MacMan Stage 3

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Department of Employment, Economic Development & Innovation

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FINAL REPORT

MC03022

"MacMan stage III"

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Purpose

This report is an account of the methods used, results and lessons learned during the third stage of the MacMan project. This information may be useful to other individuals or organisations wishing to undertake a similar project of this nature.

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Disclaimer

Table of Contents

Media summary

The MacMan project has provided growers, processors and industry consultants with tools and services to more effectively manage macadamia production and to improve orchard productivity and efficiency. These tools and services were also designed to satisfy the food safety and quality management requirements of customers in the demand chain by providing product traceability from the processor back to the paddock.

The project's primary product, the MacMan software, was developed and delivered to industry during the first term of the project (1997-2000). A second project phase (2001-2003) was initiated to further the development and adoption of the MacMan software as well as establishing a network of industry best practice groups. Software updates were released during this phase to ensure that it continued to meet the changing needs of the Australian macadamia industry and users were fully supported with technical assistance and training.

A network of seven best practice groups was also established throughout Queensland and New South Wales during the second phase of the project. Meetings for each of these groups were facilitated either annually or bi-annually to suit the needs of members. Results were regularly summarised and reported to both best practice group participants and the wider industry.

The objectives of this third phase of the project (2004-2009) included expansion of the best practice group network and associated activities as well as on-going support of the MacMan farm recording system.

The best practice group network was expanded to 10 best practice groups and 209 participants, covering all major macadamia production regions. In addition to regular scheduled best practice group activities, additional events and networking opportunities have been provided, including regional tours, combined best practice workshops and specialised field days and farm walks.

Formal evaluation found that best practice groups were the most common source of useful information nominated by participants. Participants also made substantial changes to their farm practices compared to other growers, particularly in areas such as harvest management which had been a major topic of comparison and analysis.

The MacMan client base of over 350 users has been well supported during the latest project stage. Many software updates have been released, incorporating features requested by users as well as ensuring ongoing compatibility with new technologies and operating systems. Technical support and training has been provided as required to ensure uptake and effective on-going usage.

The Mac-Net e-mail discussion group continues to be actively used, with 246 subscribers by the end of the project. The discussion group has been used to discuss a wide range of industry related topics over the last ten years.

Technical summary

The Australian Macadamia Society commissioned the development of the MacMan farm recording software to help maintain and improve Australian macadamia orchard productivity and efficiency in an increasingly competitive world market. Food safety information required by processors and customers in the demand chain has also placed new product traceability demands on commercial growers.

The first stage of the MacMan project addressed these issues through the development of industry standard recording and reporting tools. The second phase of the project added the establishment of a network of industry best practice groups in major production regions. Further development and promotion of the MacMan farm recording software also encouraged wider adoption by industry members.

This third stage of the project focussed on expanding best practice group activities while providing on-going support to the existing MacMan client base.

The project steering group, comprising key members of industry, continued to guide all major project activities. In collaboration with this group, a further 13 MacMan software updates (three major and 10 minor) were developed during this project stage. The majority of these were based on client feedback, while some were required to ensure on-going compatibility with new operating systems and technologies.

A total of 376 MacMan users were listed as commercial clients by the end of this project stage. Of these, 337 are using the current major version (1.5). As client numbers remained relatively stable throughout this project term and many had already been exposed to training during previous stages, there was less demand for formal training during this stage. A total of 159 client businesses attended 49 training events during this stage for a total of 426 client hours of training.

Provision of technical support has remained important for the on-going use of the MacMan software. Over 970 requests for technical assistance were received during this stage of the project. More than 965 hours of support was provided to clients during this period, including site visits and technical assistance via phone or e-mail.

The best practice group network was expanded during this stage of the project with 10 best practice groups operating in all major Australian macadamia production regions. 79 best practice group activities were organised and 209 growers, farm management consultants, processor representatives and researchers participated.

Most group activities focused on meetings to compare and analyse management practices and results and to identify where improvements in productivity and efficiency could be made. Key issues to be addressed by individual groups were identified by group members. Processor representatives and researchers also participated in the meetings when issues relevant to them were addressed. Summary information from the meetings was presented at industry meetings and conferences and published in industry media.

Key issues addressed during best practice meetings included:

- Farm productivity (yield of nut-in-shell and kernel per hectare)
- Kernel quality
- Harvest management
- Post-harvest handling
- Crop nutrition
- Irrigation
- Insect pest management
- Disease management
- Rat management
- Canopy management
- Orchard floor management
- Economics of macadamia production
- Establishment and maintenance of new plantings.

Extra best practice activities were organised to maximise adoption of improved management practices. These included:

- A workshop of combined NSW best practice groups to increase sharing of knowledge in increasing farm productivity.
- Specialised field days and farm walks to provide hands-on knowledge and experience with management practices (e.g. canopy management and orchard floor management).
- A study tour by combined Queensland groups to analyse practices of leading growers in NSW (e.g. harvest management and post-harvest handling).

Best practice meetings were also organised annually for pest consultants involved in the Australian macadamia industry. The meetings provided an opportunity for pest consultants to share information with each other and researchers about pest and disease management and to be updated on the latest research.

Formal evaluation of all MacMan products and services, including the best practice groups, was conducted during this stage of the project. All the functions of best practice groups were rated very highly by participants. These included:

- Usefulness of best practice groups
- Generating ideas for discussion
- Sharing information
- Comparing and analysing practices
- Providing analytical skills.

Best practice group members made the greatest number of changes to their farm practices amongst all growers surveyed, particularly in areas such as harvest management which had been a major topic of comparison and analysis. Best practice groups were also identified as the most common source of useful information by members.

Introduction

In its strategic plan for 1996-1999, the Australian macadamia industry identified a number of research and development priorities to improve problems experienced by the industry. Associated with many of these priorities was the development of standardised tools and methods for recording and collecting industry information and statistics relating to pre and post harvest management and marketing of macadamia.

Quality management needs to be extended into the production sector to achieve full product traceability. Effective industry wide on-farm quality management programmes are required if the industry is to maintain its reputation for reliable, high quality product. The identification, promotion and adoption of optimum production practices are also essential if the industry is to remain internationally competitive.

The first stage of this project delivered a standardised set of recording and reporting tools to the Australian macadamia industry, the most significant of which was the MacMan farm recording software. This software assists growers at an operational level by giving them a simple but powerful system for recording and retrieving important information that is relevant to the management of their businesses. The system also satisfies the food safety requirements of customers in the demand chain by providing product traceability from processor back to paddock.

The Australian Macadamia Society recognised that the identification and adoption of best practices is how uniformly high standards of quality and production efficiency can ultimately be achieved within industry. To this end, a second project stage was supported in order to establish a network of industry best practice groups to capitalise on the data recorded by many of its members in the MacMan software.

Through best practice group work, the second stage of the project extended the benefits associated with good farm records to growers, processors, farm managers and consultants who were willing to share and compare their farm management information with others. The potential for growers to learn directly from other growers is evident through facilitated group activities, using common MacMan data as an objective basis for discussions.

This third stage of the project focussed on increasing the availability and impact of best practice activities within the industry. This process involved expansion of the existing best practice group network to include more participants and regions as well as provision of alternative events and meeting formats to widen the appeal of best practice activities among industry.

This stage also focussed on support and expansion of the MacMan software client base. This included on-going software development and the release of product updates in response to client feedback, as well as provision of formal training sessions and unlimited technical support.

Materials and methods

The methods employed in the execution of this project stage are based on experience gained during the previous two stages of the MacMan project. An industry steering group established during stage one continued to represent the macadamia industry throughout the life of the project, providing direct guidance and feedback to the project team. This included prioritisation of all development work associated with the MacMan software as well as trialling of best practice group activities.

Software updates

Client feedback has guided all software development and refinement throughout this project. Feedback has been sought via a range of mechanisms including direct client contact, focus groups and formal evaluation (2005).

All client feedback is documented and relayed to the MacMan steering group for prioritisation. Major program updates have subsequently been developed and released to industry every 1-2 years with minor / maintenance updates released in between as required. A total of three major updates and a further 10 minor updates have been developed during this project term. A detailed revision history for the MacMan software is shown in appendix A.

Other external drivers such as the macadamia industry approved supplier programme, the code of sound orchard practices and the on-farm economic analysis project have also influenced the on-going development of features and reports in the MacMan software to ensure that these initiatives are supported.

Since version 1.5.0.6 the MacMan software has been self-updating via the Internet. Users can search for and download updates from within the MacMan program. The MacMan software also automatically manages any structural updates required to ensure on-going compatibility with underlying database records.

Support, training and technology transfer

Support and training strategies implemented during the first and second stages of the project continued during this stage. These included formal group training sessions, training during best practice group activities and technical assistance via telephone, electronic mail and in some cases site visits. A dedicated mobile training unit comprising 8 notebook computers was used extensively to provide support and training to clients during this stage of the project.

Extension and technology transfer strategies included the MacMan web site, the Mac-Net electronic mail discussion forum and articles in each edition of the AMS news bulletin.

The MacMan project and associated products and services have been regularly showcased at annual macadamia conferences with project team members staffing information booths from 1997 through to 2007. Having achieved a high profile and strong adoption rates within the macadamia industry this approach is no longer used, although project team members have continued to attend all conferences and present summaries of best practice results.

Best practice groups

Industry comparative analysis was achieved through facilitated best practice group meetings. The project industry steering group comprising key industry members operated with the project team to develop and trial suitable formats for comparison and analysis within the groups.

The MacMan team facilitated 10 best practice groups in all major Australian macadamia production regions during this stage of the project. 79 best practice group activities were organised and 209 growers, farm management consultants, processor representatives and researchers participated.

The groups were formed on a regional basis to maximise commonality of interest. Groups operated in the Bundaberg, Gympie, Beerwah, Lismore, Nambucca and Atherton Tablelands regions. The Atherton Tablelands group no longer operates following the devastation of Cyclone Larry in March 2007 that led many of the growers in that region to leave the industry. Four groups operate in the Lismore region due to the large concentration of macadamia growers. This includes a group for larger growers in the Lismore region and a group facilitated in conjunction with the Macadamia Processing Company.

Growers were invited to participate in best practice group activities via industry meetings and media and via personal contact with members of the project team. Existing members were also encouraged to invite other growers to participate. Growers needed to be willing to share their results and information to be able to participate and to respect the confidentiality of other members' data outside the meeting. Protocols to protect individual data confidentiality were also developed by the project team. Only summary information was published or presented outside the meetings.

Group participants recorded their farm results and management practices in the MacMan farm recording software or other farm recording systems (computer and/or paper based). Prior to each meeting, participants sent their relevant information to the MacMan team. Standard data collection sheets were developed by the MacMan team for use by those participants not using the MacMan software. The data was then validated and compiled for comparison and analysis during the meeting. The summary information from all the groups was also compiled for regular publication and presentation to the industry.

The industry project steering group developed an overall agenda for best practice group meetings based on improving productivity and efficiency. Key issues identified by group members were also addressed by individual groups. Processor representatives and researchers also participated in the meetings when issues relevant to them were addressed. Topics addressed during the best practice meetings included:

- Farm productivity (yield of nut-in-shell and kernel per hectare)
- Kernel quality
- Harvest management
- Post-harvest handling
- Crop nutrition
- Irrigation
- Insect pest management
- Disease management
- Rat management
- Canopy management
- Orchard floor management
- Economics of macadamia production
- Establishment and maintenance of new plantings.

Each best practice group met annually or bi-annually depending on the needs of the group. Extra best practice activities were also organised to maximise adoption of improved management practices. These included:

- A workshop of combined NSW best practice groups to increase sharing of knowledge in addressing farm productivity.
- Specialised field days and farm walks to provide hands-on knowledge and experience with management practices (e.g. canopy management and orchard floor management).
- A study tour by combined Queensland groups to analyse practices of leading NSW growers (e.g. harvest management and post-harvest handling).

The MacMan team also facilitated the annual macadamia pest consultants meeting. This is a best practice group organised for pest consultants involved in the Australian macadamia industry. The purpose of the meeting is to provide an opportunity for pest consultants to share information with each other and researchers about pest and disease management and to be updated on the latest research. These meetings were held each year prior to the commencement of the macadamia pest monitoring season in September.

Formal evaluation

A formal evaluation of the MacMan products and services was conducted in August 2005. The purpose of this evaluation was to review project progress to date, to guide future development and gain some understanding of the extent of practice change that can be attributed to the MacMan project.

The evaluation was conducted by telephone in conjunction with independent project evaluation consultants. The Bennett's hierarchy of evaluation approach was used to measure outputs across a range of levels including activities, attitudes, knowledge, practice change and outcomes.

Thirty-five Australian macadamia growers were surveyed, representing a cross-section of the industry for orchard size, location and management system. The sample set included the following groups:

- Best practice group members
- MacMan software users who are not best practice group members
- Growers who are not MacMan users and who are not best practice group members
- Growers with out-of date copies of the MacMan software
- Members of the MacMan-net e-mail discussion group who are not MacMan users.

Both detailed and summarised survey results were published in 2005. A copy of the evaluation summary is included in appendix B.

Through the identification of high priority issues relating to the MacMan software, support & training and best practice group work, the findings from this evaluation have guided subsequent development, support and extension strategies throughout the remainder of the project.

Results

MacMan software

Three major and 10 minor software updates have been produced during this stage of the project. A detailed revision history is included in appendix A. Significant updates include:

- Support for multiple enterprises
- Improved nut tracing facilities and consignment delivery reports
- Addition of irrigation recording and reporting
- Enhanced harvest recording tools including support for machinery
- Updates to factory results, including addition of commercial grade recording
- New facility for users to build their own custom reports
- Improved stock inventory management
- A range of new reports and charts including combined rejects, harvest yield summaries, shed reject trends, factory results trends, timesheets, combined outputs and planting & production statistics
- Updates to many existing reports and charts including cost of production, employees, jobs, factory results, labour, harvest, variable costs, elemental applications, nut storage estimates
- A facility to search for and install program updates via the web
- Support for Windows Vista and Windows 7

A total of 470 clients purchased the MacMan software during the project, with 153 sales (33%) in this third stage alone. A total of 376 users were still regarded as current clients at the end of this project stage. The remaining 94 users who purchased the software are no longer using it for a variety of reasons as shown in table 1 below.

Client attrition	% of total sales
Retired or sold the farm	6.8%
Deceased	0.4%
Not using MacMan or using an alternative system	3.8%
Unknown (unable to contact)	8.1%

Table 1 Client attrition information

Of the 376 clients listed at the end of the project, 337 have either purchased or updated to the latest version of the program during this project stage, so this number perhaps more closely reflects the number of clients who actively use the software.

Figure 1 shows a summary of software sales for each year of the project. It also shows the number of clients who are still listed as active at the end of the project, according to the year in which they purchased the software. The total clients whose MacMan software was current (i.e. version 1.5x) at the end of the project is also shown to provide some measure of ongoing usage.

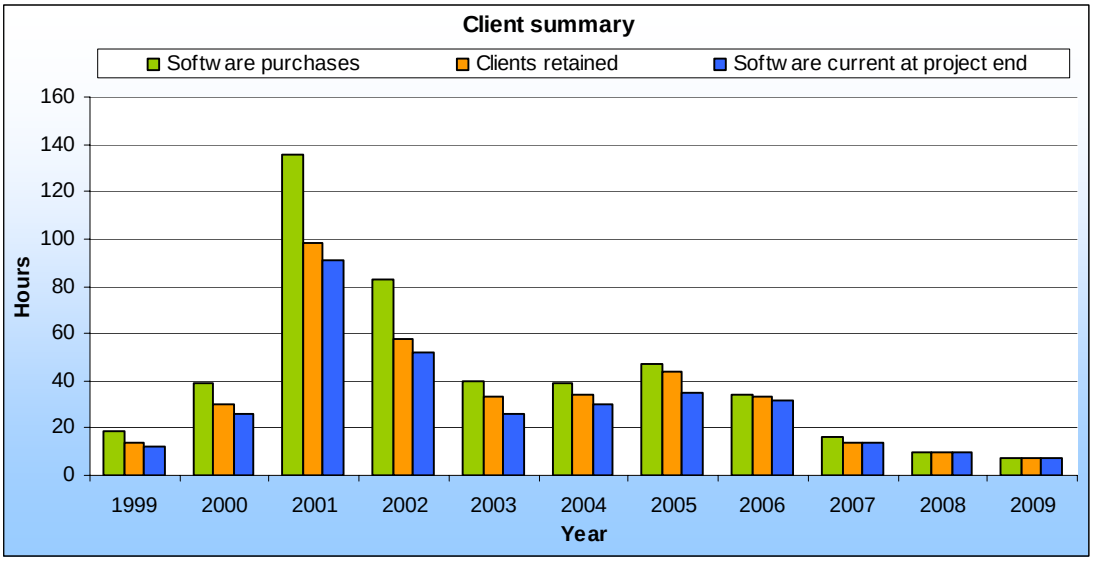

Figure 1 **MacMan sales and usage by year of purchase**

An analysis of MacMan client data was conducted to determine typical usage patterns. A total of 32 datasets were sourced from data submitted to the project team during the last 12 months, either for the purpose of technical support or for best practice analysis. The criteria for inclusion of data in the sample included evidence of on-going program usage and recent data entry. A breakdown of the most commonly used sections in MacMan and the average number of records kept is shown in table 2 below.

Usage of MacMan features (based on a sample of 32 client datasets)		
Program section	Proportion of clients using this section	Average number of records per data set
Factory results	97%	116
Jobs	94%	2611
Harvests	91%	945
Post harvest handling	78%	445
Weather monitoring	66%	1160
Pest monitoring	53%	242
Variable costs	50%	826
Time sheets	31%	4784
Growth cycles	13%	64
Leaf or soil monitoring	6%	45

Table 2 MacMan feature usage

As in previous project stages, the most popular sections of the program are orchard jobs, factory results, harvests and weather. Some clients now have extensive records spanning many seasons and this information is proving valuable, both for individuals to produce seasonal trends as well as for best practice group activities.

Table 3 shows additional agronomic information from the data sets that were analysed.

MacMan data set information (based on a sample of 32 client datasets)		
Criteria	Average per data set	Total for all data sets
Farms	2.5	80
Blocks	12.8	409
Plantings	37.7	1207
Trees	18579	594541
Hectares	55.9	1789

Table 3 MacMan data set information

Training and support

Over the life of the project a total of 321 macadamia businesses have received training in the use of the MacMan software, 101 in this third stage. A summary of training hours, sessions, businesses and attendee counts for the third project stage is provided in figure 2 below.

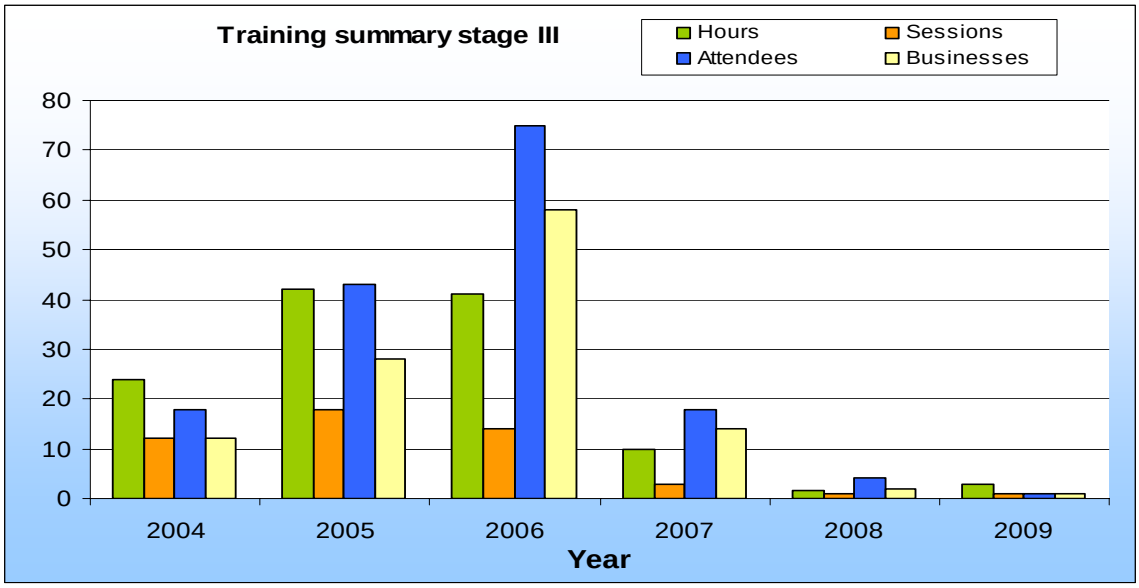

Figure 2 Training summary for stage III of the project

The chart shows the strong emphasis placed on training in the first half of this project stage (2004-2006). In the latter half of the project, as software sales decreased, demand for introductory training declined accordingly. The reduction in formal training sessions in these latter years also reflects increasing emphasis on best practice group activities in general and particularly their use as a forum for providing follow-up training to clients as required. In a survey of best practice group participants, 10% of respondents indicated that learning to use MacMan effectively was a major benefit of attending best practice group meetings. As a result, best practice group meetings were routinely used to provide MacMan software training during the later years of the project. Training provided during best practice group sessions is not included in the estimates shown above.

Detailed information about formal training sessions provided throughout the whole project is shown in table 4. Individual on-site training proved effective during this project stage in getting many new users started with the MacMan software. Much of the training activity shown in the latter years of this third stage relates to this on-site training. This also explains why a similar number of training sessions were provided in the second and third project stages but fewer businesses were trained. Where on-site support and training has been provided, priority has been given to those who have indicated an interest in joining a best practice group.

Training and on-site support	Stage I	Stage II	Stage III	Total
Total training sessions delivered	31	49	49	129
Businesses that have attended one or more training sessions (including repeat attendance)	212	236	115	563
Total training attendees (including repeat attendance)	332	302	159	793
Total hours of training delivered	148	176	122	446

Table 4 Training summary for each stage of the project

Technical support has been provided free of charge to all registered MacMan clients throughout the project and a total of 237 clients have requested support on one or more occasions during that time. A total of 1087 support calls were logged during the project, which is an average of 2.9 calls per client. Since tracking of support call times commenced in 2003, an average of 1.2 hours of support per client has been recorded. Of those who requested support, an average of 1.97 hours has been provided.

A summary of support hours and calls during the third stage of the project is shown in figure 3. The peak years for support were 2004 to 2006, which is consistent with the relatively high number of MacMan sales during this period. Following a decrease in 2007, demand remained fairly stable for the remainder of the project term, which is consistent with the relatively static client base during this period.

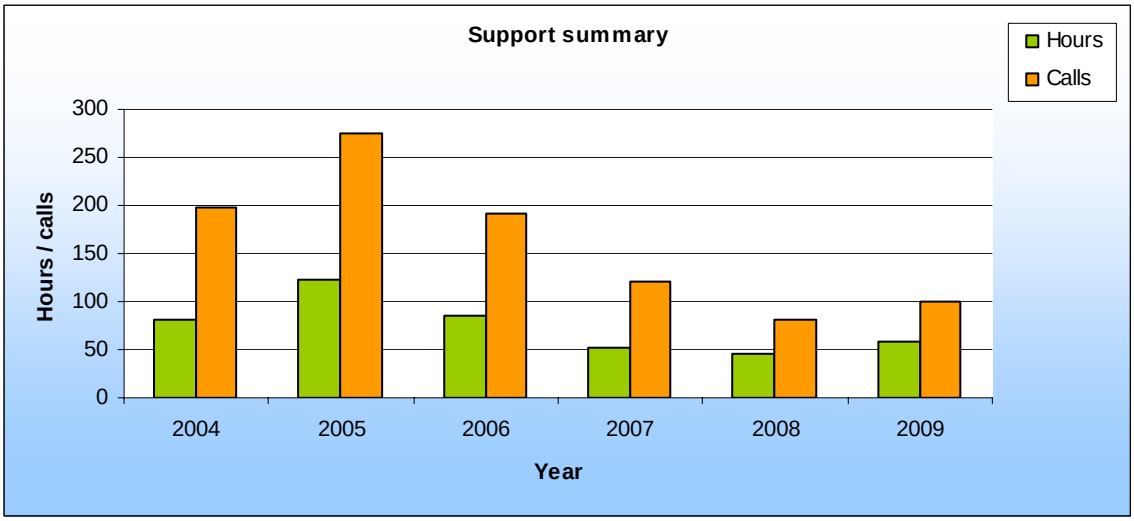

Figure 3 Support hours and calls in the third project stage

Throughout the project, the average response time for user support requests received via e-mail was less than one business day and typically much less for those received during normal business hours.

Best practice groups

The MacMan team facilitated 10 best practice groups during the third stage of the project from 2004 to 2009.

Table 5 shows the number of best practice group activities conducted during each year of the third project stage. There were a total of 79 activities, which included best practice group meetings, specialised farm walks and field days, a combined group workshop and a combined group study tour of leading orchards. Some best practice group meetings included a field component to further analyse farm management practices.

There were more activities each year from 2004 to 2007 than in 2008 and 2009 due to the absence of a NSW DPI macadamia extension officer as part of the MacMan team for much of this latter period. This was rectified with a new appointment in late 2009. The combined group workshop and study tour and specialised field days were all conducted in 2008 and 2009 as a way of meeting the learning needs of a wider cross section of growers.

Year	Number of best practice group activities
2004	14
2005	15
2006	14
2007	15
2008	11
2009	10
Total activities	**79**

Table 5 Number of activities during each year of the third stage of the project

Table 6 shows the number of best practice activities conducted with each group during the third project stage. The groups met annually or bi-annually depending on the needs of individual groups.

Most groups were organised on a geographical basis. Four groups operate in the Lismore region due to the large concentration of macadamia growers in that area. This includes a group for larger growers in the Lismore region and a group facilitated in conjunction with the Macadamia Processing Company. The Atherton Tablelands group no longer operates following the devastation of Cyclone Larry in March 2007 that led many of the growers in that region to leave the industry. The project industry steering group comprising key growers and consultants operated as a trial best practice group, particularly during the early part of the project stage. It had an important role in the development and trialling of best practice group formats.

A combined workshop of NSW best practice groups was facilitated by the MacMan team in 2008. The workshop provided an opportunity for growers from each of the groups to share knowledge and experience with each other and key researchers about improving farm productivity. This was identified by the growers as a key issue to be addressed.

A combined study tour of Beerwah, Bundaberg and Gympie growers to NSW was facilitated by the MacMan team in 2009. The tour was organised to study management practices of leading NSW best practice group members. This included harvesting and post-harvest handling techniques to improve kernel quality, and canopy management and orchard floor management practices to improve farm productivity, efficiency and sustainability.

Group	Number of best practice group activities
Alstonville	8
Atherton	5
Beerwah	10
Bundaberg	7
Gympie	10
Lismore	9
MPC	6
Nambucca	7
Rosebank	10
Steering group	5
Qld combined groups	1
NSW combined groups	1
Total activities	**79**

Table 6 Number of activities with each group in the third stage of the project

Table 7 shows the number of participants in best practice group activities during this project stage. Growers and farm management consultants were the primary target audience for the best practice group activities. Processor representatives and researchers were invited to participate when relevant topics were addressed.

The best practice groups provided an ideal opportunity for researchers to extend the results of their work. For example, the best practice group meetings held in November and December 2009 were focused strongly on extending the results of the "Macadamia kernel quality – understanding brown centres and other kernel quality defects" project.

Category	Number of best practice group participants
Growers or consultants	193
Processor representatives	9
Researchers	7
Total participants	**209**

Table 7 Analysis of number of participants in the third stage of the project

Table 8 shows the home region of growers and farm management consultants who participated in best practice group activities. Some growers and consultants attended more than one group to enable them to compare and analyse their practices with a wider range of other participants. The largest number of growers was from the Lismore region. This is a reflection of the large concentration of macadamia growers in that area.

Region	Grower or consultant participants
Atherton	9
Beerwah	35
Bundaberg	20
Gympie	29
Lismore	85
Nambucca	15
Total growers/consultants	**193**

Table 8 Number of best practice group participants by region in the third stage of the project

All of the functions of best practice groups were rated very highly by participants during the formal evaluation conducted during this stage of the project. These included:

- Usefulness of best practice groups
- Generating ideas for discussion
- Sharing information
- Comparing and analysing practices
- Providing analytical skills.

Harvest management was the area most commonly nominated where involvement in best practice groups contributed to changes in practices. The effect of harvest management frequency on nut quality and profitability has been a major topic of comparison and analysis. Other areas where involvement in best practice groups has commonly contributed to change include:

- Shed and storage management
- Fertiliser management
- Orchard floor management
- Irrigation management
- Farm record keeping and decision making.

Best practice groups were the most common source of useful information nominated by participants during the evaluation. However, it is important to note that best practice group members gather information from many sources before deciding to change management practices and the groups are just one of these sources.

Members of the MacMan team also facilitated the annual macadamia pest consultants meeting. Six meetings were organised which were attended by 44 pest consultants, farm management consultants, researchers, processor representatives and extension practitioners. Key issues addressed at the pest consultants meeting included:

- Annual review of pest management season
- Advancing Integrated Pest Management project results and developing pest problems
- Evaluation of macadamia nutborer egg parasite rearing
- Macadamia husk spot and other disease research
- Investigations into the causes of internal discolouration of macadamia kernels
- Rat management in macadamias
- Recording systems for pest consultants in macadamias
- The future of endosulfan and other chemicals in macadamias
- Area wide pest monitoring of macadamia nutborer.

Discussion

The MacMan software

Sales of the MacMan software reached a plateau in the latter half of this stage of the project, as shown in figure 1 in the results section. This was not unexpected given the strong adoption rates achieved during earlier stages of the project and the shift to emphasis on best practice group activities in this latest project stage.

With 470 software sales achieved, it is considered unlikely that significant increases in adoption rates are likely in the future. Emphasis should continue to be placed on supporting the existing client base to ensure effective on-going record keeping and to support best practice group or benchmarking activities.

The MacMan software remains a viable solution for those who require simple but comprehensive desktop recording and reporting facilities. It allows macadamia producers to record substantial relevant farm business information as well as produce a wide range of reports and analyses to help them monitor performance over time. It also provides traceability to enable growers to track issues and meet their legal reporting obligations.

With the emergence of several new technologies such as portable devices, cloud computing, GIS and precision agriculture, there are many directions that future software development could potentially take. There are however other commercial tools and systems available in the market place that provide functionality in these areas so further development work of this nature within the MacMan project is generally considered unnecessary at this point. The feedback processes used to determine client priorities throughout the project have resulted in products that are specifically targeted to the needs of the majority of existing clients and this approach is recommended as a suitable guide for any future development.

Support and training

Technical support remains important to the on-going use of the MacMan software among industry. As effective use of the MacMan system is the basis for collection of data for ongoing industry comparative and economic analysis work, it is very important that MacMan users continue to be supported. The project team has effectively managed provision of technical support for existing MacMan clients and is well placed to continue to do so. Demand for technical support is now relatively stable and is not expected to change significantly unless major changes are made to the MacMan software.

Formal training sessions have provided a cost effective way of introducing new clients to the software and they should ideally continue to be provided for this purpose where sufficient demand and resources exist. As with previous project stages, priority should ideally be given to new clients and those involved with best practice or industry benchmarking activities.

On-site support is an effective albeit more costly method of increasing adoption and improving software usage skills. The cost of providing on-site support can be minimised if skilled support staff are available in both Queensland and New South Wales.

Best practice groups

The number of best practice groups, activities and participants was expanded during this stage of the project as planned. There are now best practice groups operating in all major Australian macadamia production regions. Most groups met annually or bi-annually depending on the needs of individual groups.

The project industry steering group played an important role in the development and trialling of best practice group formats. These were used as the basis for the meetings with each of the groups. The system allowed sufficient flexibility for individual groups to also identify key issues to be addressed at the meetings.

The range of best practice group activities was also expanded to suit the needs of participants. Combined group workshops, specialised farm walks and field days and study tours were organised as well as the standard comparative analysis meetings. Many best practice group meetings included a field component to add to the comparison and analysis of farm management practices. The increased range of activities enabled the MacMan team to greatly expand the number of participants attracted to best practice.

The best practice group meetings were an opportunity to provide training in the use of the MacMan farm recording software. This also provided an opportunity for users of the program to provide feedback to the MacMan team in further program development requirements.

Data collection and validation is a key component of successful organisation of best practice group meetings. The level of on-farm recording varies considerably amongst macadamia growers, depending upon their perceived needs and benefits. The development of standard data collection templates made it easier for a greater number of macadamia growers to provide their information and enable them to participate.

Best practice group activities provided an ideal forum for researchers to extend project results and recommendations. Researchers were invited to participate in meetings where key issues (e.g. improving farm productivity or kernel quality) were identified to be addressed. The information from the comparison and analysis of grower practices and results was also important in providing communication back to the researchers.

Processor representatives were also involved in best practice group activities, particularly in relation to issues relevant to their work (e.g. improving kernel quality). One of the best practice groups is organised by the Macadamia Processing Company in conjunction with the MacMan team. Processor representatives play an important extension role in the Australian macadamia industry due to the regular individual contact with each of their suppliers.

There is still scope to substantially expand best practice group activities and participation. The increased involvement of people with an important extension role in the macadamia industry (e.g. processor representatives and industry development officers) offers potential for achieving this within the limited resources of the MacMan team.

The evaluation found that the best practice groups were very successful in achieving their planned functions (e.g. sharing information etc). Best practice group members also made the greatest number of changes to their farm management practices compared to other growers. These practice changes were mainly in areas which had been a major topic of comparison and analysis within the groups (e.g. harvest management). Best practice groups were the most common source of useful information nominated by participants. The groups have been formed on the concept of growers learning from other growers' experiences. Since other growers were a major source of information for all surveyed groups, it can be seen that the best practice groups have met this learning style in the macadamia industry.

Technology transfer

Technology transfer remains a key component of this project. The following technology transfer activities were undertaken during this stage of the project.

Best practice groups

The MacMan team facilitated 10 best practice groups during the third stage of the project from 2004 to 2009. There were 79 best practice group activities organised involving 209 participants. Most of these participants participated in several best practice group activities. The breakdown of numbers of activities and participants is shown in tables 5 to 8 in the results section.

Summaries of key best practice group results and recommendations were regularly published in the AMS news bulletin. Annual best practice group summaries were also produced and published for the industry from 2005 to 2009.

Formal training sessions

Training sessions were delivered in Queensland, News South Wales and Western Australia. Table 9 shows details of the number of sessions and attendees in each of these states. These sessions included formal group activities as well as individual on-site training and support sessions with business owners and managers.

Region	Sessions	Attendees
Queensland	39	51
New South Wales	18	66
Western Australia	4	4
Total	**61**	**121**

Table 9 Formal training sessions by region

MacMan web site

Fewer resources have been directed to updating the MacMan web site during this project stage. This is due to the fact that fewer new clients are seeking program information and the MacMan software now includes more integrated web-based facilities such as downloadable program updates and links to relevant information such as e-mail addresses, web sites and the program revision history.

Mac-Net e-mail discussion group

The Mac-Net electronic mail discussion group has been maintained during the project to allow those associated with the macadamia industry to network. This discussion forum has provided a service that its members have used for discussion of a wide range of topics relevant to macadamia farm management. Despite the fact that unreachable clients are automatically removed from the list periodically, membership has continued to grow each year, with 247 members registered at the end of this project stage.

AMS news bulletin articles

A regular MacMan news column was published in each edition of the bi-monthly AMS News Bulletin. The regular column was used to inform clients of project progress and to disseminate summarised key findings from best practice group meetings. Throughout the third term of the project, 37 articles were published in the AMS news bulletin.

Other reports and presentations

In addition to regular reports in the AMS news bulletin, a further 12 reports were produced for industry and Horticulture Australia Limited during this term of the project. These included annual project reports, summary findings from best practice group activities and findings from the formal project evaluation in 2005.

In addition to the many presentations made during best practice group activities and field days throughout the project, over 14 formal presentations were delivered at a range of industry and scientific events. These include annual industry conferences, international macadamia conferences, Asia-Pacific Extension Network conferences and workshops, macadamia science seminars and pest consultant meetings. The MacMan team has demonstrated the MacMan software and best practice summary results at the majority of industry conferences during the project term. Display booths have often also been staffed to enable clients to interact with the project team, provide feedback and assess program updates.

Recommendations

On completion of the third second stage of the MacMan project, the following recommendations are offered:

Best practice and industry benchmarking

Avenues for continued expansion of the best practice group network, activities and participants within the resources of the MacMan team need to continue to be explored. This includes on-going identification of key issues to be addressed and working closely with others providing extension services to the Australian macadamia industry. Expanding the flexibility and range of best practice group activities will help meet the learning needs of a larger number of participants.

The benefit of using best practice groups to communicate results and recommendations of their work needs to be continually demonstrated to researchers involved in the macadamia industry. This will not only improve the adoption of research recommendations but will also provide valuable feedback from growers and consultants to the researchers.

Industry benchmarking needs to be expanded. At present, summary results from the best practice groups are presented at industry meetings and published in industry media (e.g. AMS News Bulletin). Great scope exists for the expansion of collection, analysis and reporting of data for benchmarking use by individuals and the industry. This will also enable growers and consultants to participate who do not necessarily wish to belong to a best practice group.

MacMan software

The MacMan software should continue to be supported through training and technical assistance to ensure that new and existing clients continue to use it effectively, particularly in support of industry benchmarking and best practice activities.

Feedback should continue to be sought from existing software users to guide any further development as required. It is expected that further development would be minor, incremental and geared towards on-going usage rather than significant change. Any future development requests should continue to be assessed in consultation with an industry steering group that can represent the needs and opinions of the wider industry and MacMan client base.

Training and support

Training and support should continue to be provided to new and existing clients to ensure effective adoption and to provide a sound basis for industry best practice and benchmarking. Our intention as a team remains to provide a high level of support to all of our clients. Priority should continue to be given to those clients who are associated with best practice groups and industry benchmarking.

Acknowledgements

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Rod Fayle	(Product evaluation and feedback)
Lesleigh Kerr	(Former steering best practice group member)
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Tim Salmon	(Former steering group member)
Lindsay Bryen	(Former steering best practice group member)

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Industry report, Department of Employment, Economic Development and Innovation, January 2010.

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HAL annual report, Department of Primary Industries and Fisheries, Queensland, April 2009.

AMS news bulletin articles

Best practice group update and factory results recording in MacMan.
January 2004, Volume 31, Number 1.

Best practice group summaries from 2003 end of season meeting round.
March 2004, Volume 31, Number 2.

Cost of production feature and best practice group trends from 2002-2003 season.
May 2004, Volume 31, Number 3.

Best practice group production trends.
July 2004, Volume 31, Number 4.

New MacMan features including factory results trend chart, new chart of accounts and variable cost recording
September 2004, Volume 31, Number 5.

Best practice group shed and factory reject trends and reject analyses and the AMS statistics report facility in MacMan
November 2004, Volume 31, Number 6.

Best practice group yield and kernel recover trends and key findings from the 2001-2004 seasons.
January 2005, Volume 32, Number 1.

New MacMan features including the pre-season delivery report and useful contents on the MacMan CD
March 2005, Volume 32, Number 2.

Best practice group findings, including the effect of crop inputs on yield and quality and discussion of some useful MacMan features
May 2005, Volume 32, Number 3.

Recording chemical usage and harvest rejects; Comparing harvest machinery.
July 2005, Volume 32, Number 4.

Orchard performance; Fertiliser application; Husk spot preparation; Ethephon sprays.
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MacMan training roundup
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Getting started / Recording harvest yields by block
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Can you improve your yield and quality results?
March 2007, Volume 34, Number 2.

How do your inputs compare?
May 2007, Volume 34, Number 3.

Crop input trends / comparing harvester efficiency.
July 2007, Volume 34, Number 4.

How profitable is macadamia growing?
September 2007, Volume 34, Number 5.

Financial planner for macadamia / MacMan best practice group meetings.
November 2007, Volume 34, Number 6.

Improving your yield and quality improves your profitability
January 2008, Volume 35, Number 1.

Where are your losses occurring?
March 2008, Volume 35, Number 2.

Maintaining profitability in hard times
May 2008, Volume 35, Number 3.

Grower feedback shaping financial planner for macadamia
July 2008, Volume 35, Number 4.

Have you joined MacMan-Net yet?
September 2008, Volume 35, Number 5.

Drying and storage critical for managing brown centres
November 2008, Volume 35, Number 6.

Soil health and surface management important for orchard productivity
January 2009, Volume 36, Number 1, pp28-30.

Best practice study tour by Queensland growers to leading farms
March 2009, Volume 36, Number 2, pp34-35.

How do changes in yield, kernel recovery, costs and price affect your bottom line?
May 2009, Volume 36, Number 3, pp31-33.

Consultants gather to improve pest and disease management.
July 2009, Volume 36, Number 4, pp29-30.

Leasing vs financing of equipment.
September 2009, Volume 36, Number 5, pp40-41.

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Macadamia pest scouts meeting. August 2007.

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Macadamia industry science seminar, Brisbane. June 2009.

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Asia Pacific Extension Network conference, Western Australia. December 2009.

Appendix A

MacMan software revision history

Version 1.6 (includes 1600 to 1602, currently being tested prior to industry release in early 2010)	
New features	
1	Optional job reference numbers added to job recording / browsing / reporting.
2	New AMS news facility via the web – integrated into main window (subject to steering group approval)
Updates	
1	Optional printing of notes added to job chemical report.
2	Revised layout for spray diary report.
3	Optional water source name added to job recording / browsing / reporting.
4	Updated layout for factory results reports for less paper and clearer separation of sections
5	Version history available via web link in About box
6	Improvements to AMS statistics report to ensure exported / e-mailed statistics always include planting and production information
Fixes	
1	Folder icons on main window were reversed (open vs closed).
2	Updated calculation of total shed rejects to avoid errors when saving under different regional codes (e.g. Brazil)
3	Updated field cursor in post harvest handling browser to ensure correct position in browser after editing PHH record.
4	Reject analysis data lost after editing PHH record unless reject window was explicitly opened – fixed.
5	Updates to weighted averages in factory results reject calculations to avoid inaccuracies. Now weighted by relative unsound kernel weight rather than NIS @ 10% weight.

Version 1.5.0.7 released 25/02/2009	
Updates	
1	New web locations and support file names for program updates via the web
Fixes	
1	Typo in enterprises window

Version 1.5.0.6 released 18/02/2009	
New features	
1	Consignment code added to harvest browser, revise NIS tool updated to support assignment of consignment code, new filter option by consignment code in browser and reports.
2	New stock on hand information displayed in job chemical window, with before and after stock estimates.
3	Exporting of planting statistics (in XML format) for upload to the AMS web site.
4	Program self-update facility with checking for availability of program updates via the web.
Updates	
1	Updates to table language conversion facility to cope with long directory paths
2	Prevention of entry of reserved characters in various program sections
3	Consignment delivery report now supports tracing of nuts using consignment code via harvest records as alternative to post harvest handling data. This works in conjunction with the new consignment code field in the harvest section.
4	Improved logic associated with job date setting (start and end dates)
5	New glyphs in main window
6	New date selector controls throughout
Fixes	
1	Corrected re-opening of data tables following close of enterprise management section
2	Fixes to retrospective editing of job rates and ingredients to correct limitation that caused some chemicals to be skipped where multiple chemicals were applied as part of a single job
3	Updates to clearing of fields in timesheets section
4	Retention of nut in shell and harvest code information when harvest recording window re-opened via job recording checklist
5	Fixes to warning shown when cancelling recording of factory results to avoid overriding existing user selections

Version 1.5.0.5 released 30/08/2007	
New features	
1	Program now handles data updates internally (version 1.4 onwards) and will prompt for and manage structural database updates as required.
2	Program is self-registering following installation
Updates	
1	Support for Windows Vista (includes new file/data paths)
2	Enhancements to enterprise management section with more tools added for managing enterprises and associated data sets
Notes	
Windows Vista support requires data files to be stored in new locations, often with a much longer file path than previous versions. Version information in some older MacMan database files may require updating in order to function correctly with long data paths. A facility has been included in the enterprise management section for this purpose if required (see Tools, Update table version).	

Version 1.5.0.4 released 22/07/2007	
Fixes	
1	Updates to report templates for water sort report to correct access violation for some users

Version 1.5.0.3 released 01/06/2007	
New features	
1	Facility to record GST as part of contractor inputs in the labour inputs section of the job recording checklist
Updates	
1	Full support for Windows Vista (including new data paths)
Fixes	
1	Change to network control file location for basic Windows Vista compatibility.
2	Weather chart updated to avoid problem filling list of years available for charting when invalid weather date entered.

Version 1.5.0.2 released 31/07/2006	
Updates	
1	Last backup path is now saved between backups
Fixes	
1	Fixes to apportioned harvest recording via jobs checklist to avoid reverting to relative proportions after re-editing values.
2	Correction to auto backup & send facility to ensure serial number is correctly read for each separate enterprise
3	Post-harvest handling re-link facility to rectify “search for next unlinked record” function works as expected in all cases
4	Date of last backup is now correctly read during fresh installation to avoid access violation under some circumstances.

Version 1.5.0.1 released 23/06/2006	
New features	
1	Run time packages now used to reduce EXE footprint & download time
Fixes	
1	Auto-complete facility disabled during recording of activity level in pest monitoring section to avoid unwanted characters.
2	Default farm selection where only single farms present removed to allow users with multiple farms to select “ALL” option to report across farms.

Version 1.5.0.0 released 04/05/2006	
New features	
1	Enterprise switching facility allows use of multiple separate data sets
2	Harvest yield trend chart
3	Harvest yield summary reports
4	Shed reject trend chart
5	Factory results reject chart
6	Post harvest handling sorting chart
7	Timesheets report
8	Facility to e-mail reports and charts (automatically create mail message and attach report of chart for sending)
9	Colour theme support for all charts
10	New farm, block & planting tree view for data entry
11	Retrospective updating of chemical information associated with recorded jobs
12	Combined outputs trend chart
13	Advanced menu item in post harvest handling browser to update links between PHH and reject analysis records
14	New fields added to factory results section to allow Kg of kernel to either be calculated automatically or entered manually if supplied by processor (eg Suncoast Gold)
15	New variable cost categories report
Updates	
1	Updates to labour analysis, harvest and variable costs charts, including customisable settings for number of points displayed.
2	Nut storage estimates facility algorithm now searches forward for more accurate estimation.
3	Updates to elemental application report to display rates per tree and per hectare.
4	Harvest detail report updated to include yield per tree and per hectare.
5	Harvest recording now supports apportioned data entry with new Kg equivalent box as alternative to %.
Fixes	
1	Date filtering in irrigation report fixed.
2	Machine and method filtering added to harvest yield report.
3	Minor update to factory results trend chart to fix scaling on X axis under some circumstances.
4	Planting update reminder intervals now reset correctly in all cases.
5	Report header information is now refreshed correctly each time a new enterprise (or the program) is opened.
6	QA checklists removed due to limited demand and problems integrating with multiple enterprises.

Version 1.4.0.1 released 02/11/2004	
Updates	
1	Variable costs now support entry of negative dollar amounts for accrual accounting
Fixes	
1	Factory reject analysis records updated to avoid rounding when reject analysis present, which could cause problems during data entry.
2	Some help file links updated (eg team contacts)

Version 1.4.0.0 released 22/10/2004	
New features	
1	New variable costs group field added to allow broader filtering of variable costs.
2	New variable costs data entry window to allow multiple entries in single session.
3	CSV import facility to allow cashbook data to be imported into variable costs section.
4	Irrigation volume added to job recording and reports.
5	Withholding period added to chemical recording in jobs section.
6	New fields for optionally recording harvest method (hand/machine) and machinery hours.
7	New field for activating/deactivating employees as required.
8	New report for currently selected employee & revised layout for data entry.
9	Factory results – commercial grade added to data entry / browsing / reporting.
10	New combined rejects report including belt, water and air rejects.
11	New menu link to PDF manual.
12	New AMS statistics report including plantings and historical production statistics.
13	Updated / simplified notes templates facility.
14	New preference to manually refresh browsers (for advanced/network users).
15	New minimum resolution standard (800x600) throughout program with design updates to suit.
16	New custom report generator to allow users to build their own reports on demand.
17	Support for external report templates (separate from program).
18	New report archive facility to allow users to save / load reports on demand – includes report archive manager.
19	Optional confirmation message when saving records.
Updates	
1	Integrated variable cost categories facility to replace external categories.
2	Variable costs chart updated to allow grouping of data by cost group.
3	Major update to chemical selection window when adding/editing jobs.
4	New layout in jobs browser.
5	Commercial grade added to factory results recording / browsing / reporting.
6	Revised harvested NIS adjustment with rounding of Kg estimates to nearest whole Kg for amounts > 100Kg.
7	Cost of production report can now be saved to a file & can also display costs per tonne of NIS.
8	Amended variety x tree chart facility to include grid showing tree numbers and corresponding tabular report.
9	Test search facility added to all report preview windows.
10	All charts can now be fully customised by users on demand (by double-clicking on charts).
11	Overhaul of stock inventory to calculate stock on hand in real time for more accurate stock management.
12	Withholding period now visible in chemicals section.
13	Browsers now refresh beneath data entry windows even when they remain open.
Fixes	
1	Fixes to editing of existing water quality records.
2	Fixes to setting of end date via keyboard rather than date selector.
3	Delivery report updated to better handle nuts harvested, handled & consigned on the same day.

Appendix B

Summary of MacMan evaluation

Summary of

The evaluation

of

MacMan

Products and Services

2005

Executive summary

This evaluation of the MacMan products and services was conducted to review progress of the MacMan project and to help plan future developments. The evaluation also sought information on sources of useful information on macadamia farm management and changes in farm or business management practices.

Thirty-five Australian macadamia growers were surveyed. The growers represented a cross-section of the industry for orchard size, location and management system.

Sources of farm management information

Other farmers and the AMS News Bulletin were the two most commonly nominated sources of information in this survey. Other farmers were largely seen as an informal source of a wide range of information. The AMS News Bulletin was valued particularly as a source of technical information.

Best practice groups were the most common source of useful information nominated by best practice group members. Best practice groups have been formed on the concept of growers learning from other growers experiences. Since other growers were a major source of information for all surveyed groups, it can be seen that the development of best practice groups has met this learning style in the macadamia industry.

Training courses, consultants, MacGroups, AMS meetings and conferences, field days and seminars, processors and books were also nominated as common useful sources of information.

Changes in farm and business management practices

There have been substantial changes in farm or business management practices within the last 5 years.

Orchard floor management was the area where growers have made the greatest amount of changes. This has been strongly targeted by the macadamia industry in recent years and demonstrates the benefit of the industry extension and communication strategy in this area in achieving practice change.

Other common areas where growers made major changes in their practices were:

- Shed and storage management
- Harvest management
- Fertiliser management
- Farm recording and decision making

Best practice group members made the greatest number of changes. Growers who were not best practice group members and who were not MacMan software users made the least number of changes. The proportion of changes in harvest management, shed and storage management and fertiliser management, was higher amongst best practice group members than amongst all the other groups. All best practice group member respondents who irrigate had changed their irrigation management practices. The major change in farm recording and decision making has been the adoption of the MacMan farm recording system.

Canopy management was the most common area where respondents had learned something new but had not yet implemented any change. This was partly due to orchards being too young or to the perception of mixed messages as to the best canopy management approach.

This is in contrast to orchard floor management where the greatest number of changes has occurred, something the industry has pushed strongly and with simple messages, (e.g. plant groundcovers).

Best practice groups

All of the functions of the best practice groups were rated very highly by members. These included:

- Usefulness of best practice groups
- Generating ideas for discussion
- Sharing information
- Comparing and analysing practices
- Providing analytical skills

"*It's the ultimate to compare facts and figures of farms, locations and costs. It is the driver for our improved cost changes."* (Macadamia grower discussing best practice groups)

Harvest management was the area most commonly nominated where involvement in best practice groups has contributed to changes in practices. The effect of harvest management frequency on nut quality and profitability has been a major topic of comparison and analysis. Other areas where involvement in best practice groups has commonly contributed to change include:

- Shed and storage management
- Fertiliser management
- Orchard floor management
- Irrigation management
- Farm record keeping and decision making

It is important to note that BPG members gather information from many sources before deciding to change management practices and the groups are just one of these sources.

Several suggestions have been received about how we can continue to improve best practice groups to make them as useful as possible and to encourage participation. Where possible, many of these have now been implemented.

MacMan farm recording software

The survey participants had a high level of computer use compared to the average for Australian farmers. Most of the growers in the survey use a computer for business and for other interests, particularly e-mail. Best practice group members had the highest median (median is defined as the number in the middle of a given set of numbers) computer use for business. BPG members also had the highest median use of the MacMan software.

The median proportion of the time spent using MacMan in data entry is 90%. Only 10% of the time for each group is spent in data analysis. An increase in the level of data analysis would enable MacMan users to get a great deal more benefit out of the software.

The sections of the MacMan software most frequently used are:

- Jobs
- Harvest yields
- Factory results
- Post-harvest handling
- Chemicals

- Pests

Most MacMan users frequently use these sections and find them very useful.

Most MacMan users rated the MacMan software as being extremely useful in helping them analyse their farm data and make business decisions.

"It's our farm diary. If it's not recorded in MacMan we wouldn't have a record of what we have or do - it's critical for our business." (Macadamia grower discussing the farm recording software)

Those users who gave the MacMan software a lower rating for usefulness for helping them analyse their farm data and make business decisions were mainly those who used it less. Most commonly, this was with growers with orchards only starting to produce.

BPG members nominated the greatest number of changes to their management practices where their use of the MacMan software has contributed to the change. Many made these changes in conjunction with their involvement in the best practice groups. There tends to be a strong relationship between the groups and the software with both important in affecting changes in management practices amongst the members. The information recorded in MacMan is often only part of the decision making process about practice change.

Suggestions were received on improving MacMan to make it more useful. Some of these have been included in version 1.5 to be released in 2006.

A range of reasons were given by some respondents as to why they did not use the MacMan software. These include:

- Don't use computers
- Use another recording system
- Farm size too small
- Young orchard – A number of respondents with young orchards were keen and planning to start using MacMan when their orchards started to bear.
- Perceived time required for data entry.

MacMan software training and support

All areas of training and support rated as extremely useful by most respondents who had received them.

Interaction and the hands-on nature of training were seen as positive points about formal training workshops. The formal workshops have been sufficient for some people to start effectively using MacMan. An important issue is that growers attending a training session need to use their new skills as soon as possible otherwise they will have difficulty remembering what they have learned.

One to one on-site training and support was seen as useful for getting people started and for solving problems.

Support via e-mail and telephone were seen as useful for solving problems quickly and for explaining things in layman's terms.

Many of the respondents did not believe that they would benefit from further training and support at this stage. These respondents were satisfied with their current use of the software.

There was interest in learning about upgrades to the software. As a result, formal training will be offered to all MacMan software users with the release of the next version in 2006. Respondents who replied that they would benefit from formal training sessions preferred the workshops for the interaction. Some respondents replied that they would benefit from on-site training and support as this enabled them to deal with specific issues.

The evaluation found that formal training sessions, on-site training and support, and e-mail and telephone support are all important and as a result, they will all continue to be provided.

MacMan-net e-mail discussion group

Nearly all BPG members are members of the MacMan–net e-mail discussion group. However, many of the other respondents were not members and many were not aware of the discussion group. There is potential for the discussion group to be more widely used in technology transfer in the industry.

Most of the members of the discussion group read most of the e-mail messages but some topics are not relevant to them. Only 25% of the respondents who are members will e-mail a question if they have one or reply to someone else's message. For the group to thrive, a greater percentage of members need to be encouraged to post a question or reply.

Most respondents saw MacMan-Net as part of the information gathering process rather than being the major contributor to changes in farm management.

MacMan website

Few respondents had visited the MacMan website. Most of the respondents who visited the website seeking information had found the information easy to find. All respondents who attempted to download a MacMan update from the website had found it very easy to do so. The MacMan website is currently doing the job that it is intended to do. However, the potential for expansion of its use needs to be investigated.

Further information

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Appendix C

Summary of MacMan best practice group results (2001-2009)

A Summary of

MacMan

Best practice group results 2001 to 2009

Acknowledgements

The authors would like to thank the macadamia growers and managers who have provided data for use in this summary of results.

We would also like to acknowledge the funding and support for the MacMan project from the Australian Macadamia Society, Horticulture Australia Limited, Department of Employment, Economic Development and Innovation, Queensland, and New South Wales Department of Primary Industries.

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Contents

Introduction

MacMan is a joint project between Department of Employment, Economic Development and Innovation, Queensland, and New South Wales Department of Primary Industries and is supported by the Australian Macadamia Society and Horticulture Australia Limited.
There are currently 9 MacMan best practice groups (BPGs) spread across all major Australian macadamia production regions in Queensland and New South Wales (See figure 1). Formation of the groups started in 2001. The groups compare and analyse their yield and quality results and management practices. Each group decides its own priorities and individual grower data is confidential. The groups offer macadamia growers the opportunity to benchmark their performance and to learn from other growers' knowledge and experience using a structured and facilitated format.

An evaluation of MacMan products and services in 2005 found that the best practice groups were the most common source of useful farm management information nominated by the BPG members. BPG members had also made a greater average number of changes in their farm and business management practices in the last 5 years than the rest of the Australian macadamia industry.

Figure 1. Location of MacMan best practice groups and major Australian production regions

This document presents a summary of key performance indicator results from the BPGs from 2001 to 2009 and describes major changes in post-harvest handling, harvest, crop nutrition, crop protection, irrigation, orchard floor and canopy management practices.

Yield trends

Figure 2 shows the average nut-in-shell (NIS) yield trends from 2001 to 2009 of mature bearing orchards from the best practice groups in Bundaberg, Gympie, Beerwah, Lismore and Nambucca districts. The Lismore data is a compilation of results from members of 4 best practice groups in the Lismore district

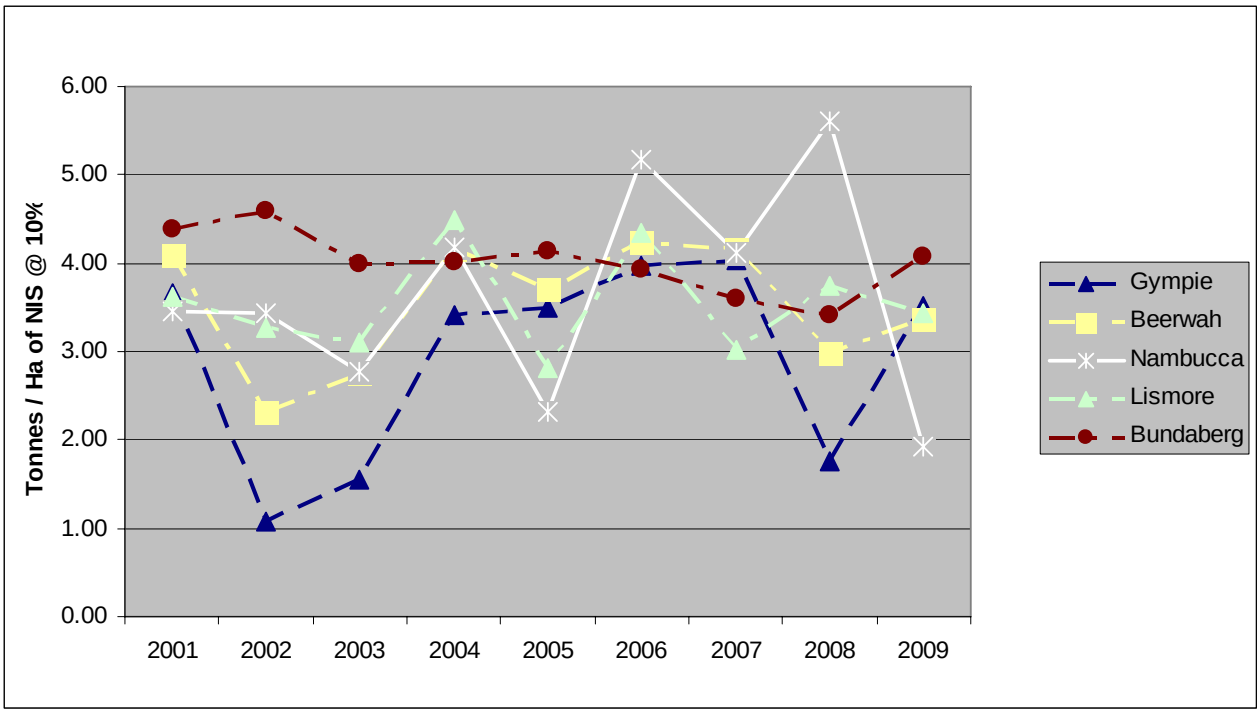

Figure 2 Yield trends per hectare 2001 to 2009

Crop load from the previous season, tree health, climatic conditions (for example, rainfall and temperature) and management practices (for example, irrigation and canopy management) have a major effect on the following season's crop.

The average NIS yield from all the farms was down in 2008 (3.5 tonnes per hectare at 10% moisture content) and 2009 (3.3 t/ha) compared to 3.7 t/ha in 2007 and 4.2 t/ha in 2006. 2009 saw an improvement in average nut-in-shell productivity compared to 2008 from the Bundaberg, Beerwah and Gympie farms and a reduction in productivity from the Lismore and especially the Nambucca farms, largely due to adverse climatic conditions.

The Bundaberg farms have maintained the most consistent yield at about 4 t/ha amongst the different regions from 2001 to 2009, largely due to the greater control over farm management inputs such as water and fertiliser. Bundaberg was the only region where the farms averaged greater than 4 tonnes NIS per hectare in 2009. The pattern of alternative years of heavy and light crops in many of the NSW orchards has been in place since 2003.

Table 1 shows the monthly rainfall totals at the Maroochy Research Station in Nambour from 2001 to 2009. These totals are indicative of the rainfall pattern in south-east Queensland and northern New South Wales during this period. Wet conditions during the first half of 2009 caused major difficulties with the start of 2009 harvest season.

Table 1 Monthly rainfall 2001 to 2009 DEEDI Maroochy Research Station, Nambour

	2001	2002	2003	2004	2005	2006	2007	2008	2009
January	129.1	119	14.4	253.8	153.2	372.6	111.4	303.5	118.8
February	200.4	114.2	794.2	203.9	62.6	166.4	296	276.8	194.7
March	88.8	103.8	160.3	294.2	31.2	195.8	97.4	89.7	196.1
April	86.6	106.9	167.7	182.7	202.3	11.8	25	42.4	452.2
May	17.8	123.9	156.4	3.3	113	55.1	91.8	103.2	193.4
June	50.9	153.8	25	14.4	186.2	88.4	150.4	307	166.6
July	63.3	3.2	76.7	0.3	20.6	48.6	8.4	183.8	12
August	10.2	150.6	86.4	6.8	44	56.8	365.4	0.7	6.6
September	26.8	18.6	10.8	31.8	36.8	157.2	144	128.8	14.2
October	22.5	73.4	110	78.8	108.2	28.7	64.4	51.2	82.6
November	192.2	99	60	192	143.9	73	104.2	296.5	65.8
December	68.5	187	160.3	259.6	173.6	57.4	218.7	60	112.5
Total	**957.1**	**1253.4**	**1822.2**	**1521.6**	**1275.6**	**1311.8**	**1677.1**	**1843.6**	**1615.5**

Quality trends

Figures 3, 4 and 5 show the sound (or premium), unsound (or reject) and total kernel recoveries from mature bearing farms from the best practice groups from the different macadamia growing regions from 2001 to 2009. The average sound kernel recovery (SKR) either decreased or remained steady in 2009. The farms in the Lismore region recorded the largest average decrease (from 33% in 2008 to just over 30% in 2009).

The average unsound kernel recovery (UKR) increased in 2009 amongst the farms in the Bundaberg, Gympie, Beerwah and Lismore regions and remained steady at 1.9% amongst the farms in the Nambucca region. There was also an increase in the average level of commercial (or manufacturing) kernel recovery in 2009, particularly amongst farms in the Lismore region.

The average total kernel recovery (TKR) remained relatively steady in 2009 amongst farms in the Bundaberg, Gympie and Beerwah regions and decreased amongst farms in the Lismore region (from 38.1% in 2008 to 36% in 2009) and the Nambucca region (from 41.7% to 38.9%). The higher average SKR and TKR amongst farms from the Nambucca compared to the other regions are largely due to the higher proportion of “A” series varieties in these farms.

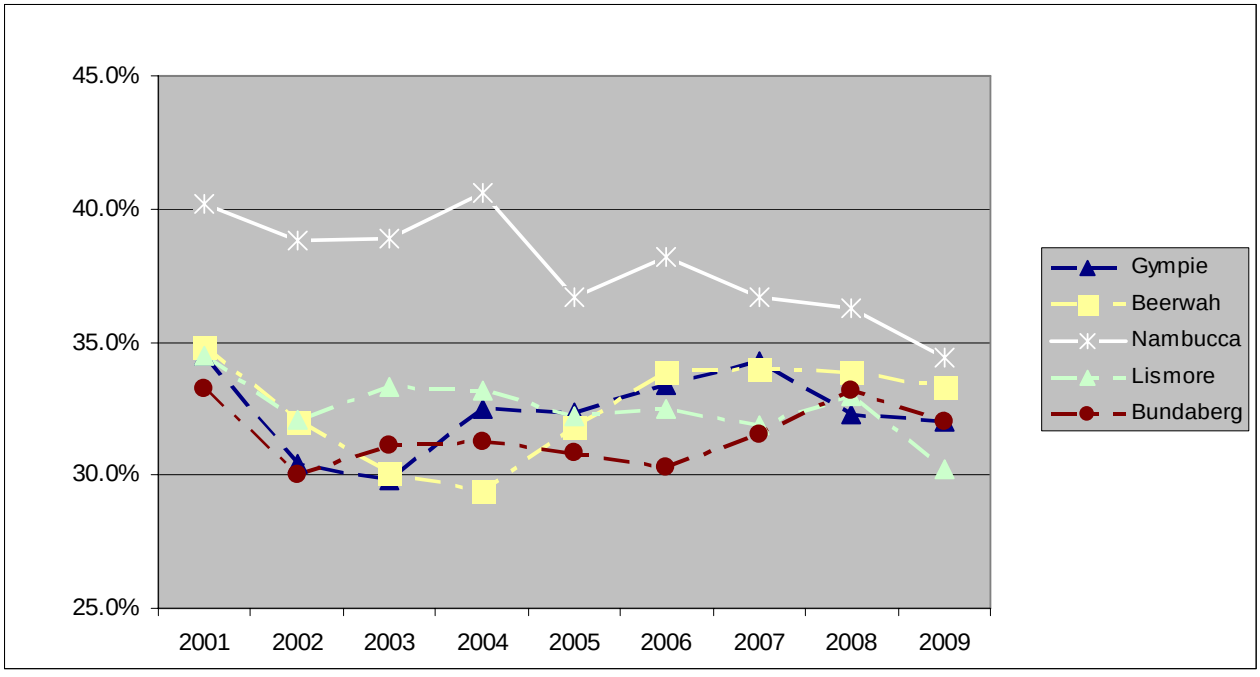

Figure 3. Sound kernel recovery trends 2001-2009

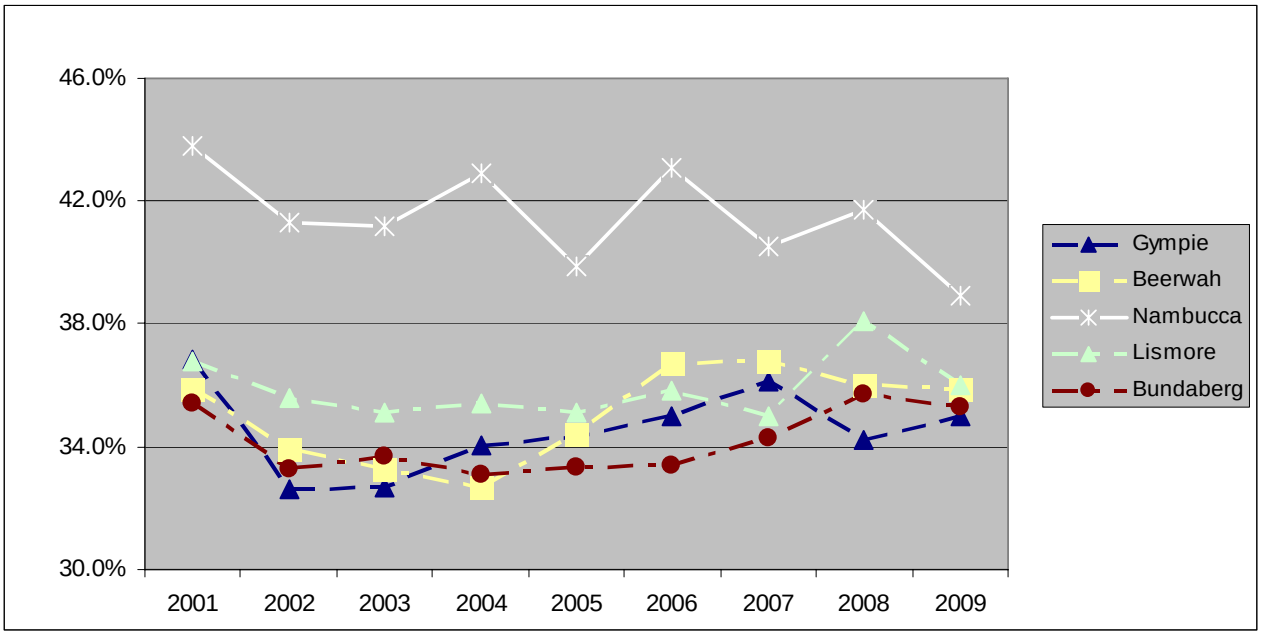

Figure 4. Total kernel recovery trends 2001-2009

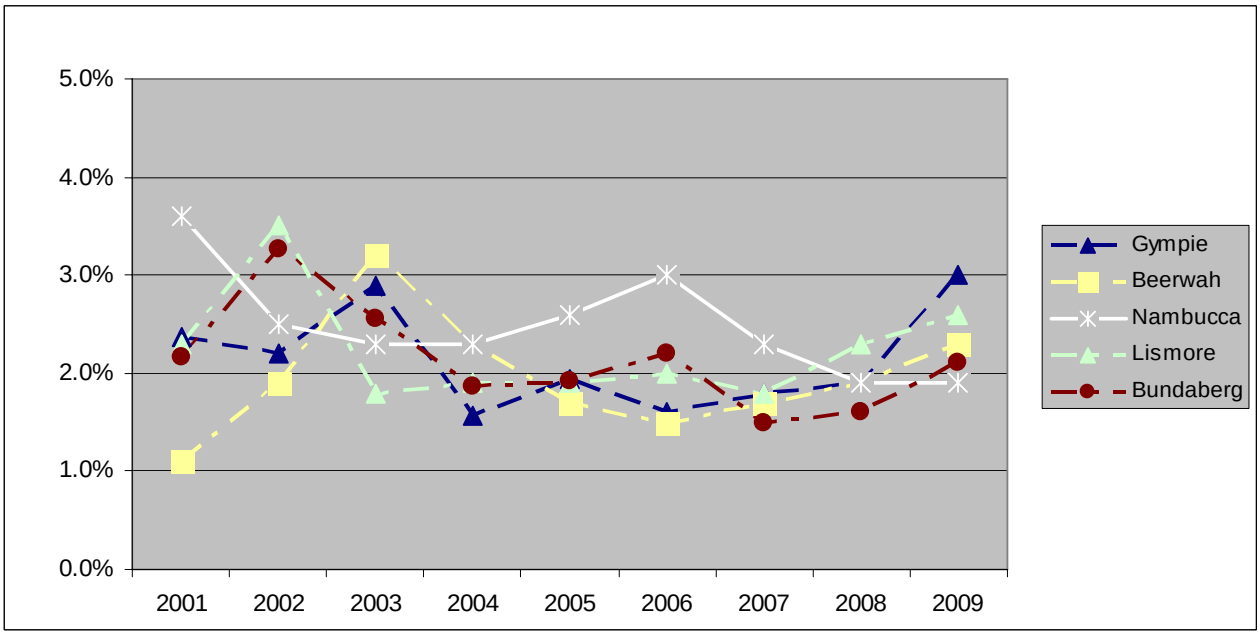

Figure 5. Unsound kernel recovery trends 2001-2009

Figure 6 shows the average total kernel yield from mature bearing farms from the best practice groups from the different macadamia growing regions from 2001 to 2009. There was an increase in average total kernel yield amongst the Bundaberg, Beerwah and Gympie farms in 2009 and a decrease amongst the Lismore and Nambucca farms. The average total kernel yield from 2001 to 2009 was most consistent amongst the farms from the Bundaberg region. Bundaberg was the only region where the farms averaged a total kernel yield greater than 1.2 tonnes per hectare in 2009.

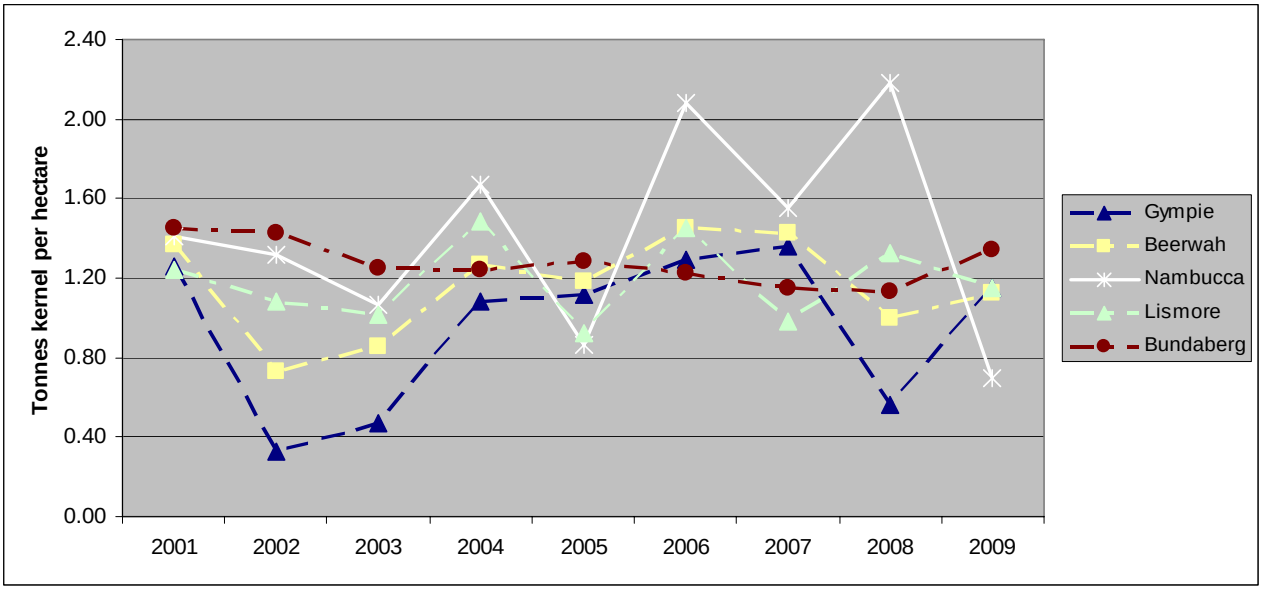

Figure 6. Total kernel yield trends 2001-2009

Shed and factory reject trends

Figure 7 shows the average amount of nut-in-shell (NIS) that was rejected from 2001 to 2009 during sorting in the shed or at the factory, as a percentage of the total tonnage harvested from 15 farms. These represent a cross section of farms within the MacMan best practice groups for location, size, and management system in Queensland and New South Wales.

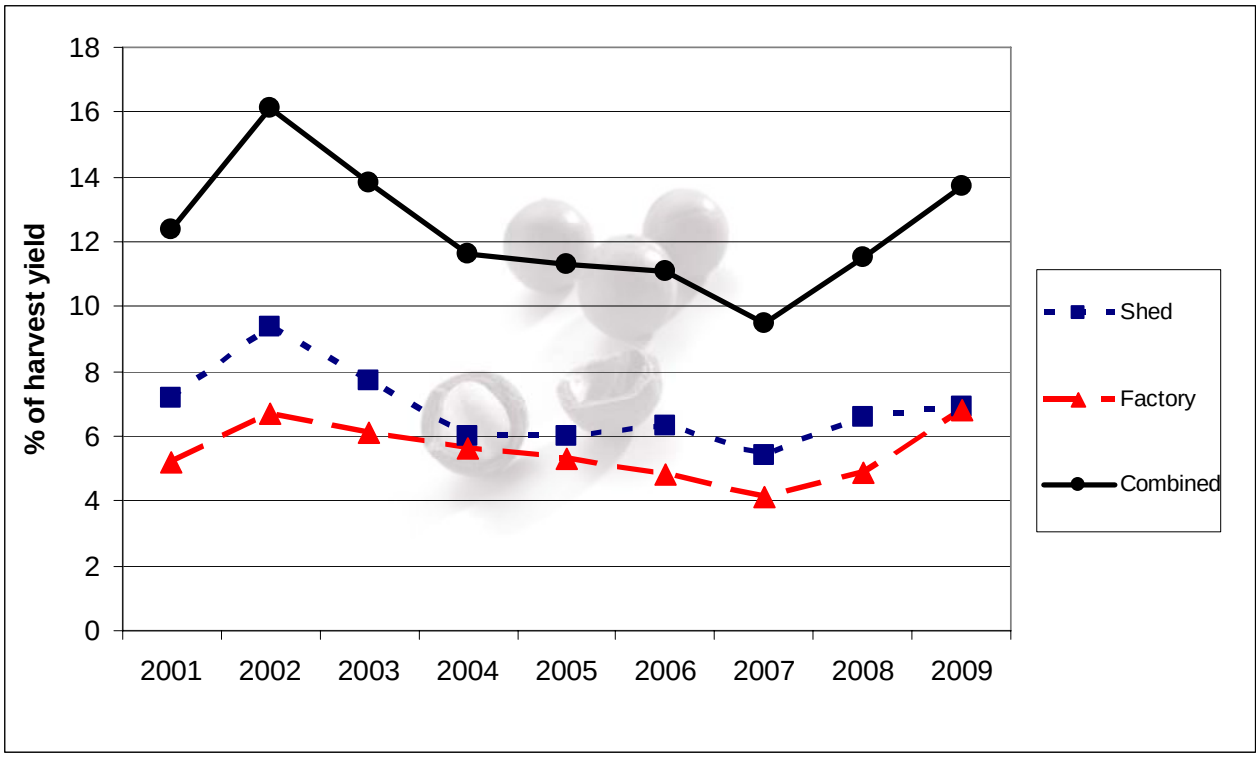

Figure 7. Shed and factory rejects as a percentage of the harvested yield 2001-2009

The average amount of nuts that were rejected in the shed (this includes belt, water and/or air sorting) in 2009 was equivalent to 6.9% of the harvested yield. This means that an average of 6.9 kg NIS was discarded for every 100 kg harvested. There was a reduction from a peak of 9.4% of the harvested yield in 2002 to a low of 5.4% in 2007. These reduced levels were due to climatic conditions and changes in management practices. Changes in management practices include reducing the harvest interval and upgrading post-harvest handling equipment to reduce the time spent drying and storing the nuts. Adverse weather conditions during harvesting led to an increase in shed rejects during 2008 and 2009.

For the same group of 15 farms, the average unsound kernel recovery delivered to macadamia processors in 2007 was 1.52%. This was equivalent to 4.1% of the NIS harvested yield. There had been a steady reduction since the factory reject level peaked in 2002 at 6.7% of the harvest yield. The adverse weather conditions during harvest also lead to increased factory rejects in 2008 and 2009 to 4.9% and 6.8% of the harvest yield.

When the reject levels are combined in figure 5, an average of 9.5% of the harvested yield of NIS was rejected in the shed or at the factory in 2007 for the 15 farm sample. This compares to 16.1% of the harvested yield in 2002 and 13.7% in 2009. A loss of 16% corresponds to almost 1 in 6 nuts being rejected in the shed or factory (and probably more as unsound kernels usually weigh less than sound kernels). This also does not include nuts that are lost prior to and during harvest.

Shed and factory reject analysis

Figures 8, 9 and 10 show the average shed reject analysis for the same 15 farms from 2003 to 2009. This includes nuts rejected during belt, air and/or water sorting. It is important to note that these are averages and some farms vary considerably from these averages. Figure 8 shows the reject categories as a percentage. Figure 9 shows the tonnes of NIS per hectare for each reject category. Figure 10 shows the tonnes of NIS for each reject category per tonne harvested.

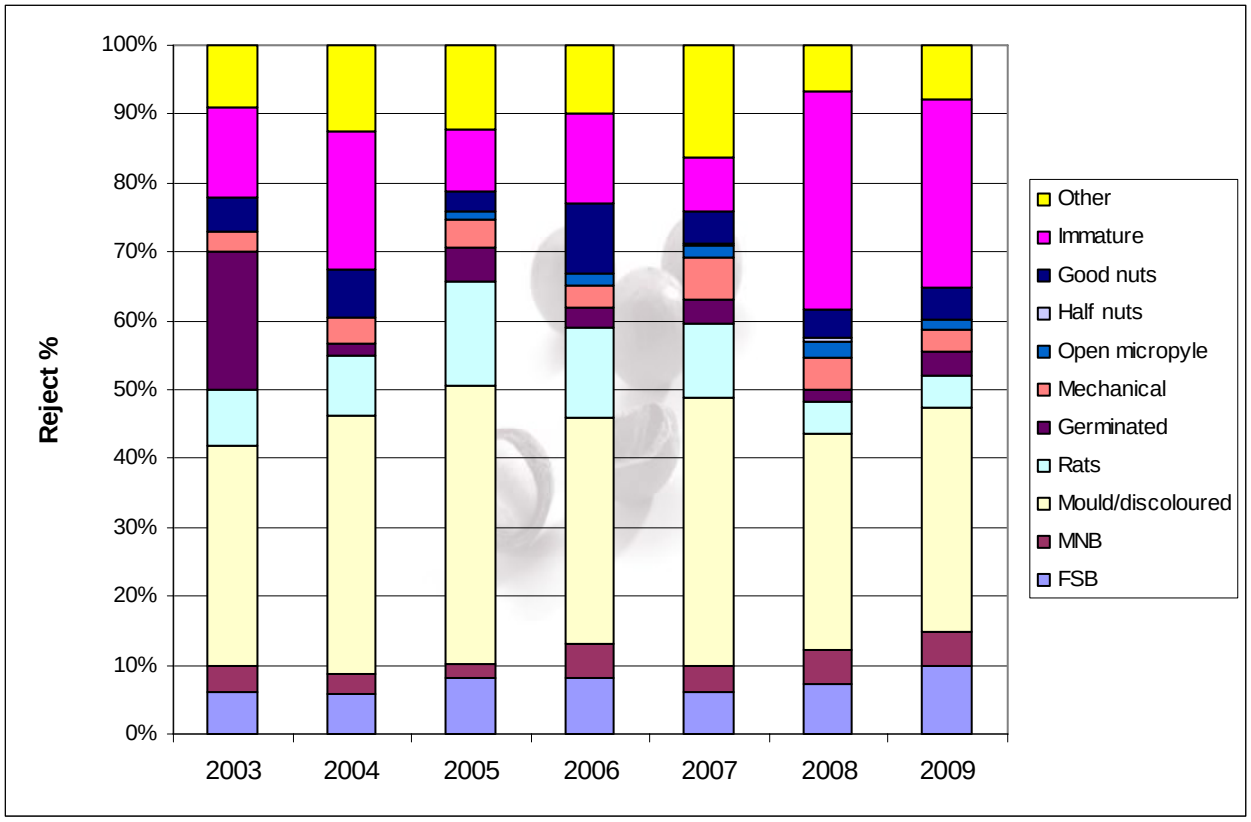

Figure 8 Shed reject analysis (belt, water and air sorting) 2003-2009

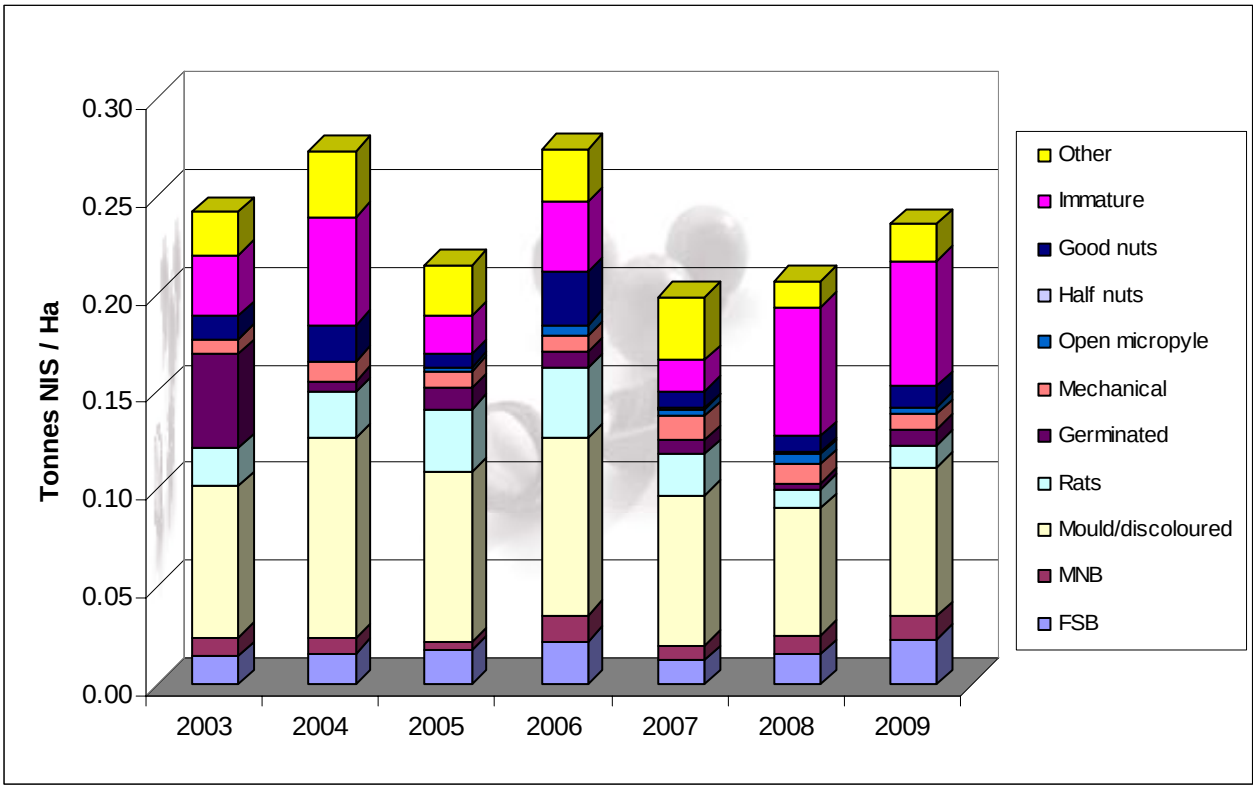

Figure 9 Shed sorting rejects showing tonnes NIS per hectare 2003 to 2009

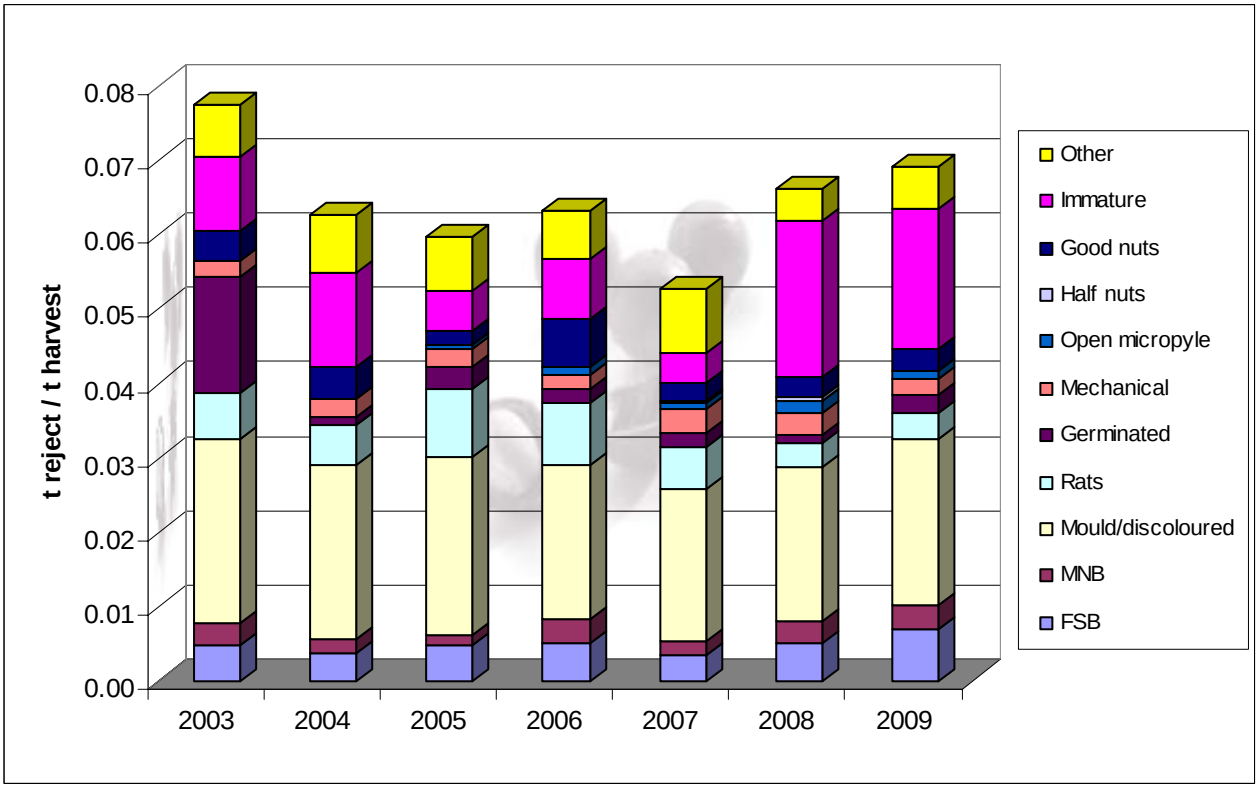

Figure 10 Shed sorting rejects showing tonnes NIS per tonnes harvested 2003 to 2009

Major trends in the shed reject levels include:

- Discolouration and mould has consistently been the major reject category at over 30% of losses in all 7 years. Although the percentage of rejects due to discolouration and mould decreased from 38% in 2007 to 31% in 2008 and 32% in 2009, the amount rejected per tonne harvested stayed steady at just over 20 kg in all 3 years due to the increased level of total shed rejects in 2008 and 2009.
- Rats have been a major problem in many orchards in recent years. The average level of rejects due to rat damage in 2008 and 2009 was only 4.8% in both years compared to 15% in 2005 and 13% in 2006. This is equivalent to 10 and 11 kg/ha rejects due to rat damage in 2008 and 2009 compared to 36 kg/ha in 2006 and 33 kg/ha in 2005. This does not take into account losses due to rat damage prior to harvest. The reduced rat damage levels have largely been due to intensive rat management programs
- Good nuts accounted for only 4.6% of sorting losses in 2009 compared to 10% in 2006. This was mainly during water and air sorting (equivalent to 11 kg/ha in 2009 compared with 27 kg/ha in 2006).
- Losses due to immaturity during shed sorting increased to 32% and 27% in 2008 and 2009 compared to 7.7% in 2007 (equivalent to 66 and 64 kg/ha in 2008 and 2009 compared to 16 kg/ha in 2007). Husk spot has been a major contributor to these increased losses due to immaturity.

The protocols for measuring crop loss were developed by Neil Treverrow (NSW DPI) and are available via the AMS website (www.macadamias.org) or from the AMS office in Lismore.

Figures 11, 12 and 13 show the average factory reject analysis for the same 15 farms from 2003 to 2009. Once again, these are average figures and many of the orchards vary considerably from these orchards. Figure 11 shows the reject categories as a percentage. Figure 12 shows the tonnes of NIS per hectare for each reject category. Figure 13 shows the tonnes of NIS for each reject category per tonne NIS delivered at 10% moisture content.
Major trends in the factory reject levels include:

- Insect damage has been the major reject category during the last 7 years. Although the percentage of rejects due to insect damage has stayed relatively consistent from 25% to 30% from 2007 to 2009, the amount rejected per tonne delivered increased from 12 kg NIS in 2007 to 20 kg NIS in 2009 due to the increase in total factory reject levels in 2009. Bug damage is believed to be the major contributing factor.
- Factory reject losses due to internal discolouration (brown centres) decreased as a percentage from 20% in 2007 to 17% in 2009 but the amount rejected per tonne delivered increased from 8 kg NIS in 2007 to 12 kg NIS in 2009 due to the increase in total factory reject levels. Internal discolouration has comprised approximately 15 to 20% of factory reject losses since 2005. A major research project is underway to investigate the causes and management of internal discolouration.
- External discolouration represented 26.7% and 16.9% of factory reject losses in 2008 and 2009 (equivalent to 41 kg NIS/ha and 39 kg NIS/ha).
- Immaturity represented 21% of losses in 2008 and 2009 compared to only 12% in 2006. This was equivalent to 12 and 15 kg NIS per tonne delivered being rejected due to immaturity in 2008 and 2009 compared to only 6 kg NIS per tonne delivered being rejected in 2006).
- There was a big increase in percentage losses due to mould from 10% in 2008 to 18% in 2009. This was equivalent to an increase from 6 kg NIS per tonne delivered being rejected due to mould in 2008 compared to 14 kg NIS in 2009. This increase was largely due to increased wet weather during harvesting and nut storage in 2009.

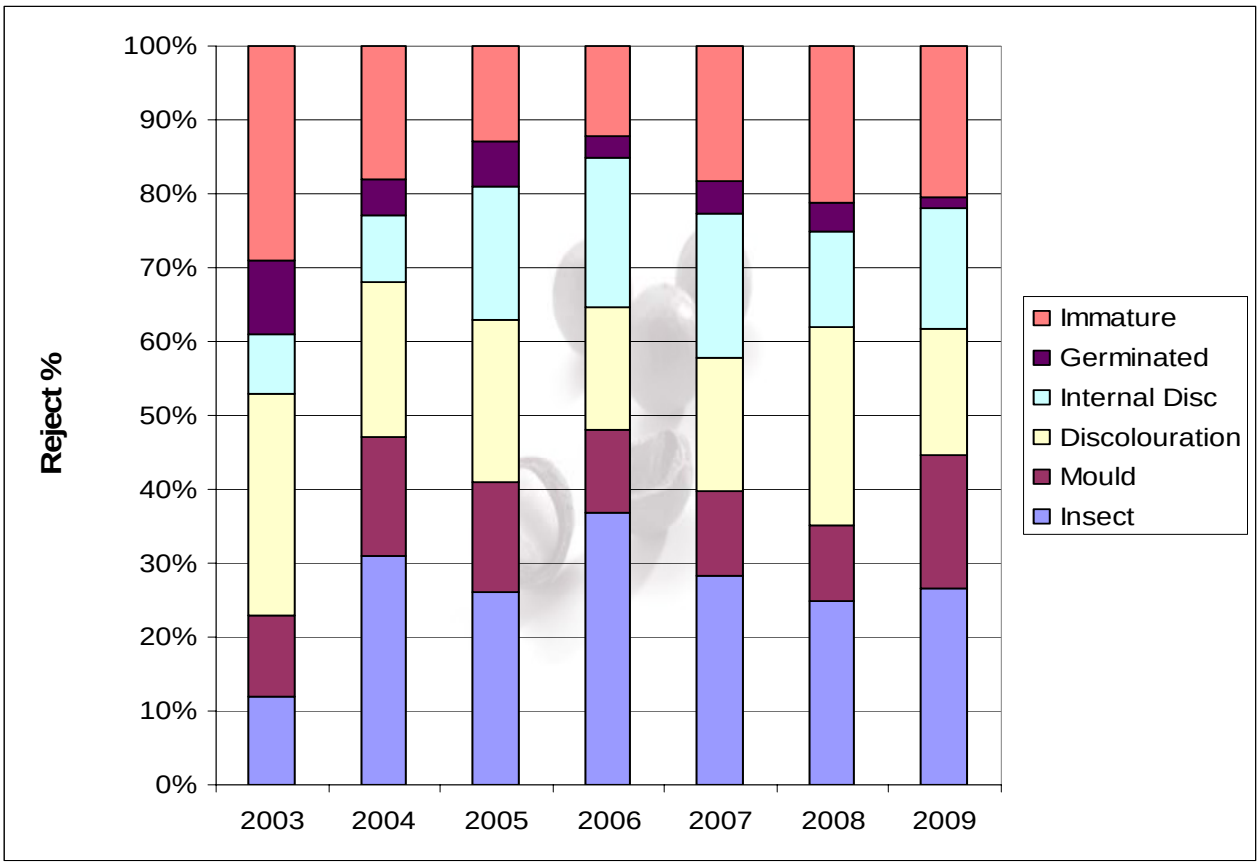

Figure 11 Factory reject analysis 2003-2009

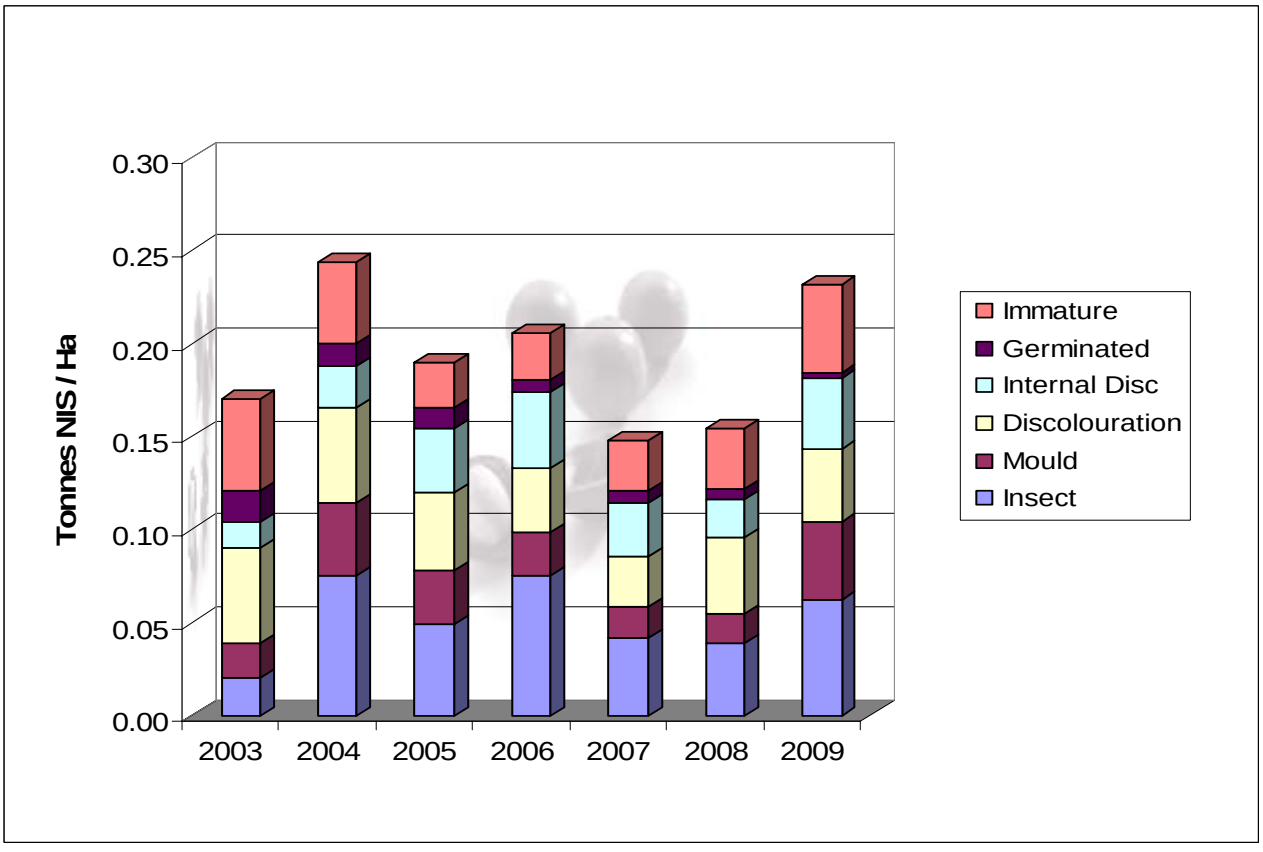

Figure 12 Factory reject categories showing tonnes NIS per hectare 2003 to 2009

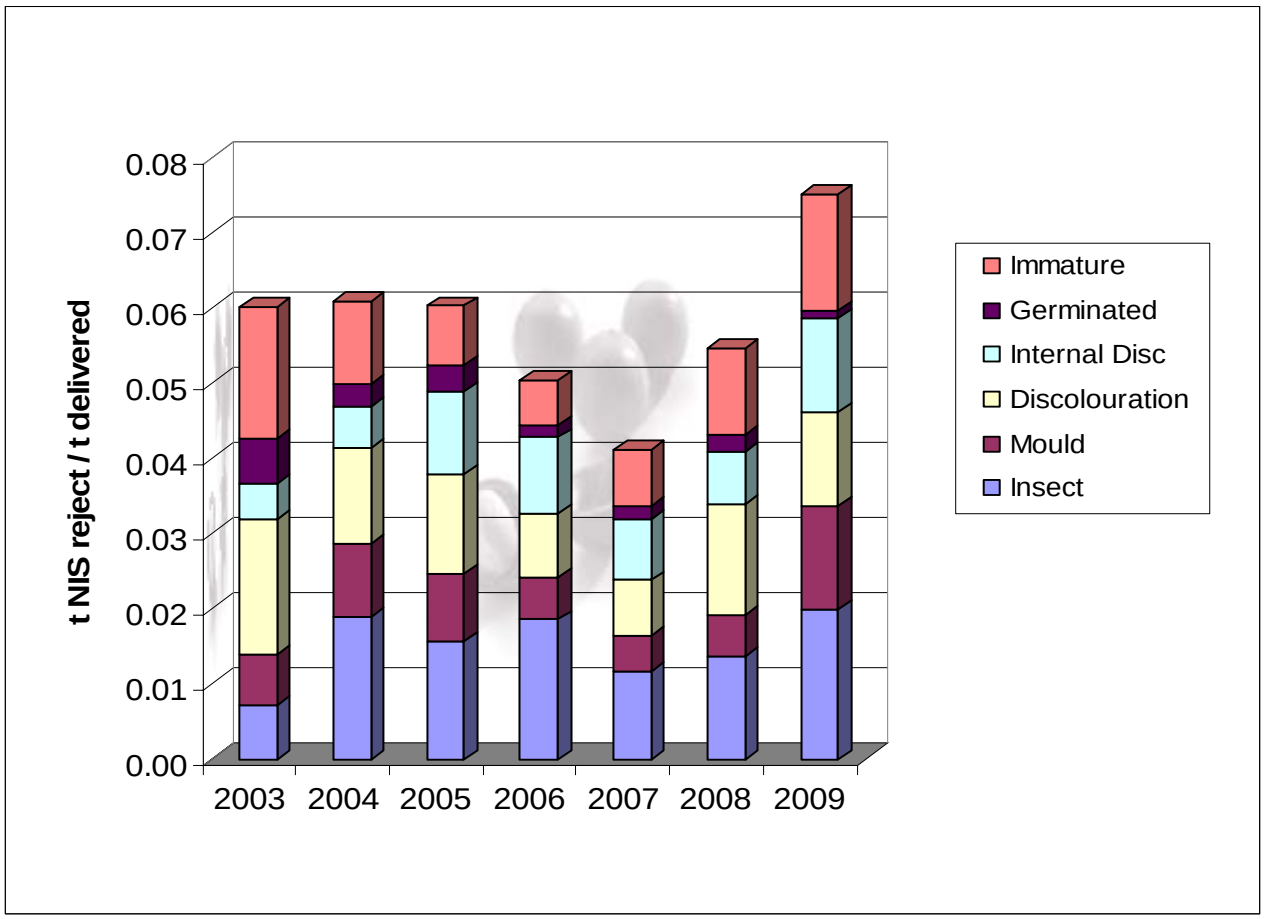

Figure 13 Factory rejects showing tonnes NIS reject per tonne delivered @ 10% moisture content 2003-2009

Labour analysis

Figure 14 shows the top ten labour categories in hours per hectare for a sample of 15 farms for the 2007/08 and 2008/09 financial years. The sample represents a cross section of bearing orchards from Bundaberg, Northern New South Wales and South East Queensland from the MacMan best practice groups. Only 5 of the 15 farms in the sample irrigate.
The major job categories are:

- Dehusking or sorting or handling the nuts in the shed
- Machine harvesting
- Mowing or slashing
- Repairs and maintenance of orchard machinery

The increased amount of shed rejects during 2008 and 2009 was reflected in the increased time spent dehusking or sorting or handling the nuts in the shed in 2008/09. This was largely driven by adverse weather conditions during harvest.

Hand pruning is a category that has not featured highly in previous labour analyses. This reflects the increased time being spent by macadamia growers training their trees (including limb removal) to increase machinery access and light penetration and reduce overcrowding.

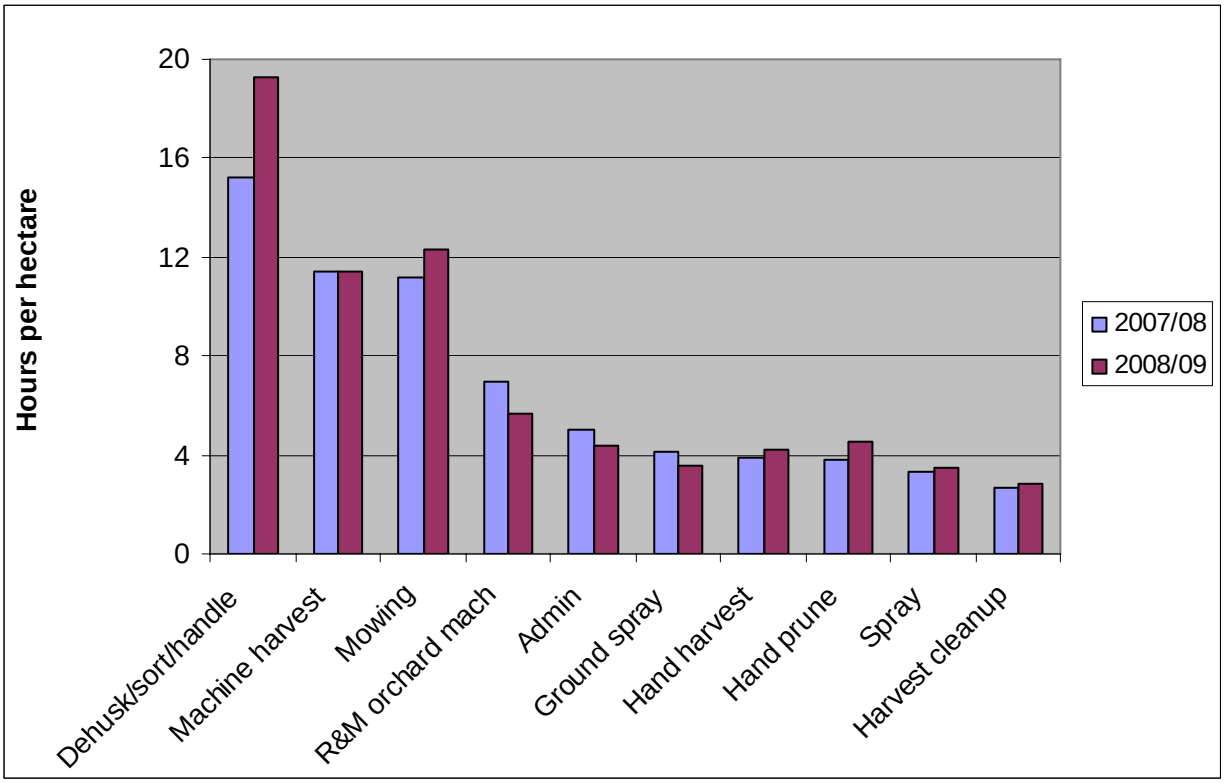

Figure 14. Labour analyses 2007/08 and 2008/09

Post-harvest handling trends

Figure 15 shows the decrease in the average time spent handling the nuts by a cross section of 12 bearing farms from approximately 6 hours/tonne in 2001-2003 to 4 hours/tonne in 2005-2007. Nut handling includes all the labour hours spent dehusking and sorting, resorting, transferring nuts between silos, dispatching nuts to processors and other related tasks.

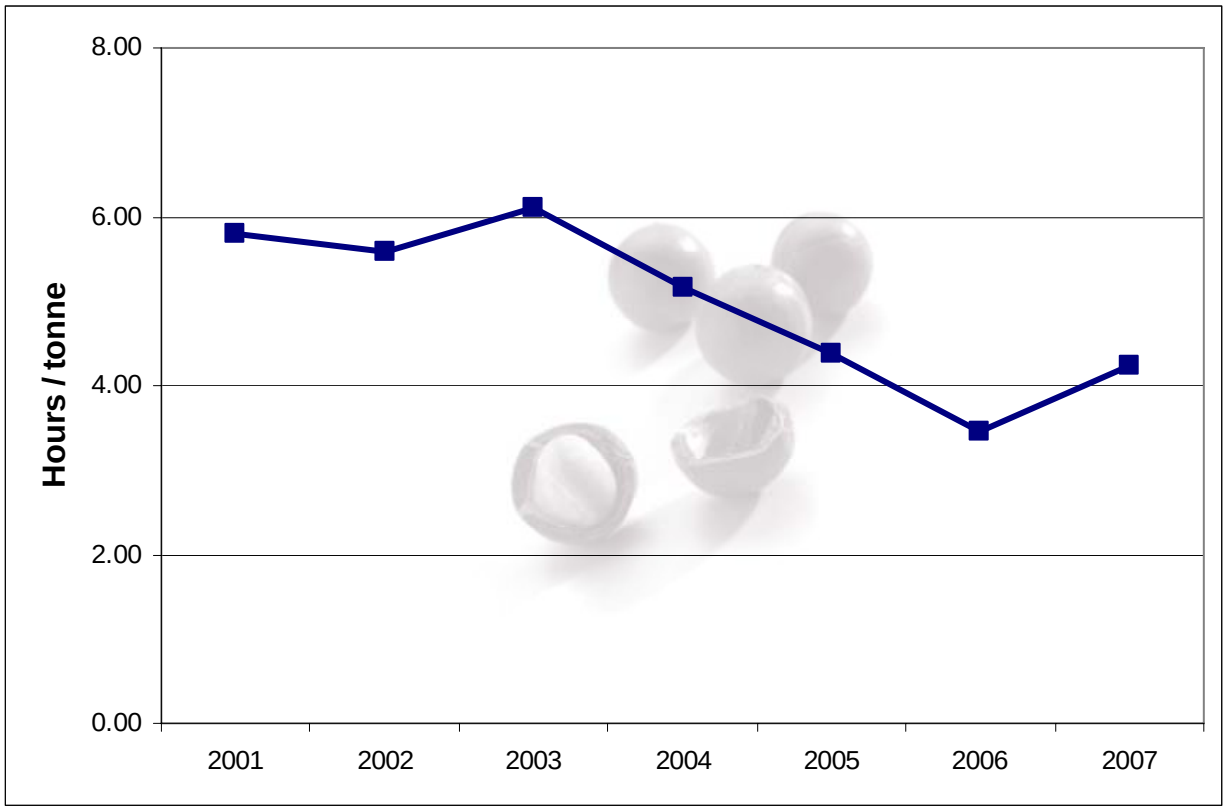

Figure 15. Post-harvest handling labour hours/tonne 2001 to 2007

Major changes in shed and storage management amongst best practice group members include:

- Upgrading storage and drying systems
- Upgrading improved dehusking and sorting systems
- Storing for less time on farm
- Increased storage capacity

In a 2005 survey of grower practices in the *Adoption of quality management systems in macadamia* project (being conducted by NSW DPI, University of Qld, University of Sunshine Coast and Qld DPI&F), approximately 70% of the respondents reported that they always resort. An increasing number of growers, however, are basing the amount of sorting and the speed of the sorting belts on an assessment of the quality of the nuts and the economic benefit of the sorting. They are then comparing the results of this assessment to the projected cost of sorting and the likely amount of good nuts being rejected.

A major focus point for discussion in MacMan best practice groups has been on managing handling, sorting and drying systems to get nuts through the shed and storage systems and consigned to the processor as quickly as possible, rather than storing the nuts for longer on the farm at moisture contents where deterioration in quality may occur.

Harvest management trends

Figure 16 shows the decrease in the hours/tonne spent machine harvesting by the 12 bearing farms from a peak of nearly 4 hours/tonne in 2003 to approximately 2.5 hours/tonne in 2006 and 2007. This includes the entire time spent machine harvesting over the year, including preparing machinery for harvest, sweeping and blowing as part of the harvest operation and carting the nuts back to the shed.

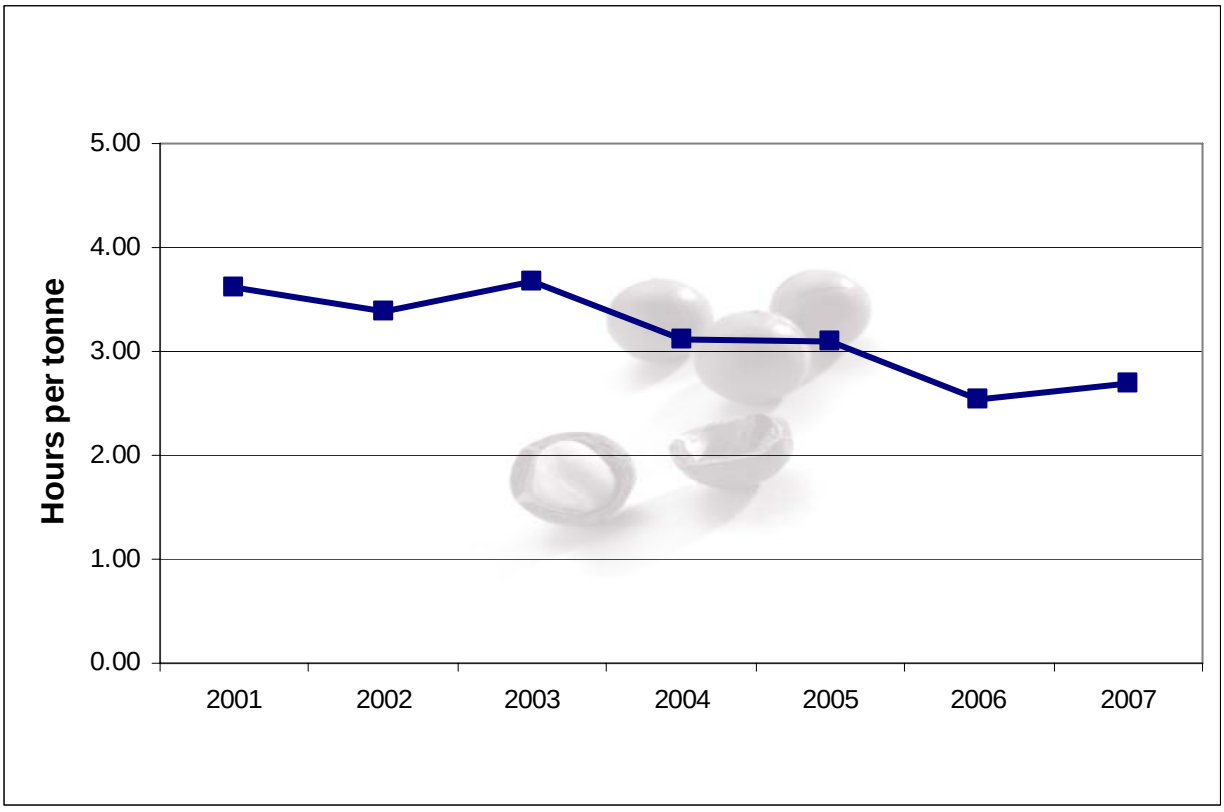

Figure 16. Machine harvest labour hours/tonne 2001 to 2007

Major changes in harvest management amongst best practice group members include:

- Harvesting more frequently
- Upgrading harvest equipment to improve productivity and efficiency
- Spraying with ethephon to promote nut drop and reduce the number of harvest rounds

There is a continuing trend within MacMan best practice groups to reduce the interval between harvest rounds and the number of passes per round. Many growers have also upgraded their harvest equipment to enable them to pick up more often to reduce the time the nuts are on the ground. These changes in harvesting methods and equipment have not led to more time spent harvesting, but have resulted in better quality and fewer rejects. In the “Adoption of quality management systems in macadamia” project, longer harvest intervals were found to be associated with a higher percentage of rejects due to discolouration.

Crop nutrition trends

The *On-farm economic analysis in the Australian macadamia industry* project (conducted by Qld DPI&F, University of Southern Qld and NSW DPI) found that crop nutrition represented between 10 and 15% of the total annual costs of production from 2003 to 2006 in Australian macadamia orchards.

Figure 17 shows the average crop nutrition labour hours and fertilizer costs per hectare by the 12 bearing farms from 2002/03 to 2006/07. Time spent in crop nutrition for mature orchards within the BPGs commonly ranges from 1 to 4 hours/ha. This involves all time spent in crop nutrition, including broadcasting fertiliser, applying foliar fertilisers and applying fertiliser through irrigation systems. Average annual fertiliser costs for the farms increased to $727/ha in 2006/07.

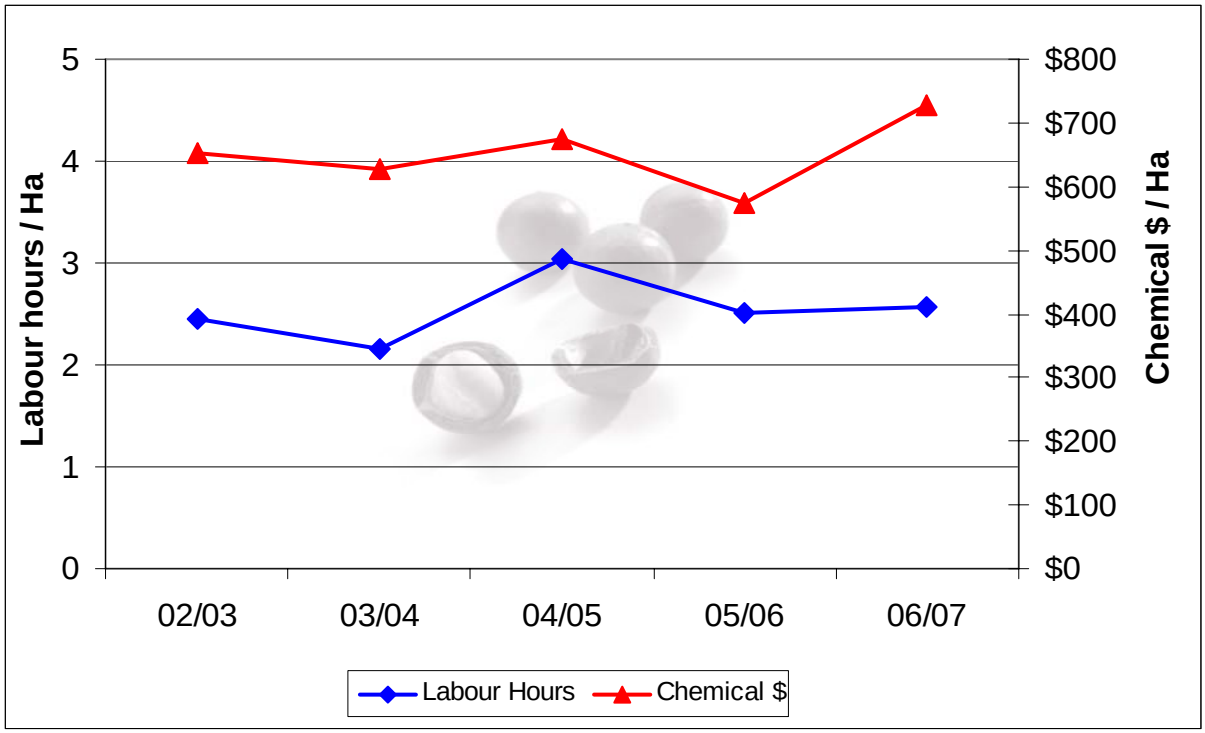

Figure 17. Crop nutrition labour hours and chemical costs/hectare 2002/03 to 2006/07

Figure 18 shows the average rate of application of major nutrients per hectare by the 12 farms from 2002/03 to 2006/07. An average of 204 kg N/ha, 70 kg P/ha and 128 kg K/ha was applied in 2006/07. This was an increase per hectare for each of these 3 major nutrients. Fertilisers include straight fertilisers (e.g. urea); mixed blends and organic products (e.g. composted poultry manure). Similar rates of nitrogen and potassium are commonly applied in mature orchards in best practice groups in Queensland but lower rates of phosphorus. The higher rates of phosphorus in the Lismore orchards are to allow for fixation in the kraznozem soils (ferrosols).

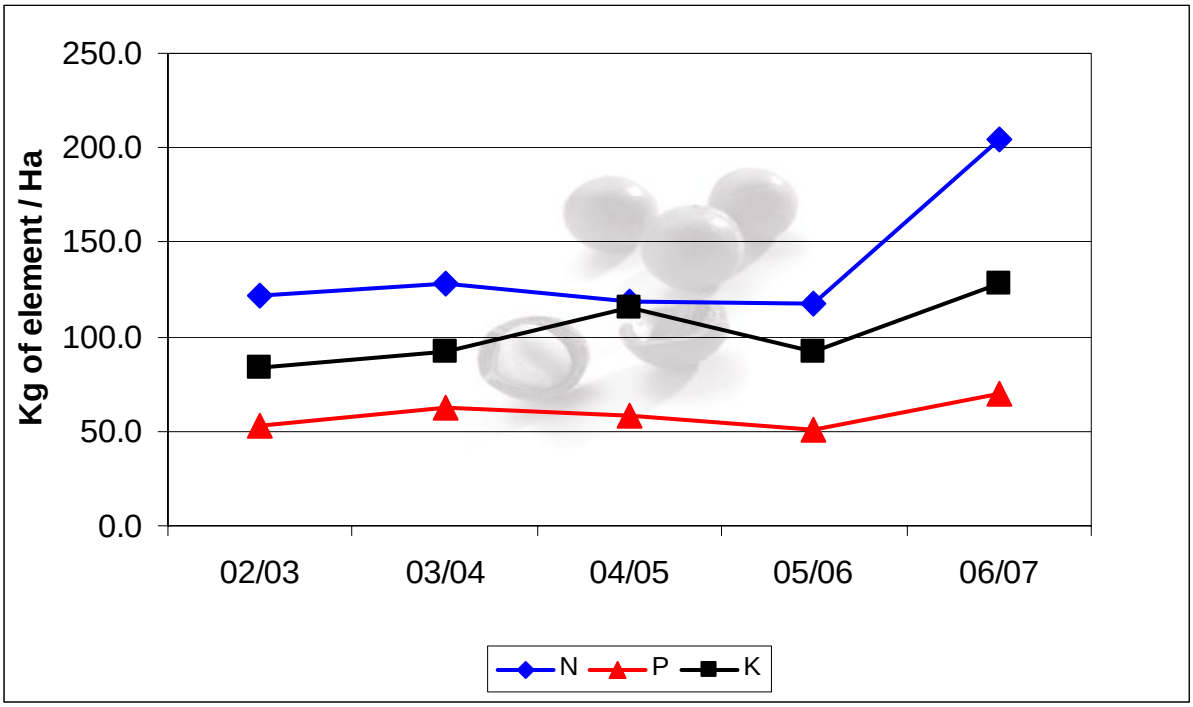

Figure 18. Fertiliser application elemental analysis / hectare 2002 / 03 to 2006 / 07

It is important to note that these nutrient application rates are higher than the rates determined by the nutrient removal concept (the amount of nutrient removed by the crop adjusted for expected nutrient losses from leaching and soil fixation).

Table 2. Nutrient removal by the crop (tree nutrient removal + adjustment for leaching and other crop losses) with varying crop yields

Crop yield (t / ha)	Requirements for full replacement of lost nutrients (kg / ha)		
NIS at 10 % m.c.	Nitrogen	Phosphorus	Potassium
2	27	2.5	22
4	55	5	44
6	82	7.5	66

Calcium and magnesium are applied mainly as lime, dolomite or gypsum as required, depending on soil analysis levels and soil acidity. Boron and zinc are the most common trace elements applied, usually either as foliar sprays or as part of mixed fertilisers.
Major changes in crop nutrition practices amongst the best practice group members include:

- Increasing the frequency of fertiliser applications. Most of the growers split their fertiliser (particularly nitrogen) into at least 3 applications per year, with many applying fertiliser 6 to 8 times per year. Where irrigation is available, fertiliser is usually watered in following application
- Increasing the amount of fertiliser being applied.
- Increasing the use of soil and/or leaf analysis and crop replacement strategies to plan their fertiliser programs
- Applying organic materials such as compost and chicken litter as part of fertiliser programs to improve soil health as well as increasing nutrient levels

Crop protection trends

Figure 19 shows the average crop protection labour hours and chemical costs per hectare by the 12 farms from 2002/03 to 2006/07. Time spent in crop protection for BPG members, generally ranges from 3 to 6 hours/ha. This involves all time spent in crop protection, including spraying, vermin control and pest and disease monitoring. Average annual costs of pesticides used in crop protection within the 12 farm sample was $175/ha in 2006/07.

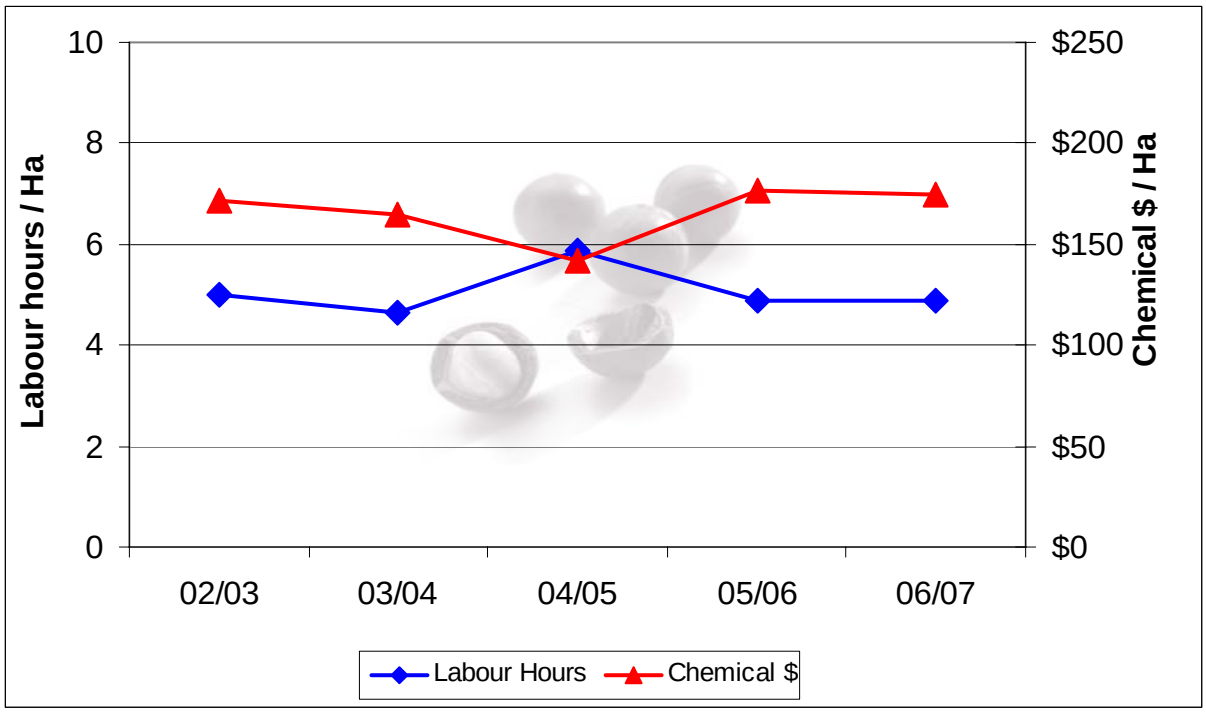

Figure 19. Crop protection labour hour and chemical costs/hectare 2002/03 to 2006/07

Major changes in crop protection practices amongst the best practice group members include:

- Increasing use of Integrated Pest Management (IPM) and spraying only when necessary
- Using a pest consultant for pest monitoring
- Encouraging or introducing biological controls such as Trichogramma wasps for nutborer control. Reduced spraying with pesticides such as beta-cyfluthrin for nutborer control has resulted in fruitspotting bug and green vegetable bug control, particularly during late nut development becoming a major issue.
- Changing chemical concentrations in low volume spraying.

Orchard floor management trends

Figure 20 shows the average orchard floor management labour hours and chemical costs per hectare by the 12 farms from 2002 to 2007. There was a slight increase in the average labour hours and chemical costs by the 12 farms to 13 hours and $35 per hectare in 2007. Time spent in orchard floor management for BPG members commonly ranges from 10 to 20 hours/ha. This involves all time spent in orchard floor management, including ground spraying, mowing and erosion control. Average annual costs of pesticides used in orchard floor management within the MacMan best practice groups commonly range from $10 to $50/ha for mature orchards.

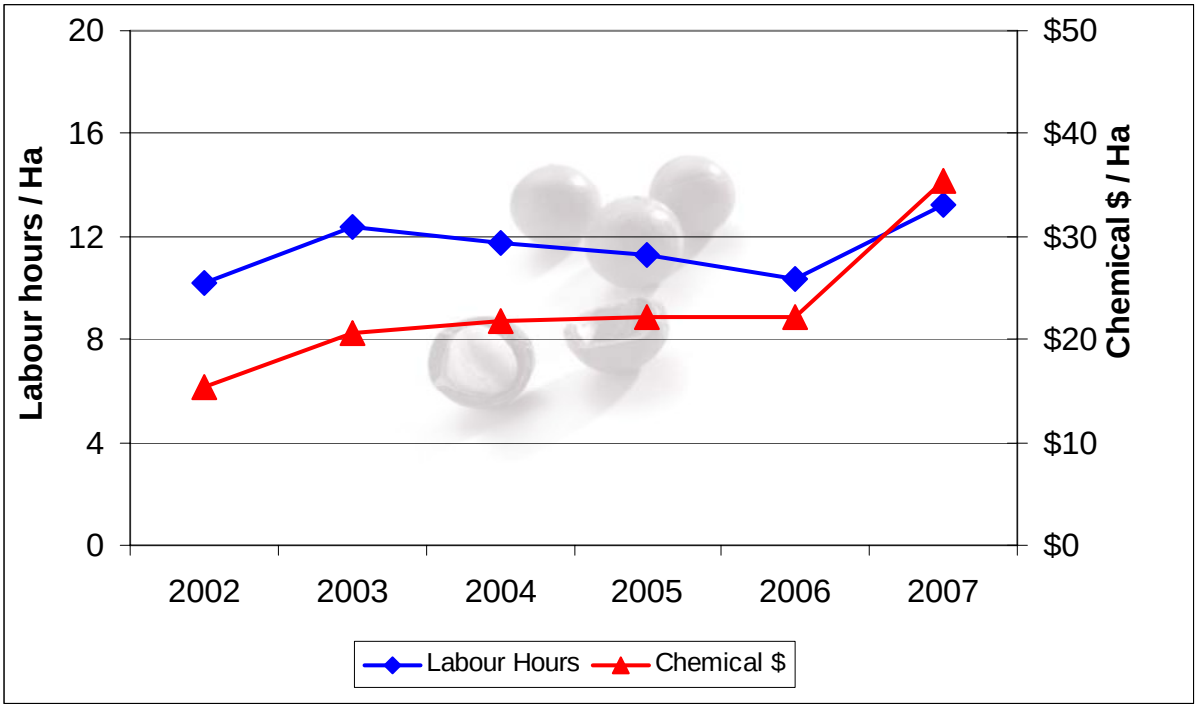

Figure 20. Orchard floor management labour hours and chemical costs/ha 2002-07

The evaluation of MacMan products and services found that orchard floor management was the area where Australian macadamia growers had made the most changes in their farm management practices in the last 5 years. This is an area that has been strongly targeted by the Australian macadamia industry.

The major changes in orchard floor management amongst best practice group members include:

- Controlling water runoff in the orchard
- Establishing ground covers and grass between the rows
- Decreasing the spray area under the trees
- Directing grass clippings under the trees.

The major reasons for the changes were:

- To reduce soil and nutrient loss from the orchard
- To improve soil and tree health
- To maintain soil organic matter levels

Irrigation management trends

Most Australian macadamia orchards are not irrigated. Irrigation is mainly restricted to drier production areas, particularly in Queensland (for example, Bundaberg, Gympie and north Queensland). Reduced yields in the Gympie region in 2002 and 2003, where water availability was limited in 2001 and 2002, demonstrated the importance of management of crop inputs such as water in achieving sustained yields in macadamias. Many of these orchards have since increased their water supply available for irrigation. Common annual water budgets amongst irrigating best practice group members are 3 to 4 ML/ha.

The major changes in irrigation practices amongst best practice group members include:

- Increasing the amount of water applied
- Increasing the frequency of irrigation
- Monitoring water use and soil moisture levels in order to use the water as efficiently as possible.

Canopy management trends

Many best practice group members have not introduced changes in their orchard canopy management in recent years. This was mainly due to the young age of trees and the perception amongst some growers that canopy management was not yet necessary, or due to uncertainty as to the best approach to take. Most canopy management strategies undertaken have involved improving and maintaining light penetration and machinery access.

The major changes in canopy management practices amongst best practice group members include:

- Selectively pruning and shaping and removing branches. There is strong interest in this system amongst best practice group members, in order to reduce drops in yield in comparison to major hedging or topping treatments.
- Hedging and skirting
- Training young trees to avoid hedging problems as trees mature.

Conclusion

The network of MacMan best practice groups provides Australian macadamia growers with an ideal opportunity to benchmark their results with other farmers, and to compare and analyse their farm management practices. The best practice groups have been shown to be a major source of useful farm information for their members. The growers benefit by sharing information and by learning from other growers' knowledge and experience.

The groups have proven to be a successful, inexpensive method to achieve adoption of farm management practices to improve productivity and efficiency. Best practice group members have made substantial changes to their farm management practices as a result of their participation in the groups in the last 9 years.