and to determine if there are any areas where improvement could be made to enhance outcomes.

This review addressed the above terms of reference and was undertaken in November 2014.

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[1] Research specifically relates to HAL Projects: '*AV06025: Avocados Australia consumer sensory project*' and '*AV07019: Online consumer quality survey* '

2.0 Objectives and approach to review

Objectives

The objectives of this review are to:

- Evaluate the management of the project against the milestone schedule

- Evaluate progress to date against the project outputs and outcomes

- Provide recommendations for the remainder of the project

- Provide recommendations for future investment in quality improvement.

Approach

Based on the review objectives, a method for the collection of the required information was developed and refined after consultation with Avocados Australia. As a result the following approach has been adopted:

Step 1) **Collect background documentation** (project contract, milestone reports and materials developed as part of the project e.g. scorecards and evaluation summaries etc.) and review all background material related to AV12012 including the following HAL projects: AV06006; AV09001; AV07023; AV08034; AV11015; AV08017; AV10006; AV10019; AV010002; AV012007; AV07023 and any other relevant projects that can be identified.

Step 2) **Define relationship of project AV12012** (including evaluation contribution) to other relevant quality and supply chain projects being undertaken by HAL.

Step 3) **Review / reconfirm scope of analysis** – refine as necessary.

Step 4) Review the **quality improvement and extension component** of the project (Qualicado sub-program). Undertake a desktop exercise to evaluate the management of the Qualicado sub-program against the milestone schedule and evaluate progress to date against the required outputs and outcomes, by:

- Reviewing all material developed as part of this sub-program including scorecards; report cards, monitoring systems and evaluation forms

- Reviewing the deliverables of the sub-program including activities (workshops/scorecards); consultations (report cards) undertaken with supply chain parties; and communication activities against the project/milestone criteria

- Reviewing findings / outcomes of activities, consultations and evaluation forms (noting that confidentiality of some material needs to be considered) to determine:

    a. How effectively the sub-program has engaged with the nominated sectors of the industry (growers, packers; wholesalers/ripeners and transporters) – level and quality of engagement

    b. Timing of sub-program delivery

    c. The likely benefits / impacts that have been derived from the sub-program by the respective supply chain parties

d. How findings from the sub-program have been applied by the Program Manager in the (future) development of the project

e. Areas where improvement could be made to the sub-program and where future industry development activities may be required by industry.

Step 5) **Conduct telephone interviews with key service providers** that are supporting Qualicado to ascertain their perspective of the sub-program in relation to implementation, impact and future development.

Step 6) **Analyse and report all the above material** (steps 4-5) and also provide recommendations for the remainder of the project and for future investment in quality improvement.

Step 7) **Review the Infocado component** of the project. This will entail undertaking a desktop exercise to evaluate the management of the Infocado sub-program against the milestone schedule and evaluate progress to date against the project outputs and outcomes, by:

- Reviewing previous reports (*'AV11013: Review of avocado industry and market information systems'* - review completed 2012) and ascertaining the level of and limitation to adoption of previous recommendations

- Identifying any changes in the industry/supply chain/ technical environment that affect Infocado data collection or reporting and warrant changes in how this component is delivered to industry.

Step 8) Analyse and report all the above material from above (step 7) and also provide recommendations in relation to project improvement measures and potential future investment.

Step 9) **Review the OrchardInfo component** of the project. This will entail undertaking a desktop exercise to evaluate the management of the OrchardInfo sub-program against the milestone schedule and evaluate progress to date against the project outputs and outcomes, by:

- Reviewing previous reports including *AV11013* and ascertaining the level of and limitation to adoption of previous recommendations

- Reviewing the outcomes from the remote sensing and crop forecasting studies

- Identifying any changes in the industry/supply chain/ technical environment that affect OrchardInfo data collection or reporting and warrant changes in how this component is delivered to industry.

Step 10) Analyse and report all the above material from above (steps 9) and also provide recommendations in relation to project improvement measures and potential future investment.

Step 11) **Review overall project management and evaluation framework of the project**

This will entail discussions with the current Program Manager regarding the progress of the project to identify issues, limitations etc. It will also draw on the analysis of related projects and their relationship to this Program (AV12012) to analyse the evaluation framework and to make recommendations on how this might be improved from a process perspective.

Step 12) **Develop draft report** – review with panel

Step 13) **Finalise report.**

3.0 Results

3.1 Review of related projects (Step 1)

3.1.1 Projects reviewed

As a first step in this review the following projects or extracts of the following projects have been reviewed. All of the projects listed below have some relationship with the Program.

- *'AV06006: Scoping of a national avocado quality system and management of avocado industry information systems'*

- *'AV06026: Avocado supply chain mapping and resource audit'*

- *'AV07018: Avocado quality retail surveys'**

- *'AV07023: Avocado retail price survey'**

- *'AV08017: Avocado supply chain education materials' **

- *'AV08034: Avocado retail quality surveys phase 2'**

- *'AV09001: National avocado quality and information management system'*

- *'AV10002: Avocado best management practices and internet-based information delivery'**

- *'AV10006: Avocado supply chain education materials phase 2'**

- *'AV10019: Reducing flesh bruising and skin spotting in Hass avocado'**

- *'AV11015: Avocado industry fruit quality benchmarking'**

- *'AV11013: Review of avocado industry and market information systems'*

- *'AV12007: Data collection to facilitate supply chain transparency'**

- *'AV12009: Understanding and managing avocado flesh bruising'**

  * - Managed or participated in as part of AV06006, AV09001 or AV12012.

3.1.2 Summary of projects reviewed

'AV06006: Scoping of a national avocado quality system and management of avocado industry information systems'

This project was specifically developed to manage a supply change improvement program aimed at addressing fruit quality, supply chain efficiency and measuring productivity.

The program included three distinct but related activities:

- Management of the avocado supply chain improvement program

- Scoping study for a quality management system

- Management of Infocado and development of a productivity data collection system.

The resultant outcomes from this program have been the development of an information supply chain from the orchard through to retail, whereby obtainable and valued data sets have or are being developed to improve decision making at production, supply chain and retail level and provide benchmark data for evaluation purposes. The continuation of this work was *'AV09001: National avocado quality & information management system'*, then the current Program (*AV12012*) being reviewed.

'AV06026: Avocado supply chain mapping and resource audit'

The purpose of this project was to understand the different supply chain models that exist in the avocado industry, identify the key roles in the supply chain, identify key issues impacting the supply chain performance, provide recommendations on how these might be addressed and to conduct an audit of research related to best practice at each point in the supply chain.

'AV08018: Development of best-practice guidelines for avocado ripening' (Completed: Sep 2011)

Development of an avocado ripening manual.

'AV09001: National avocado quality & information management system' (Completed: Mar 2013)

Expansion of the work completed through Project '*AV06006: Scoping of a national avocado quality system and management of avocado industry information systems'*. This has included two key objectives:

- Ongoing coordination of the suite of supply chain projects that *AV06006* managed or participated in. These and other projects have provided industry with valuable information relating to a range of issues including internal fruit quality, fruit maturity and supply chain education to improve handling. This information has enabled industry to identify and begin to rectify issues relating to fruit quality and irregular supply into the market. These factors strongly influence consumer demand and industry's ability to anticipate and meet that demand. Also through this project a quality management system was to be developed and implemented to help ensure industry could meet consumer's quality expectations.

- Ongoing management of Infocado, the avocado industry's crop forecasting system and OrchardInfo, a system which collects production and productivity information. These two systems provide the industry and individual businesses with data to assist in decision making. The data includes: long term production forecasts; short term crop forecasts and dispatch data; key planting statistics, and orchard productivity data. These systems require ongoing development, management and maintenance.[2]

'AV07023 – Avocado retail price survey' (Completed: Aug 2012)
'AV12007 - Data collection to facilitate supply chain transparency'

Weekly collection of retail prices across four city markets (Brisbane, Sydney, Melbourne and Perth) aimed at facilitating supply chain transparency.

'AV08017 – Avocado supply chain education materials' (Completed: Jun 2010)
'AV10006 – Avocado supply chain education materials phase 2' (Completed: Nov 2012)
'AV12013 – Implementing improvements in the avocado supply chain' (Due: Nov 2015)

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[2] HAL Final Report '*AV09001: National avocado quality & information management system*', 2013.

These projects have delivered:

- A range of supply chain education material including information about picking, harvesting, grading, packing, transporting and colour and ripeness of fruit. The material is aimed at improving quality by improving handling practices along the supply chain.

- A retailer education program has been rolled out to more than 1100 retailers spread across Sydney, Perth, Melbourne, and Brisbane. This program is designed to improve retail handling practices to ensure fruit quality.

- An online, interactive, adult training system where existing education materials has been converted to a training format.

- Development and maintenance of the Best Practice Resource (BPR) (including infrastructure and supply chain content). This is an online resource that aims to provide growers and other stakeholders with key information on best management practices, and has the potential to deliver the information in a number of different forms including text, interactive learning modules and video.

'AV07018 – Avocado quality retail surveys' (Completed: Nov 2008)
'AV08034 – Avocado retail quality surveys phase 2' (Completed: Nov 2011)
'AV11015 – Avocado industry fruit quality benchmarking' (Due: May 2016)

These projects benchmark / monitor internal fruit quality at a retail level and avocado maturity. Ripe Hass and Shepard fruit are purchased from 64 retail outlets across Sydney, Perth, Melbourne and Brisbane each month and assessed for internal defects. Fruit is also selected at random from the Sydney wholesale market once a month and independently assessed to monitor maturity. With this data, the industry will be able to continue to gauge the success and adoption of its supply chain education programs and materials.

'AV11013 – Review of avocado industry and market information systems' (Completed: Jul 2012)

This review considered the value of investment in industry and market information systems, in particular Infocado and OrchardInfo. The review recommended continued investment in Infocado and OrchardInfo with consideration to improvements to improve data accuracy.

'AV10002 – Avocado best management practices and internet-based information delivery' (Completed: Dec 2013)

This project has delivered:

- The development of the 'Avocado Problem Solver Field Guide' which describes pests, diseases and other disorders, and provides advice on their prevention and treatment

- The development of avocado production content for the Best Practice Resource (BPR).

'AV10019 – Reducing flesh bruising and skin spotting in Hass avocado' (Completed: Nov 2014)
'AV12009 - Understanding and managing avocado flesh bruising' (Due: Dec 2014)

As bruising is the single most important post-production contributor to poor quality in avocado fruit, the aim of this project was to reduce flesh bruising in Hass avocado fruit, by understanding how and when bruising occurs and how to minimise it. Data from both supermarkets and supply chains were complementary, in that bruising clearly and consistently occurred mostly at the retail store level. Further work is being undertaken to better understand flesh bruising by tracking fruit and understanding contribution of bruising

by retail staff and the consumer ('*AV12009: Understanding and managing avocado flesh bruising*'). This latter project has not been reviewed.

3.2 Relationship between projects (Step 2)

As can be seen from the number of projects that the Program either manages, contributes to or interacts with, there is significant investment in R&D being undertaken to address quality issues across the supply chain.

Managed and linked projects inform, support and assist in evaluation of the Qualicado component of the Program. The following table outlines the linkages. Note that the contribution from earlier projects is not highlighted in the table below.

Definition of quality issues	The following projects (current in the Program's life) assist in defining specific quality issues to be addressed through the Program and also in the continuous improvement process at a Program level: • '*AV11015: Avocado industry fruit quality benchmarking*' (Due: May 2016) • '*AV12009: Understanding and managing avocado flesh bruising*' (Due: Dec 2014) • '*AV12013: Implementing improvements in the avocado supply chain*' (Due: Nov 2015) • Feedback from Qualicado workshops and supply chain partners through the Program
Information / extension	The following projects assist informing content related to management of quality issues: • '*AV10019: Reducing flesh bruising and skin spotting in Hass avocado*' (Completed: Nov 2014) • '*AV10002: Avocado best management practices and internet-based information delivery*' (Completed: Dec 2013) • '*AV12013: Implementing improvements in the avocado supply chain*' (Due: Nov 2015)
Information dissemination	The following projects (current in the Program's life) assist in disseminating information regarding quality issues management and the broader Program: • '*AV10008: Avocado Industry Communications*' • '*AV10002: Avocado best management practices and internet-based information delivery*' (Completed: Dec 2013) • '*AV12013 – Implementing improvements in the avocado supply chain*' (Due: Nov 2015)
Program evaluation	The following projects (current in the Program's life) assist in evaluation of the Program : • '*AV11015: Avocado industry fruit quality benchmarking*' (due May 16) • '*AV12007: Data collection to facilitate supply chain transparency*' • Feedback from completed evaluation forms at Qualicado workshops and supply chain partners through in-built evaluation mechanisms in the Program

Table 1: Interactions between the Program and other managed/linked or aligned projects.

The figure below also shows the main projects undertaken since 2005 that address quality issues across the supply chain either substantially or in part and also the relationship between AV12012 and other managed / linked and aligned projects (see Figure1).
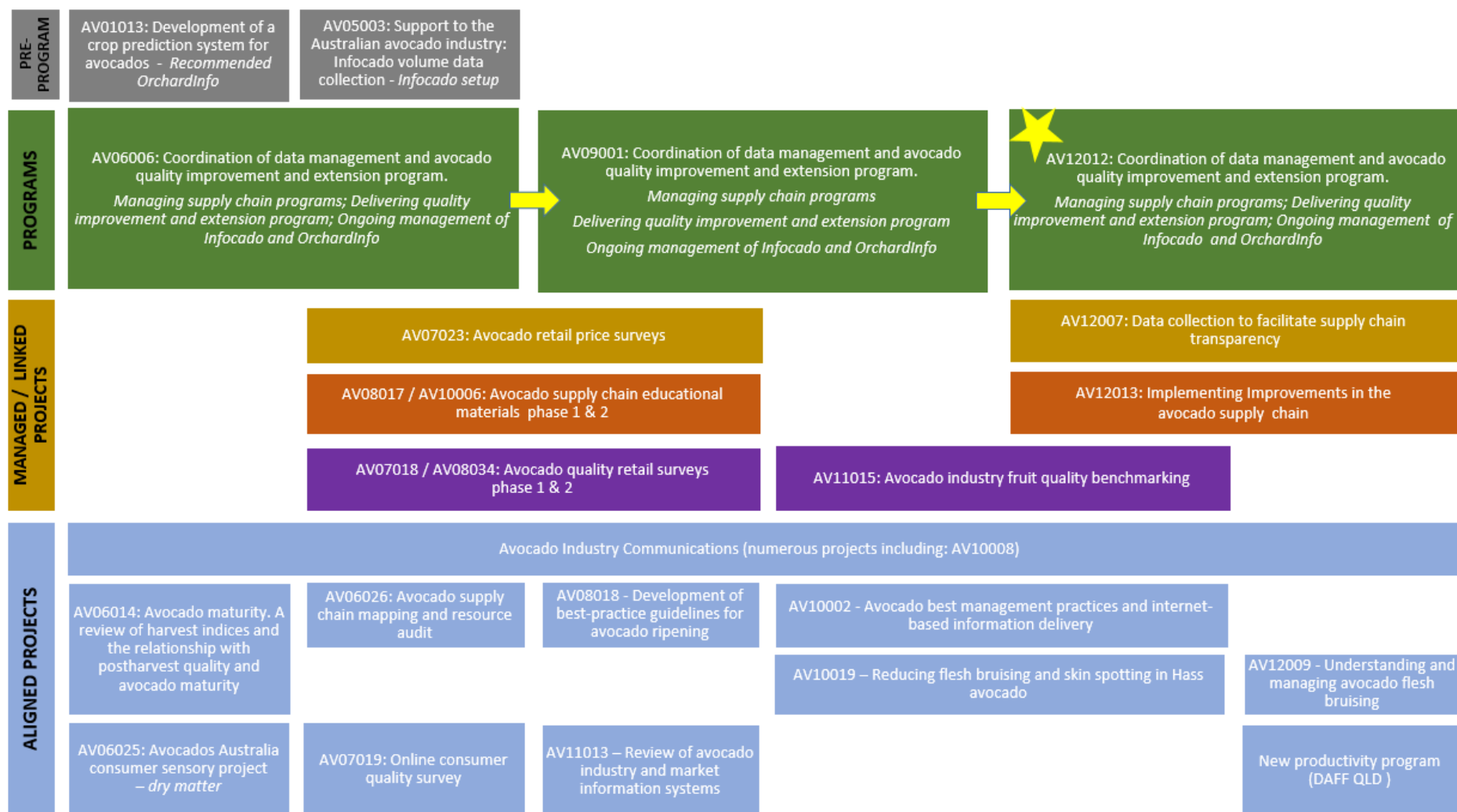
Figure 1: Diagram showing the main quality management projects undertaken since 2005 and the relationship between AV12012 and other projects that support quality improvement across the avocado supply chain

3.3 Summary review of Program against milestones schedule

The following is a summary assessment of delivery against milestones. More detailed assessments of each component of the Program are provided in Sections 3.4 to 3.6.

1) **Milestone 101:** contracting of project completed 2 March 2013.

2) **Milestone 102**, due 30 September 2013, required:

   - Progress report on quality improvement and extension sub-program - completed.

     o Schedule for Qualicado workshops - completed

     o Qualicado facts sheet (12/8/13) developed to outline initiative

     o One Qualicado workshop held in North Queensland - completed (15 August 2013)

     o Workshop evaluation – completed.

   - Report card and scorecard templates completed for packers and growers - completed

   - Minimum of 10 scorecards completed – 25 scorecards completed

   - Progress report on remote scanning -initial scoping stage completed and report provided (subcontracted to DAFF Queensland)

   - Progress report on crop forecasting – Identification of 1 - 3 businesses in each region that are demonstrating high level of accuracy in relation to crop forecasting (based on Infocado records) has been completed and one interview completed. Review of AV01013 being undertaken.

   - Communication activities – various - completed, including articles in *'Talking Avocados', 'Guacamole', 'Grower Updates'*, updates to website and invites to workshop (see section 3.6.3 - Communications' on page 35).

   All requirements for Milestone 102 were met and delivered on time.

3) **Milestone 103**, due 31 March 2014, required:

   - Progress report on quality improvement and extension sub-program - completed

   - Two additional grower workshops - completed (Tri-State and Sunshine Coast)

   - Three wholesaler workshops - completed (Brisbane, Sydney, Melbourne)

   - Workshop evaluations - completed

   - Report card templates completed for wholesalers/ripeners and transporters - completed

   - Training of retail store assessors by DAFF Queensland - completed

   - Minimum of 30 scorecards completed to date – completed

   - Provision of the two most recent Infocado weekly and quarterly reports and update on any changes to the system – completed

   - All weekly and quarterly reports delivered - completed

   - Additional effort has been made by contacting regional directors and larger growers to validate accuracy of data in both the weekly and quarterly Infocado report.

- Recommendations for next stage of remote sensing documented – deliverable moved to Milestone 104 as indicated in Milestone 102

- Recommendations for crop forecasting – still being actioned

- Review of AV01013 - being undertaken (due to change of Program Manager)

- Communication activities – various - completed, including articles in *'Talking Avocados', 'Guacamole', 'Grower Updates'*, updates to website, invites to workshop and presentations being uploaded to the BPR (see section 3.6.3 - Communications on page 35).

All requirements for Milestone 103 were met and delivered on time.

4) **Milestone 104**, due 30 September 2014, required:

- Progress report on quality improvement and extension sub-program - completed

  o Four additional grower workshops - completed (Tamborine / NNSW; Southern Qld; Central NSW and Western Australia)

  o Two wholesaler workshops - completed (Adelaide and Perth)

  o Workshop evaluations - completed.

- Minimum of 14 training workshops held to date – only 13 workshops have been held, however there is a 14th organised for 14 December, 2014 in North Queensland

- 24 report cards completed to date – 20 completed

- Minimum of 50 scorecards completed to date – 176 completed.

- Update OrchardInfo data collection – 2012 OrchardInfo Reports completed

- Provision of copies of last two Infocado weekly and quarterly reports - completed

- Final report of remote sensing sub-project - completed

- Communication activities – various - completed, including articles in 'Talking Avocados', 'Guacamole', invites to workshop and presentations being uploaded to the BPR.

Most requirements for Milestone 104 were met, except for one Qualicado workshop and 4 report cards. Provision has been made for these to be completed by December 2014.

3.4 Review of quality improvement and extension (Qualicado) (Steps 4 - 6)

One of the two key objectives of the Program is:

1) To expand on the results of '*AV09001: National avocado quality & information management system'*, which includes:

   a. The ongoing coordination of a suite of supply chain improvement projects that collectively form the support systems for the quality improvement and extension sub-program (Qualicado)

   b. Establish, maintain and improve the quality improvement and extension sub-program which aims to improve fruit quality.

As part of the review of this component of the Program, a desktop exercise was undertaken to evaluate the management of the Qualicado sub-program against the milestone schedule and to evaluate the progress-to-date against the required outputs and outcomes.

In relation to the Qualicado sub-program the following review tasks were undertaken:

a. Review of material developed as part of the sub-program including scorecards; report cards, and evaluation forms

b. Review of the deliverables of the sub-program including activities (workshops / scorecards); consultations (report cards) undertaken with supply chain parties; and communication activities against the project / milestone criteria

c. Review of the findings / outcomes of activities, consultations and evaluation forms (noting that confidentiality of some material needs to be considered) to determine:

  o How effectively the sub-program has engaged with nominated sectors of the industry (wholesalers/ripeners; packers; growers and transporters) – level and quality of engagement

  o Timing of sub-program delivery

  o The likely benefits / impacts that have been derived from the sub-program by the respective supply chain parties

  o How findings from the sub-program have been applied by the Program Manager in the (future) development of the project.

  o Areas where improvement could be made to the sub-program and where future industry development activities may be required by industry.

3.4.1 Coordination of managed supply chain projects

As outlined above, in HAL Project *'AV09001'* and this Program, there has been a requirement to manage a number of related projects. Currently the following projects are managed under the Program umbrella, include:

- *'AV12007: Data collection to facilitate supply chain transparency'*

- *'AV11015: Avocado industry fruit quality benchmarking'* (Due: May 2016)

- '*AV12013: Implementing Improvements in the Avocado Supply Chain'*.

From discussions with the Program Manager, managed projects continue to be delivered and are meeting milestone requirements. Full assessments of these projects has not been undertaken as part of this review, however, in assessing the delivery of the Infocado sub-program, deliverables for these managed project have been noted. These include:

- Weekly retail pricing (as an attachment to Infocado report) – noted as delivered

- Monthly dry matter testing (as an attachment to Infocado report) - noted as delivered.

It also noted that internal review of AV12013 is currently being undertaken by Avocados Australia and will reported in December 2014.

3.4.2   Delivery of the quality improvement and extension component (Qualicado)

In Project *AV09001*, a plan for a formal industry quality management scheme (QMS) was scoped. This scheme would have involved accreditation or certification of businesses that met minimum standards in regard to their production, supply chain and /or business practices. Following consultation with key stakeholders it was determined there would be insufficient support for such a scheme in the proposed format, however there was strong support for a program that focussed on education, training and continuous improvement. These elements were seen as delivering better outcomes for the industry without the impost of unnecessary costs and regulation. As a result the quality improvement and extension (Qualicado) component of *AV12012* was developed.

Materials reviewed

The following materials were reviewed:

- Milestone report 102

- Milestone report 103

- Milestone report 104

- Qualicado facts sheet (12/8/13)

- Avocado growers engagement preference survey results (May 2013)

- Grower self-assessment (scorecard)

- Qualicado communications including articles in '*Talking Avocados*' and '*Guacamole*'; '*HAL Avocado Industry Annual Reports', 'Grower Updates'*, media releases etc.

- Qualicado packhouse, wholesalers /ripener, transporter system health check templates (report cards)

- Workshop materials from each workshop, including: invitations / agenda, scorecard assessments, evaluation forms and collated reports.

3.4.3   Progress towards required outputs and outcomes

The Program contract lists the following output requirements from the Program:

- Establishment of quality improvement and extension sub-program

- Scorecard templates for growers

- Report card templates for packers, wholesalers, ripeners and transporters

- Completed scorecards - 100 growers (for full Program)

- Completed report cards – 32 packers (for full Program)

- Completed report cards - 20 wholesalers (for full Program)

- Minimum of 13 training workshops being held each year (one in each of the eight growing regions and one in each of the major wholesale markets)

- Action plans developed for packers, wholesalers, ripeners and transporters who have completed report cards

- A recognitions system for participating businesses

- A system for reporting quality issues

- A log of quality issues reported over time which can be interrogated to identify trends and areas in need of further investment and investigation

- A comprehensive list of qualified personnel with expertise in various fields relating to avocado production and issues affecting fruit quality.

- On-going revision and improvement of the quality improvement and extension program to include new information, technology or recommendations as they become available.

- Articles in Talking Avocados to advertise the Program, who is already participating and where interested parties can find their rating.

The Program's contract lists the following output requirements from the quality improvement and extension component of the Program:

'This system is designed to identify areas for improvement within the avocado supply chain which will have direct impact on fruit quality. The system will provide support mechanisms for supply chain members to identify where they can improve their systems and thus quality. This will allow other members of the supply chain to make more informed decisions about where and who they would either supply their fruit to or buy it from. The desired flow on effects is improvement of the overall quality of fruit being supplied into the market as a system are improved and businesses are recognised for their efforts.

The system will be evaluated through a number of means:

- Internal quality will continue to be monitored through *'AV11015: Avocado industry fruit quality benchmarking'*

- Maturity will continue to be monitored through *'AV11015: Avocado industry fruit quality benchmarking'*

- Uptake from industry will be monitored

- Report cards and scorecards will be compared – a before and after snapshot from implementing the action plan or from having completed training

- Anecdotal information from central points in the supply chain like packers and wholesalers about whether they have noticed a quality improvement over time

- A review milestone at the two year point to assess Program to date.

3.4.4 Assessment of delivery against required outputs

1) Establishment of quality improvement and extension sub-program

The quality improvement and extension sub-program (Qualicado) has become well established in the production sector in a short period of time. This can be attributed to:

- Effort in the project planning stage, including consultation with key stakeholders (workshop and engagement survey)

- Collaboration with other service providers, in particular DAFF Queensland

- Good documentation, in particular the 'Qualicado facts sheet' outlining what the project is about and the scorecard for growers

- Other communication activities

- Momentum from early Qualicado workshops being well attended and received by the target audience.

2) Scorecard templates for growers

The scorecard and supporting information for growers has been well developed.

Feedback from the Program Manager indicates that some growers struggle with the concept and layout of the form, especially the requirement to enter their scores twice, so that Avocados Australia can maintain a record for assessment. As a result extra time has had to be allocated to walk through the processes in the workshop. One suggestion was that in future filling out of the scorecards should be done earlier in the agenda of the workshop, so growers are still fresh. It is noted that this change has been made in the workshop planned for December 2014.

As part of the evaluation process for project '*AV10002*: *Avocado best management practices and internet-based information delivery'*, Simon Newett (DAFF Queensland) asked growers the following question:

'Have you completed a Qualicado self-assessment? (at a Qualicado field day).

In total there were 57 respondents to the survey.

- 12 respondents skipped the question;

- 28 respondents (49%) said 'yes';

- 20 respondents (35%) said 'no' and

- 9 respondents' (16%) said 'haven't had the chance'

Of the 28 respondents (49%) that said yes,

- 17 respondents (61%) said they found it useful or very useful.

- Only 1 respondent (4%) said it was not useful.

When asked what it was about the self-assessment that they found valuable the following responses were recorded:

- *As a memory jogger for things I should be doing on my orchard*? - 14 positive responses (50%)

- *To check that I was on the right track with my orchard practices?* - 17 positive responses (61%)

- *The maximum points allocated to each section helped me understand the relative importance of each area of management?* - 7 positive responses (25%)

- *The potential to compare (in the next round of meetings) my management practices to see if I have progressed?* – 7 positive responses (25%)

- *Other?* – 1 positive response.

It was also advised by Simon Newett that there has been some minor changes to the grower scorecard as a result of feedback from the first round of workshops. These changes will not affect the ability to make comparisons from the first to second years.

These results coupled with the number of growers that have completed the scorecard to date (176), are a good indication of the acceptance of the process to date.

3) **Report card templates for packers, wholesalers, ripeners and transporters**

The report card templates for the system health check for all supply chain parties have been completed.

It is understood as this report card is completed by an individual assessor (Terry Campbell, DAFF Queensland) working with a supply chain party that the same level of supporting information in the documentation has not been developed. Ideally more supporting information, drawing on learnings from the work that has been done to date, should be incorporated into the report card template (similar to the level provided with the scorecard) so the documents are self-explanatory and stand alone. In this way, in the future, it will be easier to re-administer and can be consistently applied as new supply chain partners enter the market. Ideally this should be completed as soon as possible given expected staff changes at DAFF Queensland.

4) **Completed scorecards - 100 completed for full Program**

As of September 2014, there was a requirement to have 50 scorecards completed. In total by September 2014, 176 scorecards had been completed.

5) **Completed report cards - 32 packers and 20 wholesaler/ripeners completed for full Program**

As of September 2014, there was a requirement to have 24 report cards completed. In total 20 system health checks (4 wholesaler/ripeners and 16 packers) have been completed. Provision has been made complete the 4 outstanding system health checks before the end of 2014.

In discussion with Terry Campbell (DAFF Queensland) who has been undertaking the system health checks (report cards) with supply chain partners the need to de-couple the system health checks for packers from the Qualicado workshops was highlighted. As Qualicado workshops are held outside of the harvest season, packhouses are not operational. This makes some of the assessment processes difficult and it was also felt that it limits the insights and learnings that can be gained. Ideally system health checks should be undertaken when the packhouse is operational.

There are also limitations on what the instrumented sphere assessments[3] can achieve given the constraints of time and the technology. In a draft report for Avocados Australia[4], DAFF Queensland notes that the instrument sphere is not shaped liked the fruit and does not have the same mass, however it was still suitable for identifying high impact transfers in the handling system. The report goes on to highlight "a major deficiency of the work is the lack of impact tests to establish damage thresholds for avocados". Although the "study does identify the amount of impacts in typical avocado packing lines and variations between shed", it is "recommended that further work on impact tests to establish damage thresholds with avocados is needed to determine impact and fruit conditions which result in fruit damage". Hence this is an area where further work could be done to support supply chain assessment processes.

The findings from the 16 packhouse system health checks which had been undertaken provide interesting insights. They identify a number of areas where packhouses can improve performance. These include: temperature monitoring and management, fruit maturity assessment, postharvest fungicide treatment, reducing mechanical damage to fruit, staff training, quality feedback and communication. As a result DAFF Queensland have recommended ten practice improvements, based on the characteristics and size of the packing operation, which would assist in improving fruit quality (Terry Campbell, draft report for AV12012 and pers. comm., November 2014). Reports and action plans (see point 7 below) based on these recommendations are yet to be forwarded to participating packers.

The findings from the first group of packers to complete the system health check can now be used to better inform reporting and meeting information needs for packers that participate in future assessments.

6) **Training workshops – 13 training workshops each year** (one in each of the eight growing regions and one in each of the major wholesale markets)

There was a requirement for 14 training workshops to be delivered by September 2014. By this date 13 workshops (one in each of the eight growing regions and one in each of the major wholesale markets) had been completed and the 14th will be completed in December 2014.

Over the life of the project it is expected that 34 workshops in total will be undertaken. Indications are from the outset of the project that the implementation phase would cover 2.5 years and based on 13 workshop per annum this equates to 34 workshops. Currently the Program is on track to meet this requirement. If the program is underspent it is recommended that the final milestone date be extended to late 2016 and further workshops, and if possible the remaining five, be completed over the extended period.

The Program Manager and Program service providers noted the high attendance at Qualicado workshops and industry demand for updated information / extension to improve productivity and quality. There was good discussion and questioning at the workshops.

They also commented that the workshops were well attended by new growers to the industry who appeared to gain benefit from their participation.

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[3] An instrumented sphere is a microprocessor-based impact data acquisition unit which measures the time and true x,y and z acceleration of impact events.

[4] Draft report for Avocados Australia 'Impacts recorded on avocado packing lines' (November 2014)

Other comments were:

- The overall concept of the Program and the scorecard needs to be 'better sold', focusing on the 'why' and the benefits for individual businesses. It was thought this might encourage more growers to participate in the self-assessment process (scorecard)

- Consideration should be given to doing pre- or post- workshop training sessions with larger packhouse and their staff and update meetings with local rural merchandise companies whilst Program service providers are in the region.

7) **Action plans developed for packers, wholesalers, ripeners and transporters** who have completed report cards.

Although there have been email exchanges between the assessor and individual packers, ideally, in the future, packers should receive a standardised but personalised report and action plan shortly after the visit by the assessor. It is suggested that this occurs within four weeks of the visit.

Now that a number of system health check have been completed and a better understanding of the factors likely affecting fruit quality have been determined, this process should be easier to manage.

8) **A recognitions system for participating businesses**

Avocados Australia has addressed this requirement by listing all participating businesses (who have given permission) on the front page of the Best Practice Resource (BPR) section of the Avocados Australia website. In total there are currently 62 grower, 14 packers and 4 wholesaler ripeners listed.

It is recommended that stakeholders who participate in a second round of self-assessment are also acknowledged with a certificate of participation that they can display in their office / place of work.

9) **A system for reporting quality issues**

Avocados Australia have a number of mechanisms for collecting information on quality issues, including feedback from growers and wholesalers at Qualicado workshops (discussion and evaluation forms) and feedback from retail quality assessors through project *'AV11015: Avocado industry fruit quality benchmarking'* and *'AV12013: Implementing improvements in the avocado supply chain'*. Feedback from the evaluation forms are collated as an internal reporting process for the Program. Data from *AV11015* is collected and collated on a monthly (dry matter) and six monthly basis (retail quality assessment).

In addition to this Avocados Australia have also encouraged growers and wholesalers to discuss quality issues directly with the Program Manager so that these can be addressed through the Qualicado program. There are a number of ways that growers and wholesalers are encouraged to engagement including phone; email, or via the BPR site. Unfortunately, these mechanisms have not really been utilised to date. Given the nature of businesses in the industry is not surprising. Ideally more engagement time needs to be spent particularly with the wholesale sector to develop relationships and exchange of information. This would require the Program Manager to spend more time in the key wholesale markets.

10) A log of quality issues reported over time which can be interrogated to identify trends and areas in need of further investment and investigation.

Avocados Australia are currently updating the BPR so that an industry stakeholders are more easily able to log issues online. Once this is completed the intention is to promote this facility widely to growers and supply chain partners so that it is used.

A log of issues and contributing factors will assist in explaining any deviation in continuous improvement in quality and will assist in interpreting results from other projects, such as HAL project AV11015.

Decline in fruit quality at retail may be due to various factors including:

- Poor agronomic management (including poor pests and disease management)

- Adverse weather conditions during production and / or harvest

- Poor postharvest and supply chain management

- Light supply resulting in less than optimal quality fruit being supplied in response to market demand

- Poor retail management

- High retail pricing resulting in fruit remaining on retail shelves for too long.

An example of this is shown by the recorded increase in Hass damage in 2013 (see Figure 2 below). In the period from January to September 2013, data showed that the incidence of damaged fruit continued to reduce. However in the period from October to December 2013 there was a period short supply and high retail pricing. The high retail pricing resulted in depressed demand, hence fruit was remaining on retail shelves for longer than optimal. Consequently it was being handled excessively (by retail staff and consumers) and as a result there was a significant spike in bruises and rots being recorded in fruit during this period. This resulted in an overall annual increase fruit damage.

Without a log of issues the specific conditions contributing to a decline of quality could be easily misinterpreted. The example above also highlights the how the combination of fruit quality data (AV11015), Infocado data (AV12012) and retail pricing data (AV12007) can facilitate improved supply management and quality across the year.

Figure 2: Recorded Hass damage by year
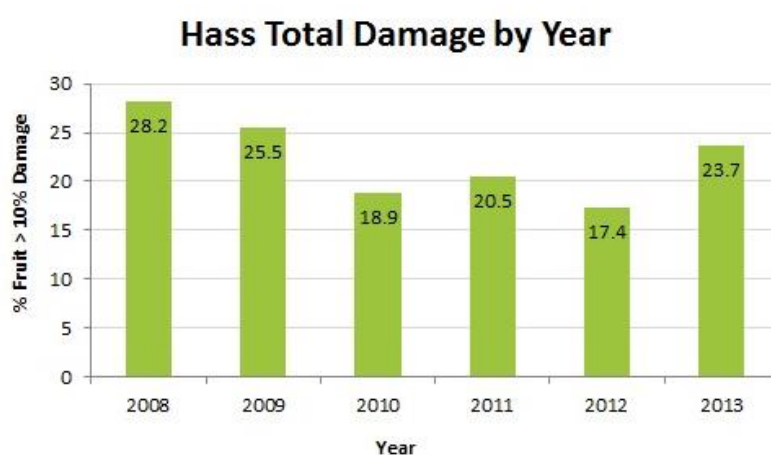
11) **A comprehensive list of qualified personnel with expertise in various fields relating to avocado production and issues affecting fruit quality.**

Avocados Australia have a list of qualified personnel that have been utilised to deliver the Qualicado workshops and undertake stakeholder assessments.

One of the challenges for the industry is the limited pool of expertise that is available to provide knowledgeable input into the Program. It is also known that one of the key personnel from DAFF Queensland undertaking the packer and wholesaler /ripener assessments will not be available to participate in the Program from early 2015; hence a change of staffing will potentially cause disruption in the delivery of the Program. This lack of expertise is an issue is not unique to the Australian avocado industry - it is being experienced by most of the horticultural industries. The challenge however is for Avocados Australia to continue to build the pool of expertise it has available - from both the public and private sector. A positive sign is the inclusion the private sector consultants, Ripe Horticulture (Lisa Martin), Birdwood Nursery (Denis Roe), Chris Searle and Graeme Thomas, in the process. Where possible and appropriate this should be encouraged.

12) **On-going revision and improvement of the quality improvement and extension program to include new information, technology or recommendations as they become available.**

There is strong evidence of ongoing revision and improvement in the Program. This is evidenced by:

- The administering of an initial 'Avocado Growers Engagement Preference Survey', which resulted in rescheduling of workshop dates to better suit the production sector in each region

- Modification of delivery of components of the workshop i.e. the way the scorecard is explained and delivered

- The topic selections for the upcoming round of workshops is based on feedback from evaluation forms and new related topics e.g. inclusion of benchmarking sessions and productivity topics and their relation to quality

- The inclusion of technologies such as 'sphere assessments' to gain a better understanding of packhouse handling practices

- Encouragement by service providers for packers and wholesalers/ ripeners to adopt new monitoring practices (and associated technologies) to improve supply chain management and thus fruit quality.

13) **Articles in 'Talking Avocados' to advertise the Program, who is already participating and where interested parties can find their rating.**

Information regarding the components of the Program, in particular the Qualicado appear to have been targeted and well communicated. For more information see section 3.6.3 - Communications on page 35.

Those growers, packers and wholesaler / ripeners that agree have their name published as participants on the front page of the BPR site.

There is no rating system for those participating in the Qualicado component of the Program. A rating system was to be included in the original Quality Management Scheme which was proposed, however this was not progressed.

3.4.5 Assessment of delivery against required outcomes

The Program lists the following output requirements from the quality improvement and extension component of the Program:

'This system is designed to identify areas for improvement within the avocado supply chain which will have direct impact on fruit quality. The system will provide support mechanisms for supply chain members to identify where they can improve their systems and thus quality. This will allow other members of the supply chain to make more informed decisions about where and who they would either supply their fruit to or buy it from. The desired flow on effects is improvement of the overall quality of fruit being supplied into the market as a system are improved and businesses are recognised for their efforts.

The system will be evaluated through a number of means:

- Internal quality will continue to be monitored through *AV11015*

    Being achieved.

- Maturity will continue to be monitored through *AV11015*

    Being achieved.

- Uptake from industry will be monitored

    Being achieved. This will be determined by attendance at workshops and by outcomes for second round of assessments with growers starting in December 2014.

- Report cards and scorecards will be compared – a before and after snapshot from implementing the action plan or from having completed training

    Comparison of scorecards at an individual level and aggregated level will be undertaken in second phase of Program.

    There is a need to identify a mechanism to capture changes at a packhouse / wholesaler / ripener level. It is recommended that a short survey is completed with all supply chain partners that participate in the system health checks.

- Anecdotal information from central points in the supply chain like packers and wholesalers about whether they have noticed a quality improvement over time

    This needs to be addressed in second phase of Program.

    To establish a benchmark, Avocados Australia could take a very short snapshot targeted (qualified knowledgeable industry people) survey prior to 2015 workshops. This will provide a record of packers and wholesalers' perception of quality at a given point which can then be re-assessed at end of Program.

- A review milestone at the two year point to assess Program to date

    Achieved through this review.

3.4.6 Evaluation

Qualicado Workshop evaluation

Avocados Australia have asked attendees to complete evaluation forms at each of the Qualicado workshops they have hosted. An overall summary of the evaluations is provided on page 25. Evaluation summaries for each individual Qualicado workshop are available from Avocados Australia.

There was an overall 34% response rate to the evaluation.

In total 732 stakeholders have attended workshops, of these 682 were growers.

The evaluation form that was used was easy to understand and suitable for the environment in which it was being administered. To assist with future evaluation it is suggested that one qualifying question is added to the form, requesting respondents to indicate what type of business they represent e.g. represent e.g. production; production and packing ; packing only; transport; wholesale / ripening; rural merchandise; consultant; researcher or other (please list).

Overall the feedback from the workshops was very impressive, with nearly 100% of respondents indicating that the workshops provided useful information and that they gained value from attending the event.

A score of 7.8 out of 10 indicating that they would likely use information gained during the workshop to improve practices was also very good.

Growers and wholesalers also indicated other quality-related topics that would be of interest in the next round of Qualicado workshops. Avocados Australia have analysed these and the Program Manager has indicated that the intent is to deliver against the more popular topics indicated.

One question on the evaluation form which had recently been added indicated that 98% of respondents would be interested in the use of presentation videos in the workshops and on the Best Practice Resource (BPR) site.

Best Practice Resource

Although the BPR is not directly funded through this Program, it is used as a platform to support practice change to achieve better fruit quality. Presentations from the workshop have been loaded into the system, along with other relevant supporting information.

Avocados Australia also indicated the following statistics related to the BPR as of November 2014:

- Total number of registered users – 350

- Total number of grower / packer users – 266

- Total number of wholesalers – 79

- Total number of other users – 5

- Total number of separate visitations to BPR over period. For the period 1 Sept 2013 to 21 Nov 2014 there were 17,170 page views. There were 4,639 separate sessions (number of times a user accessed and perused the site).

- The main areas / topics where growers are engaging are: 1) nutrition, 2) irrigation, and 3) other insect pests 4) phytophthora.

These figures indicate good uptake and with further promotion of the BPR at future Qualicado workshops and through general communications it would be expected this would increase before the end of the Program.

Analysis of scorecards

Avocados Australia indicates that there are 564 production businesses across the 8 regions where Qualicado workshops have been held. In total 682 growers have attended the workshops – this is attributable to more than one person from a business attending. Of those that attended 187 (33%) filled out scorecards and of these 33% (or 11% of the total number of producers) provided their details and agreed to be acknowledged on the Avocados Australia's Best Practice Resource (BPR) site.

The cumulative scores from the scorecards also provide insight into areas where growers believe there could improving their practices. Avocados Australia have undertaken this analysis. There are naturally regional variations to the key issues where growers have indicated they could be doing a better job, however at a national level these are:

- Disease management (anthracnose and phytophthora)
- Irrigation management
- Quality assessment.

Attendees were also asked to provide other comments the workshops. There were comments of general praise for the initiative and content and there were also practical suggestions which Avocados Australia should consider, in particular the use of a PA system at the workshops.

The Program Manager has indicated they are also using this data to inform workshop material for phase two of the Program.

3.4.7 General comments

The Qualicado workshops have been attended and received by the production and wholesale/ ripener sector.

Avocados Australia maintain records of the production, supply chain businesses in each of the regions. Records show that grower workshops were well attended and that it is likely in many cases that 2 or more persons from each business attended, given that in some regions there were significantly more attendees than businesses in the region. The wholesaler/ripener workshops were not as well attended, although attendance rates were still commendable give the nature of these businesses and the environment in which they operate.

Evaluations indicate that the quality of engagement has also been considered high by these groups. Attendees at the workshops (growers and wholesalers/ripeners) strongly indicated that they would likely use information gained during the workshops to improve practices, this will hopefully lead to improved practices and thus fruit quality.

Of those that attended 187 (33%) filled out scorecards and of these 33% (or 11% of the total number of producers) provided their details and agreed to be acknowledged on the Avocados Australia BPR site. Although it would be good to have higher participation rates, attaining a 33% engagement is very acceptable.

Once reports and action plans are provided to packers and wholesaler / ripeners who have participated in the system health check (report card) process, further follow up should be undertaken to confirm that the has been beneficial and if there is any intent for the business to action plans or engage expertise to undertake a more rigorous consultation process.

Program planning has ensured that the timing of delivery of the Qualicado workshops is meeting industry needs. Packhouse system health checks need to be undertaken during the harvest period, instead of the same time as the Qualicado workshops.

Avocados Australia have adopted a flexible and responsive approach to Qualicado and appear to delivering against the indicated needs of the industry. This is positive and provides the best chance to maintain engagement with the various sectors of the supply chain and be able to influence practice change and quality outcomes.

Table 2: Summary of Evaluations from Grower and Wholesaler Qualicado Workshops

Evaluation Form - Summary of Results		Workshops (8 Grower workshops; 5 Wholesaler / Ripener Workshops = 13 workshops in total)												
Key metrics		NQ*	Tri*	Mel*	Bris*	SC*	Syd*	TNR*	SQ*	Adel*	CNSW*	Per*	WA*	CQ*	**Tot**
Target audience (G = grower; W = wholesaler / ripener)		G	G	W	W	G	W	G	G	W	G	W	G	G	
Total number of stakeholders in attendance:		120	70	12	14	33	9	44	86	8	78	7	167	84	**732**
Number of stakeholder businesses / region **		78	64	30	31	45	25	74	59	16	82	21	117	45	
Attendance rate for region		154%	109%	40%	45%	73%	36%	59%	146%	50%	95%	33%	143%	187%	
Total number of respondents to Evaluation Form:		40	35	10	11	11	8	16	39	8	23	6	22	17	**246**
Response rate to Evaluation Form (%):		33%	50%	83%	79%	33%	89%	36%	45%	100%	29%	86%	13%	20%	
Has this workshop provided you with useful information? (%)															
	Yes	98	100	100	100	100	100	100	100	100	100	100	95	100	**99**
	No	3	0	0	0	0	0	0	0	0	0	0	5	0	**0.6**
Rating of the quality of speakers: (1 to 10 where 1 is poor, 10 is excellent)															
	Av.	7.0	8.0	8.0	8.0	8.6	8.0	9.0	8.7	8.5	8.6	8.7	7.7	8.5	**8.3**
Rating of the choice of location: (1 to 10 where 1 is poor, 10 is excellent)															
	Av.	9.0	8.0	8.0	8.8	9.1	8.0	8.8	8.5	8.9	8.6	8.2	7.8	9.1	**8.5**
Overall did you gain value from attending this event? (%)															
	Yes	100	100	100	100	100	100	100	100	100	100	100	95	100	**100**
	No	0	0	0	0	0	0	0	0	0	0	0	5	0	**0.4**
Likelihood of using info gained during this workshop to improve practices: (1 to 10 where 1 is strongly disagree, 10 is strongly agree)															
	Av.	8.0	7.0	8.0	7.0	7.7	7.0	8.8	8.1	8.5	8.3	7.4	7.4	7.7	**7.8**
Would the usage of presentation videos in workshops & on the BPR be useful? (%) N.B.: This is a question that was added to the questionnaire only recently															
	Yes											100	95	100	**98**
	No											0	5	0	**1.7**

*NQ – North Queensland Grower Workshop; Tri – Tri-State Grower Workshop; Mel – Melbourne Wholesaler workshop; Bris – Brisbane Wholesaler Workshop; SC – Sunshine Coast Grower Workshop; Syd – Sydney Wholesaler Workshop; TNR – Tamborine / Northern Rivers Grower Workshop; SQ –Southern Queensland Grower Workshop; Adel – Adelaide Wholesaler Workshop; CNSW – Central NSW Grower Workshop; Per Perth Wholesaler Workshop; WA – WA grower Workshop; CQ - Central Queensland Grower Workshop.

** Stakeholder businesses in regions refer to grower and grower / packer businesses; stakeholder businesses in capital cities refer to wholesalers, wholesaler / ripeners and other avocado marketing businesses.

3.5 Review of Infocado and OrchardInfo (Steps 7 - 10)

One of the two key objectives of the Program is ongoing data management, specifically related to Infocado and OrchardInfo.

As part of the review of this component of the Program, a desktop exercise to evaluate the management of the Program against the milestone schedule and evaluate progress to date against the required outputs and outcomes was undertaken. This involved:

- Reviewing previous reports ('*AV11013: Review of avocado industry and market information systems'* completed 2012) and ascertaining the level of and limitation to adoption of previous recommendations.

- Reviewing the outcomes from the remote sensing and crop forecasting studies

- Identifying any changes in the industry/supply chain/ technical environment that affect Infocado data collection or reporting and warrant changes in how this component is delivered to industry.

- Analysing and report all the above material from steps 7 and 9 and also providing recommendations in relation to project improvement measures and potential future investment.

Materials reviewed

The following materials were reviewed:

- Milestone report 102

- Milestone report 103

- Milestone report 104

- HAL Project '*AV11013: Review of avocado industry and market information systems'*

- Infocado weekly and quarterly reports from the commencement of the Program

- OrchardInfo reports for various regions - 2011 and 2012

- Communications including articles in '*Talking Avocados'* and '*Guacamole'; HAL Avocado Industry Annual Reports, 'Grower Updates'*, Avocados Australia website updates and media releases etc.

3.5.1 Progress towards required Infocado and OrchardInfo outputs and outcomes

The Program lists the following output requirements from the Program:

- Infocado – weekly reports produced and emailed to all contributors

- Infocado – quarterly reports produced and emailed to all contributors

- Infocado - individual reports produced and emailed to each contributing packhouse

- A log of forecasting techniques used by growers and packers to be completed by the end of the season

- OrchardInfo – database updated with capacity to deliver reports by region, tree age and variety

- More detailed productivity data provided and tracked with a subset of growers

- Annual reports produced and delivered to all contributors (once enough contributors providing data)

- An analysis of Australian industry productivity levels

- The remote sensing scoping study will develop a method for independently obtaining specific data as well as providing a validation toll for existing data sets. It will also evaluate the accuracy and feasibility of remote sensing technology to address these needs, as well as its potential to predict the spatial variability of an orchard, in terms of tree health, fruit maturity, quality and yield and provide clear recommendations to the industry for future investment.

The Program lists the following outcome requirements from the Program:

- Improved returns to growers as result of better marketing decisions made by individual contributing businesses and industry as a whole in developing programs to manage high volumes of fruit at various times throughout the season.

- The accuracy of data will be evaluated by comparing total statistics against levy data and Australian Bureau of Statistics (ABS)

- Improved forecasting through documented and communicated forecasting case studies. This will be evaluated through ongoing monitoring of packhouse and growers' long and short term forecasting.

- This segment will be evaluated by measuring the uptake by industry at the conclusion of the project the goal is to maintain a level of 80% of production within OrchardInfo and Infocado Systems.

- A better understanding of the number of avocado trees in the ground, leading to more informed marketing and R&D investment in the future

- An understanding of how accurate and useful remote sensing technology will be to industry in remotely monitoring tree numbers and health.

- This segment will be evaluated by measuring the uptake by industry at the conclusion of the project the goal is to maintain a level of 80% of production within OrchardInfo and Infocado Systems.

3.5.2 Assessment of delivery against required outputs

1) Infocado – weekly reports produced and emailed to all contributors

   Achieved.

2) Infocado – quarterly reports produced and emailed to all contributors

   Achieved.

3) Infocado - individual reports produced and emailed to each contributing packhouse

   Achieved.

4) A log of forecasting techniques used by growers and packers to be completed by the end of the season

   In process of being addressed.

5) OrchardInfo – database updated with capacity to deliver reports by region, tree age and variety

   Achieved and reports improved between 2011 and 2012, allowing better interpretation by users.

6) More detailed productivity data provided and tracked with a subset of growers

Achieved.

7) **OrchardInfo annual reports produced and delivered to all contributors (once enough contributors providing data)**

2012 data has been completed (July 2014) and provided to industry.

It is noted that contributions are still falling below the required levels (80% production) however the incentive (win an iPad) provided for growers to complete their data and has increased participation. This is a positive advancement. Additionally the redevelopment of the report is anticipated to encourage more growers to provide data.

8) **An analysis of Australian industry productivity levels**

Completed for 2012 data. 2013 and 2014 data on track to be completed in first half of 2015.

9) **The remote sensing scoping study will develop a method for independently obtaining specific data as well as providing a validation toll for existing data sets. It will also evaluate the accuracy and feasibility of remote sensing technology to address these needs, as well as its potential to predict the spatial variability of an orchard, in terms of tree health, fruit maturity, quality and yield and provide clear recommendations to the industry for future investment**

The remote sensing scoping study has been completed and has found that high resolution imagery, together with GIS and Google Earth can improve prediction of tree numbers at orchard level and coupled with ground surveys can greatly improve current auditing techniques both at a farm and national level. It has also demonstrated that surrogate maps of a number of tree health and yield parameters can be developed.

3.5.3 Assessment of delivery against required outcomes

1) **Improved returns to growers as result of better marketing decisions made by individual contributing businesses and industry as a whole in developing programs to manage high volumes of fruit at various times throughout the season**

This outcome is difficult to quantify, however anecdotal evidence indicates that the system has provided valuable information to both the Australian and New Zealand industry. In recent months the market has experienced the highest weekly volumes of fruit ever seen in the Australia due to increasing volumes of Western Australian fruit and a large New Zealand crop. Infocado has been able to forecast the supply and as a result the industry and market has been able to prepare for the expected volumes. There were concerns that the large volumes may cause the market to collapse, however market prices have remained relatively strong throughout this period.

2) **The accuracy of data will be evaluated by comparing total statistics against levy data and Australian Bureau of Statistics (ABS)**

OrchardInfo data has been compared against ABS data. In 2012 OrchardInfo tree numbers as a percentage of ABS figures was approximately 64%. Contributions to OrchardInfo are increasing and it is expected the difference between 2013 and 2014 OrchardInfo data and ABS data will be less.

Data is compared with levy figures from time to time but is not formally reported. There should be a greater internal analysis of levy figures to validate accuracy of Infocado and OrchardInfo data. This

could be reported at a higher level to provide confidence in the Infocado and OrchardInfo data however there likely remains sensitivities within the industry around use of levy data for this purpose which should be considered.

3) **Improved forecasting through documented and communicated forecasting case studies. This will be evaluated through ongoing monitoring of packhouse and growers' long and short term forecasting**

   This is being addressed.

4) **A better understanding of the number of avocado trees in the ground, leading to more informed marketing and R&D investment in the future**

   As stated, contributions to OrchardInfo are improving and this is expected to provide better estimates of medium and long term industry volumes. As a result the industry is able to factor this into R&D and marketing investment.

5) **An understanding of how accurate and useful remote sensing technology will be to industry in remotely monitoring tree numbers and health**

   This has been achieved through remote sensing scoping study.

6) **This segment will be evaluated by measuring the uptake by industry at the conclusion of the project the goal is to maintain a level of 80% of production within OrchardInfo and Infocado Systems**

   To be completed at the end of the Program.

3.5.4   Other findings

In 2012, P2P Business Solutions completed a review of the industry and market information systems in which the avocado industry invests.

The objectives of the review were:

- To determine how available information was intended to be used

- To determine how available information was actually used and what benefit it provided to growers, the broader avocado industry and HAL

- To determine how data could be used strategically and what benefit this could provide to growers, the broader avocado industry and HAL

- To determine what (and when) additional information was required to support business and industry decision making and evaluation

- To identify opportunities for improved integration and analysis of data / information and how this might be implemented

- To determine if there are other data collection and reporting systems / concepts, used in other industries (Australian and international) that might have application for the Australian avocado industry.

Based on the findings of the review a number of recommendations were made on how more valuable information could be delivered to meet the needs of growers, packers, the supply chain and HAL. These

recommendations are included in Table 2 below (page 30) and the response and achievements by Avocados Australia since the review is included.

Overall, the administration of Infocado and OrchardInfo is meeting the Program and industry requirements. Considerable work is being done with both systems to improve the quality of data and resultant reports generated through the systems. It should be noted that there was a change of Program Manager in early 2014 and Avocados Australia should be acknowledged for continuing to deliver weekly reports and for the minimum disruption to the delivery of the overall Program.

Table 2: Key recommendations related to Infocado from 'AV11013: Review of avocado industry and market information systems' and response by Avocados Australia

Overview of recommendations	Response/achievement by industry and/or Avocados Australia
The Australian avocado industry should continue to invest in all current data sources	Achieved
There should be greater project resourcing to allow investment in the time and tools required to improve data accuracy, verify data, and educate users (in particularly growers and packers) in how to analyse industry information to maximise business development opportunities	This is being achieved in part within the current budget of the Program – through greater focus on identifying and contacting eligible contributors and seeking other technologies (remote sensing) to validate OrchardInfo data. Recommendations provided in regard to future investment opportunities as part of this review also address educating users on the use of data to potentially improve business outcomes
Once decisions regarding these recommendations have been made, Infocado users and the broader industry should be informed about a new approach to industry information management. This message should be part of a broader communication package that should acknowledge shortcomings in Infocado and how these are to be addressed, and seek to restore confidence in Infocado	Achieved through communication to contributing parties and reinforced through Qualicado meetings
Identify and seek to gain greater participation by those that are eligible to provide data (growers, packers and wholesalers)	On-going process. From discussions with the Program Manager there appears to have been considerable effort to improve participation, however ongoing work is needed with the wholesale sector
Encourage and assist eligible participants to provide more accurate data	On-going process. From discussions with the Program Manager there appears to have been considerable effort to encourage data accuracy
Provide additional tools, such as a simple dispatch system, to encourage smaller businesses to participate in Infocado, if the investment is justified	This is still currently under review. The investment in the development of a simple dispatch system, ongoing maintenance and training is difficult to justify. Although requested by a group within the industry there is doubt it would be widely adopted
Improve accuracy of Infocado data	
Develop crop forecasting methodologies: The industry should develop guidelines and processes to assist growers and packers in developing crop forecasting figures taking account of fruit numbers and size (count) throughout the season	In process of being developed
Seek inclusion of accurate import data directly from New Zealand exporters and ensure timing for inclusion of this data in Infocado is correct	Achieved. Avocados Australia is now working more closely with Avocados NZ
Continue to monitor data coming into the system (i.e. crop forecasts vs dispatches; wholesale data etc.) and address issues as they are identified	On-going by Program Manager

Improve accuracy of Infocado data continued	Response/achievement by industry and/or Avocados Australia
Develop Regional Reference Groups, made up of local growers, packers and knowledgeable independent consultants / extension officers to inform the reporting process	The Program Manager advised that this has been attempted but was not successful. As a result contact has been made with individuals within the regions to attempt to ascertain more knowledge about potential contributors and regional volumes
Strengthen the 'Comments' section of Infocado Weekly Report by providing informed comment from the wholesaling sector and directing users to other complementary reports available through the Avocados Australia website	Further comment could be made on market conditions on a weekly basis however this requires greater engagement between the Program Manager and the wholesaling sector. Users are being directed to other reports / information that can assist in decision making processes
If greater contribution cannot be achieved from the wholesaling sector consider withdrawing this information from the Infocado Weekly Report and limit the reports distribution	Greater contribution has been achieved, however there is an on-going need to identify, maintain and improve engagement with this sector
Verify Infocado data	
Seek to verify Infocado data through mechanisms outlined in Section 3.4 of this review (AV11013). In particular consider investment in remote sensing technology (satellite mapping) to validate plantings and potentially yield forecasting	Achieved in part. The concept of using remote sensing has been researched and validated as part of this project. Further consideration is being given to how this might be advanced Other mechanisms as outlined (Section 3.4 in *AV11013*) should be revisited by the Program Manager including accessing data from carton manufacturers and Central Market organisations
Provide qualifications to users around the accuracy of data i.e. provide an assessment of the representation based on data from other (verification) sources and include appropriate comments in the Infocado Reports to highlight discrepancies in reported data	There is ongoing work to qualify weekly Infocado reports using quarterly Infocado information. Additional work can be undertaken with levies data (which will be addressed in the second phase of the Program) The process for qualifying data in OrchardInfo is good. It highlights where the data collected through the OrchardInfo process is lacking compared to other sources, such as ABS and levies
Continue to explain difference between data in the Infocado Weekly and Quarterly Reports.	This is now highlighted in Quarterly reports as a standard notice and has been explained through industry communications
Improve reporting	
Introduce minor format improvements and changes to improve clarity and to acknowledge discrepancies in the data (see section 3.3 – AV11013)	This has happened and further refinements are being undertaken to both the Infocado and OrchardInfo Reports. Further details outlining limitations of data within Infocado report could be included

Improve reporting continued	Response/achievement by industry and/or Avocados Australia
With regard to crop forecasting, when there are known changes in regional crop performance which may have an impact on supply chain performance then interim (monthly) reports should be released e.g. instead of releasing Infocado Quarterly Reports in January, April, July and October only, it may be required to release interim reports in other months also.	Acknowledged by Program Manager, but no significant event to require additional reporting at this time
Continue to focus on developing OrchardInfo as this will provide important information to support longer term strategic planning at a business and industry level	On-going
Consider investing in weekly wholesale price reports as an incentive to encourage growers to provide data for OrchardInfo	Considered and will not be advanced at this time
Publish the quarterly export / import report on the Avocados Australia website (under log-in)	Achieved
Seek to introduce a Brisbane Price Index and evaluate for usefulness	Not advanced at this time - still under review, but not likely to proceed
Consider introduction of a fee-for-service offering around customised reporting to support businesses.	Not advanced at this time - still under review
Communication and grower education	
Develop and resource a comprehensive communication program, building on the existing program, to support industry's objectives around data collection and industry development	On-going – see section 3.6.3 - Communications on page 35
Encourage and educate users in how historical data could be used to inform business development processes	Not being addressed at this time
Develop a more comprehensive marketing education program for the industry	Being addressed in part through Market Communications program.
Continue to hold Infocado Summits, where possible, every two years.	Under consideration. Further consultation needs to be undertaken with key stakeholders to determine need, objective and benefit. Also now dependent on new HIA funding policies.
Risk Management – Infocado system	Response/achievement by industry and/or Avocados Australia
Mitigate risk associated with Infocado system management by developing a comprehensive process manual and ensuring sufficient staff have a full working knowledge of Infocado and other industry information systems and processes (Section 3.3).	A full review of the Infocado system is currently being undertaken. The system has recently been transitioned to 'web form' so that it more user friendly. Process manuals have been produced and are under constant review. Currently three Avocados Australia staff have a working knowledge of Infocado and the other industry information systems and processes.

3.6 Review overall project management and evaluation framework of the project (Step 11)

This part of the review entailed:

- Discussions with the current Program Manager and key service providers regarding overall management and progress of the Program to identify any issues, limitations etc.

- The assessment of communications activities around the Program

- The assessment of related projects and their relationship to the Program (AV12012) to analyse the evaluation framework and to make recommendations on how this might be improved from a process perspective.

3.6.1 Program management

The Program Manager (Nathan Symonds) is new to the role (starting in early 2014) and therefore was not involved in previous quality related projects or the development of this Program, hence there has been a need for him to quickly understand and engage with the Program so that required outputs and outcomes could be achieved. Commendably, this has been achieved over the course of 2014 and all milestones have been met or accounted for.

There are many elements to the Program which are interlinked and there is considerable time to ensure all of these Program elements as well as elements in other aligned/linked projects are cohesively managed and implemented. Having time to understand and achieve all of the project requirements, processes, and developing ideas to improve the Program outcomes is a challenge which needs to be managed.

The Program Manager raised the following issues / risks, in discussion:

- It has been difficult to engage with the transport sector and it was noted a more concerted effort is needed to engage key suppliers in this sector

- To date, there has not been time to spend developing relationships with the wholesaling sector

- Having access to suitably skilled service providers for future delivery of the Program will be a constant challenge.

3.6.2 Feedback from service providers

As part of this review, DAFF Queensland staff were consulted in regard to the overall engagement process for the development and delivery of Qualicado. The feedback received was:

- The overall the level of planning and engagement with Avocados Australia as the lead service provider was considered good

- DAFF Queensland staff were pleased with the uptake of the self-assessment process (scorecard) in the first round of Qualicado workshops

- DAFF Queensland will be starting a productivity project and are aiming to integrate this new project with Qualicado workshops to address common identified needs within the production sector.

3.6.3 Communications

Information regarding the components of the Program, in particular the Qualicado appear to have been targeted and well communicated. Below is a list of materials reviewed and a listing of relevant content:

'Talking Avocados'

- *'Talking Avocados'* Autumn 2013 - Infocado; OrchardInfo articles

- *'Talking Avocados'* Winter 2013 - Announcement of Qualicado program, Qualicado program calendar, invite to first Qualicado event (15 August 2014), Promotion of BPR, Orchard Info article,

- '*Talking Avocados'* Spring 2013 – Update on first Qualicado event, announcement and details of future Qualicado events (6 pages), BPR information, Qualicado program calendar, invite to future Qualicado events, Promotion of BPR

- *'Talking Avocados'* Summer 2014 – Update on Qualicado events etc. (4 pages), purpose of Qualicado program, Qualicado program calendar, OrchardInfo article

- *'Talking Avocados'* Autumn 2014 – Chairman and CEO's update, Update on Qualicado events (6 pages), Infocado reminder and purpose

- *'Talking Avocados'* Winter 2014 – Front cover, Chairman and CEO's update, Update on Qualicado events, Infocado and OrchardInfo (reminder) (5 pages), Avocado R&D program overview.

'Avocado Industry Annual Reports' (HAL)

In both the Avocado Industry Annual Report 2012/13 and 2013/14 details of the Program are provided.

'Guacamole'

Guacamole is the fortnightly e-newsletter that Avocados Australia distributes to industry stakeholders. In total 30 e-newsletters were reviewed over the period from 1 July 2013 – 30 November 2014. In 28 of the 30 publications reviewed, there was at least one article on one of the components of the Program i.e. Qualicado, Infocado or OrchardInfo. Qualicado articles were a major feature appearing in 26 of the 30 e-newsletters. Often there were multiple articles - reviewing past workshops, inviting growers and other stakeholders to future workshops and also directing growers to the BPR to find presentations and information on topics covered at Qualicado workshops

Avocados Australia website

Detailed information is available on the Avocados Australia website regarding Qualicado, Infocado and OrchardInfo.

In regard to Qualicado section (Grower section – services) there are links to related documents and the self-evaluation form which can be downloaded. There was also information in the 'Growers Notices' section about Qualicado. Information on future workshops is also published in the 'Events' section of the website.

Information is also available regarding Infocado and OrchardInfo, including why these data collection systems exist, how participants can contribute. Historical reports are also provided.

'Grower Updates' and notices to wholesalers, ripeners and transporters

Avocados Australia has also sent 'Grower Updates' to growers and notices to wholesalers, ripeners and transporters via email inviting participation in upcoming Qualicado workshops and outlining details of the event.

Various reminders, including 'Grower Updates' via email, have also been sent to growers encouraging and reminding them to contribute to OrchardInfo data.

Media Releases

Avocados Australia issued a number of media releases to inform the industry of upcoming events and the success of the Qualicado Program.

Overall assessment

Overall the standard of communication around the Program has been very high. This is reflected in the high attendance rates at Qualicado events and the increasing contribution to OrchardInfo.

3.6.4 Evaluation

The evaluation components of the Program are outlined in Section 3.2 and 3.46 and include:

- Findings from *'AV11015 – Avocado industry fruit quality benchmarking'* (Due: May 16)

- Findings from *'AV12007 - Data collection to facilitate supply chain transparency'*

- Feedback from completed evaluation forms at Qualicado workshops (growers and supply chain partners)

- Monitoring levels of engagement with the production and supply chain sectors through Qualicado

- Monitoring of contributions (number of participants and percentage of industry volume) through Infocado and OrchardInfo

- Monitoring accuracy of Infocado and OrchardInfo data through validation from other sources

- Infocado data from this Program (*AV12012*) – to measure volume, quality (*AV11015)* and price data (*AV12007)* over time.

The evaluation mechanisms for this program are strong. Through this Program and through other managed projects, HIA and Avocados Australia hold significant data that can be utilised to evaluate the performance of the market and the Program.

However, two identified challenges for the Program to demonstrate its benefit will be:

- Adverse weather conditions (or other events beyond the control of the industry) impacting on fruit quality

- The time taken for on-farm or supply chain practice change to be adopted and take effect. The timeframes for evaluation within the Program will limit the ability to identify change.

4.0 Discussion

Overall the Program has been well designed and managed to date.

It has numerous components as well as oversight and engagement with other HAL / HIA projects. In effect it is the framework which ties together the quality and productivity work of the industry and then extends it. For this reason its management and implementation is critical if the industry is going to address quality issues across the sector.

Overall delivery against the milestone schedule has been very good. All requirements for Milestones 101, 102 and 103 were met and on time. There was a justified need to change a deliverable (the final report of the remote sensing sub-project) from Milestone 103 to Milestone 104. Also one Qualicado workshop and 4 report cards remain incomplete (at Milestone 104) however provision has been made for these to be completed by December 2014. At this stage in the Program the required outputs and outcomes are being met and are on track to be achieved by the end of the Program.

Overall the feedback from the Qualicado workshops was very impressive, with nearly 100% of respondents indicating that the workshops provided useful information and they gained value from attending a workshop. A score of 7.8 out of 10 indicating that they would likely use information gained during the workshop to improve practices was also very good. There could be greater participation in the self-assessment process – those not contributing need to be convinced of the benefit.

It is too early in the Program to determine what benefits the packing and wholesale sector will realise from the system health checks, however initial findings from the work undertaken by DAFF Queensland indicate there are numerous areas where improvements can be made for small, medium and large packhouses.

Infocado and OrchardInfo continue to be maintained and improved, both from a process and data quality perspective. This is an on-going process that requires consistent encouragement and engagement with growers and wholesalers to maintain participation. In the future it is hoped that new technologies such as remote sensing can support data collection, improve data accuracy and reduce data collection costs for the industry.

5.0 Recommendations

5.1 Recommendations on remainder of the project

5.1.1 Qualicado

The following recommendations are made in regard to the Qualicado component of the Program:

Qualicado Workshops

- Continue to deliver Qualicado workshops as proposed

- Continue to ask the attendees at the Qualicado workshops what skills and knowledge areas related to quality they would like to cover in future sessions and deliver against these requests. Utilise consolidated data from scorecards to also determine topics that might be of interest to businesses. This will ensure that workshops are relevant and meeting the needs of industry in relation to quality and related productivity and supply chain issues, as well as, facilitating industry (grower and supply chain) engagement

- To encourage more growers to participate in the self-assessment process (scorecard), it is recommended that the overall concept of the Program and the scorecard approach needs to be 'better sold', focusing on the 'why' and the benefits for individual businesses

- The filling out of the scorecard should be done earlier in the agenda of the workshops, so growers are still fresh. It is noted that this change has been made in the workshop planned for December 2014

- Encourage larger packhouses to invite their key staff to Qualicado meetings

- Encourage local rural merchandise companies to attend Qualicado meetings

- Where practical and beneficial, integrate future Qualicado workshops with DAFF Queensland Productivity workshops.

Scorecards

- Although there have been some initial issues with the format of the scorecard it is not recommended to change it at this time. Growers are now familiar with the form and to change it now will likely only cause more confusion and difficulty in comparing year to year performance.

- If the Program continues beyond the current project, it is suggested that a new scorecard format might be considered at that time.

System health checks for packers and wholesaler/ripeners

- It is recommended that more supporting information is included in the report card template for the system health checks. This could include details such as: the purpose of the system heath check, how the report card document is used and the supporting processes. Ideally the document should be self-explanatory and stand alone, similar to the scorecard used for growers. In this way, in the future, it will be easier to re-administer and can be consistently applied as new supply chain partners enter the market. Ideally updating of the report card template should be completed as soon as possible given expected staff changes at DAFF Queensland.

- De-couple the system health checks (report cards) for packers from the Qualicado workshops to overcome the issue of packhouse assessments occurring outside the harvest season and to improve assessment processes and learnings.

- Aim to have standardised but personalised reports and action plans forwarded to packers or wholesalers/ripeners within four weeks of assessment by the service provider. This should be addressed in the subcontract for the work.

- Undertake desktop assessment to identify improved supply chain assessment technologies that may be available and could assist the Australian avocado industry in assessing and monitoring conditions that affect fruit quality i.e. are there improvements in the instrumented sphere technology (that could overcome the current limitations) or other technologies that are used by other industries (international avocado industries or other horticultural industries) that would be more suitable or affordable for the Australian avocado industry. If suitable for commercial use, growers and supply chain parties should be encouraged to adopt new technologies that will provide benefits.

Evaluation

- To assist with future evaluation of the Program, it is suggested that one qualifying question is added to the Qualicado workshop evaluation form, requesting respondents to indicate what type of business they represent e.g. production; production and packing ; packing only; transport; wholesale / ripening; rural merchandise; consultant; researcher or other (please list).

- Some small incentive should be given to encourage more Qualicado workshop participants to complete evaluations forms on the day, with the aim to lift evaluation completion to greater than 50%.

- To establish a benchmark, Avocados Australia could take a very short snapshot targeted (qualified knowledgeable industry people) survey prior to 2015 workshops, so that there is some record of the packers and wholesalers' perception of quality at a given point and then revisit this at end of Program.

  An example of the type of questioning, which could be administered by email or phone is provided below:

  To be administered in early 2015,

    1. On the scale of 1 - 10, thinking about the Australian avocado crop over the 2014 calendar year how would you rate the general quality of the marketed product?

    2. What were the major issues with quality?

  To be administered in early 2016,

    1. On the scale of 1 - 10, thinking about the Australian avocado crop over the 2015 calendar year how would you rate the general quality of the marketed product?

    2. Was there an improvement in quality over the 2014 crop? Yes, No, Not detectable, Don't know.

    3. What were the major issues with quality in 2015?

- Once report cards and action plans are provided to the packers and wholesalers/ripeners who have participated in the system health check process, further follow up should be undertaken by Avocados Australia, in the form of a survey. This survey should seek to ascertain if the process and

learnings have been beneficial and if there is any intent for the business to action plans or engage additional expertise to undertake a further assessment and improvement.

Recognition of participation

Certificates of participation that can be displayed in business premises should be given to growers that attend both workshops, complete assessments and demonstrate improvement, as an acknowledgment of effort.

Wholesale and transport sector engagement

- It is recommended that the Program Manager spends more time in the key markets to develop better relationships with the wholesaling sector. This will assist in facilitating feedback on specific quality issues in the market.

- Likewise engagement with the major transport companies is also important to achieve practice change. Difficulty in engagement with this sector is not specific to the avocado industry and there are a number of other horticultural industries that have identified quality issues related to transportation. Future investment might involve a multi-industry approach to improving product handling during transit.

Service provider engagement

- Maintain engagement with DAFF Queensland to ensure that the appointment of new staff will meet the needs of the Program. In lieu of this, identify alternate solutions to deliver this component of the Program should staff changes at DAFF Queensland not be satisfactory.

- Request DAFF Queensland to update to the report card template to include more supporting information

- Request DAFF Queensland to provide individual reports and action plans to supply chain businesses within 4 weeks of completion of assessment. These reports and action plans should also be copied to Avocados Australia for reporting purposes.

- Continue to develop the list of qualified service providers with suitable expertise across various fields related to avocado production and quality.

5.1.2 Infocado and OrchardInfo

The following recommendations are made in regard to the Infocado and OrchardInfo component of the Program:

Wholesale sector engagement

It is recommendation that Program Manager spends more time in the key markets to develop improved relationships with the wholesaling sector to assist in facilitating:

- Identification of avocado wholesalers

- General exchange of information

- Greater contribution of data to Infocado on a weekly basis

- The inclusion of more informed comment on market conditions on a weekly basis in Infocado
- Feedback on specific quality issues in the market.

Ongoing validation of Infocado and OrchardInfo

Continue to seek other data to validate Infocado and OrchardInfo figures including accessing carton manufacturer figures and other data from Central Market organisations such as Brismark Credit Service and FreshState.

Remote Sensing

The concept of using remote sensing has been researched and validated as part of this project. Further consideration is being given to how this might be advanced in a cost effect manner.

The avocado industry should consider different funding models to develop this technology within the sector. Apart from benefits in collection of industry data, there are significant on-farm benefits that individual production businesses can gain from access to this technology (as demonstrated in the pilot).

Other funding / investment models might include co-investment between industry and commercial enterprises or co-investment with other industries that have an interest in accessing similar information from similar regions in which avocados are grown, thereby resulting in sharing of costs of required for satellite imagery.

5.2 Recommendations on future investment in quality improvement

The recommendations provided in this section focus on future investment in quality improvement at the production and supply chain level beyond the scope of this Program (AV12012).

It is recommended that the industry continues to strive 'to increase percentage of fruit sold at retail level meeting consumer requirements from 75% to 90%'.[5]

Although bruising is considered the single most important post-production contributor to poor quality in avocado fruit and indications are that bruising mostly occurs at the retail store level[6], on-going improvement at the production/supply chain level is still considered extremely important. (Recommendations on quality improvement at retail level should be predominantly informed by the outcomes of AV10019, AV12009, AV11015 and AV12013).

To assist in achieving a 90% + level of fruit meeting consumer requirements it is recommended that investment is made in the following production and supply chain related areas:

Research and Development

- If a desktop review, as recommended in the previous section (5.1), identifies new supply chain assessment technologies that could assist the Australian avocado industry in assessing and monitoring conditions that affect fruit quality, consider appropriate investment in research that might be required to validate the technologies for use by the Australian avocado industry.

- Undertake further impact testing (using improved technology if possible – see recommendation above) to establish damage thresholds with avocados to determine impact and fruit conditions

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[5] Based on the '*Avocado Industry Strategic Investment Plan 2011-2015*'

[6] 'AV10019: Reducing flesh bruising and skin spotting in Hass avocado' and 'AV12009: Understanding and managing Avocado Flesh Bruising' (Due: Dec 2014)

which result in fruit damage in the supply chain and develop suitable recommendations to improve fruit handling practices and quality outcomes.

- Assesses a number of key avocado supply chains, from field to retail, to gain a greater understanding of key areas where fruit quality is negatively affected due to poor production and supply chain management practices. This assessment should consider both the physical attributes of the fruit and supply chain as well as the key decisions points (and available information on which decisions are made) in relation to fruit handling and supply management.

    Findings and case studies from this work should provide learnings and insights for other supply chains so that they might improve their supply chain management practices. Supply chain parties should be encouraged to co-invest in this work.

- Continue to develop appropriate tools that growers, packers, transport companies and wholesalers/ ripeners can use to optimise management of fruit through the supply chain.

Extension

- Maintain an industry engagement / extension program that focuses on areas where there is an identified requirement or opportunity to introduce improved skills or knowledge (based industry consultation, evaluation of industry performance, new research findings and / or new technologies) that could facilitate improved quality outcomes. It is recommended that that the content of the program is broadened from the current focus of Qualicado workshops to also include other factors influencing quality such as supply management and supply chain communications. Ideally, this program would support annual regional workshops (except in conference years).

- Develop a targeted transport industry engagement and education program, in conjunction with other relevant horticultural industries, to address common transit issues which impact on fruit quality.

- Consider a 'quality focused' study tour to look at operations that lead the horticultural sector in terms of quality systems e.g. Mission (California); Zespri (New Zealand) and how their processes might be adopted and adapted to improve quality outcomes for the Australian avocado industry.

Information

- Continue to deliver Infocado reports as this information is highly valued by industry and businesses within the industry.

- Continue to deliver OrchardInfo reports as this information is valued for medium and longer term industry and business planning

- Pursue remote sensing and other technologies that will assist in providing more accurate OrchardInfo data and potentially plant health data.

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- Mr Simon Newett, Principal Extension Horticulturalist, DAFF Queensland

- Mr Terry Campbell, Principal Extension Horticulturalist, DAFF Queensland

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