Horticulture Innovation Australia

Final Report

Improving farm productivity and competitiveness in the Australian macadamia industry

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Summary

High variability in on-farm productivity is a significant issue for the Australian macadamia industry. Benchmark data has shown that the top 25% of farms typically achieve five times greater production per bearing hectare than the bottom 25%. The financial sustainability of individual businesses underpins the Australian industry's ability to compete globally. Improving productivity is therefore a high priority in the industry's strategic investment plan.

This project sought to improve productivity and quality by raising awareness of its key drivers. The project also promoted industry best practice by analysing and showcasing management practices of farms that consistently achieve high productivity. This work targeted growers and farm managers but also involved close collaboration with processors, consultants and researchers.

Three strategies were employed for improving orchard productivity and promoting practice change, including:

- on-farm benchmarking;
- facilitated productivity groups;
- financial information and forecasting tools.

On-farm benchmarking included annual collection and analyses of yield, quality and planting data. These data were collected from growers and processors over six production seasons (2009-2014). The proportion of industry participating in benchmarking increased each year of the project, reaching over **55% by production and planted area** in the final season. The data pool represents a cross section of the industry by region, farm size and tree age.

All participating farms annually received personalised benchmark reports that confidentially ranked individual performance against averages of similar farms based on locality, region, tree age, farm size, management style and irrigation status. More than 1500 of these reports were delivered to participants during the project.

Five annual industry benchmark reports and corresponding executive summaries were also published. These included statistical analyses to identify trends and relationships within the data. Analyses of the top 20 farms in the benchmark pool provided further insight into the performance of leading farms. Six video-based case studies of high productivity farms were subsequently produced, providing models for practice change among industry.

A network of seven Productivity Groups between Bundaberg (Queensland) and Nambucca (New South Wales) facilitated sharing of information between growers. Forty Productivity Group meetings and farm walks facilitated during the project provided structured opportunities for growers to compare management practices, costs, yield and quality. Meetings also provided an important platform for extending and evaluating research results through close involvement of researchers. Meetings were also critical for collecting and verifying detailed farm practice and cost data. Summarised findings were incorporated into wider benchmarking analyses while individual farm data remained confidential within the groups.

A financial forecasting software tool called the *Financial Planner for Macadamia* was developed to inform decision making relating to on-farm practice change and investment. This tool was designed for use by growers, processors and consultants.

Financial forecasts were developed for a wide range of practice change scenarios including canopy management, tree replacement and changes to financial arrangements. The tool provides consultants and investors with objective appraisal of expected cash flows associated with investment in either new or established orchards.

Forecasts based on whole industry scenarios have informed industry strategic planning and evaluation of research. Ongoing availability of this tool has added significant capacity for improved decision making.

Keywords

Macadamia; best practice; benchmarking; productivity; economic; financial; analysis; ranking; profitability; production.

Introduction

The Australian macadamia industry is under increasing economic pressure due to rising production costs and growing global competition. Rapid growth of macadamia industries in countries such as South Africa have seen added competition for international market access. At the same time there is increasing consumer demand from countries such as China that offer opportunity for significant industry growth. While market growth presents Australia with the opportunity to grow, 70% of its production is currently exported making it susceptible to increased global market competition.

The wholesale price of nut-in-shell has historically fluctuated significantly. Despite recent strong prices, net price growth over the last 20 years has been substantially lower than CPI. This places strain on the profitability on those farms with small operating margins.

Industry best practice and on-farm economic analysis work (MC03022, MC03023) has shown that productivity is the dominant driver of macadamia farm profitability. Benchmark data has highlighted significant yield variability between farms. This variability spans production regions, farm sizes, tree ages and ownership structures. For example, the average saleable kernel production per bearing hectare of the top 25% of farms in the benchmarking study was more than five times that of the bottom 25% of farms (1.31 t/ha vs 0.25 t/ha for the 2009 to 2014 seasons).

Benchmarking data has also shown that the most productive macadamia farms in any given season are generally also highly productive in all seasons, barring extreme weather conditions. Detailed observation of management practices on these farms has revealed recurring patterns in approach, attitudes and key practices, suggesting that on-farm management is a significant determinant of farm productivity and profitability.

To remain profitable and competitive, Australian growers must therefore ensure that their farm management reflects industry best practice. To this end, it is vital that both new and experienced growers and managers have access to the latest production benchmarks and best practice guidelines, to provide an ongoing framework for effectively managing the key drivers of productivity and quality.

This project builds on previous work within the macadamia industry that established a standardised farm recording system and best practice group network (MC03022) and identified on-farm economic trends (MC03023). The establishment of a national industry on-farm benchmarking service, including annual data collection, analysis and reporting of key productivity and quality performance indicators, extended the scope and benefits of previous best practice work (10% participation by production) to a much larger proportion of the industry (55% participation by production and planted area).

The macadamia industry's strategic investment plan 2014-2019 lists improving productivity of the existing orchard base and advocating orchard development and expansion among its key objectives. Information generated by this project has directly informed this plan and is continuing to support these key objectives through delivery of reliable industry productivity and quality benchmarks and provision of economic analysis tools to support investment and practice change decisions.

Methodology

The primary target audience for this work was commercial macadamia producers and farm managers to support the goal of improving productivity and quality in the Australian macadamia industry. Many other industry stakeholders also play an important role in on-farm and industry performance and function and many of these directly collaborated with, or used outputs from this project. These included all of the major macadamia processors, private consultants such as agronomists and pest scouts, the peak industry body (AMS), agribusiness representatives and government departments and authorities.

A project Industry Steering Group comprising six leading stakeholders was formed and met annually to review policies, outputs and priorities. Key issues overseen by this group included data collection strategies, privacy and confidentiality standards, timing and content of reports and commercial delivery plans.

Three key strategies were employed for promoting practice change and improving orchard productivity:

- on-farm industry benchmarking;
- facilitated productivity groups; and
- financial forecasting tools and information.

On-farm industry benchmarking

Benchmarking primarily focussed on collection, analysis and reporting of annual yield, quality and planting data. Yield data included nut-in-shell tonnage and kernel recoveries, from which kernel equivalents were derived. Quality data included moisture content, whole kernel percentage and reject analyses.

Planting data including total and bearing trees, row and tree spacing and variety information (optional) was sourced directly from growers. Yield and quality data was sourced directly from processors' consignment records wherever grower consent was provided to encourage participation and minimise workload for growers.

Planting data was organised according to tree age and combined with farm area calculations to produce a matrix of historical planting details, which was verified and updated each season. Annual planting summaries included total and bearing trees and hectares, weighted average tree age and weighted average planting density. Additional criteria such as irrigation and organic status were also aligned to this annual summary to allow further categorisation of farms.

Recording of production costs also commenced during this project. Costs were separated into 17 heads of expenditure, based on a chart of accounts established during previous on-farm economic analysis work (MC03023).

All data was collected via annual census following each production season. A simple data collection form was developed on which growers could record farm and consignment details. This form was progressively refined based on grower feedback.

Substantial resources were dedicated to encouraging and assisting growers to submit data. Team members directly contacted growers, consultants, managers and processors to facilitate data collection. Cooperation of processors has been critical as more than 60% of all consignment data has been collected via processors throughout the project.

A database was developed for data storage, verification and reporting. This database was also used to generate individual grower benchmark reports and also much of the content for industry reports. Access to this database is restricted to key team members to safeguard the confidentiality of sensitive grower information.

Data was verified annually with each participating grower prior to producing confidential benchmark reports (Appendix 1). These reports ranked individual farm performance against averages for similar farms in the benchmark sample based on locality, region, farm size, tree age, management structure and irrigation use. Farm performance trends over multiple seasons were also plotted against industry averages.

Industry benchmark reports were also produced annually (Appendix 2). These included detailed analysis of average performance for multiple farms in the benchmark sample by season, region, tree age, farm size, planting density, irrigation status, management structure and organic status. Data analyses and groupings included weighted and unweighted averages, percentile distributions, cross tabulations, correlations and analyses of variance. Identification of the top 20 farms also provided insight into best practice and high productivity benchmarks.

Productivity groups

A network of seven productivity (formerly best practice) groups was facilitated by the project team in each major macadamia production region in Queensland and New South Wales, including Bundaberg, Gympie, Glasshouse Mountains, Lismore, Alstonville, Rosebank and Nambucca.

Group meetings held at least annually provided structured opportunities for small numbers of growers (up to 12) to compare management practices, costs, yield and quality results as well as local farm management issues determined by group members themselves. The meetings also provided a forum for sharing knowledge and experiences with each other and interacting with invited researchers and consultants.

Facilitators collected and compiled relevant data from participants prior to each meeting as the basis for comparison and discussion. Individual business data remained confidential within each group. Summarised data were reported to the wider industry via industry media such as the AMS News Bulletin.

Productivity groups also undertook field days, study tours and farm walks to support on-farm investigation of management practices discussed at the meetings.

Financial forecasting

The *Financial Planner for Macadamia* software resulting from previous work (MC03023) was commercialised for use by growers, processors and consultants. Users were fully supported during the project term. The resulting financial forecasts and profiles supported informed decision making for growers contemplating changes to their business, such as canopy management, tree replacement, purchase of capital or changes to finance arrangements.

Economic profiles and reports generated by the *Financial Planner* also directly supported decision making for a range of stakeholders including investors, banks and Government authorities (example in appendix 3).

Monitoring and evaluation

A formal mid-term evaluation was undertaken in 2013 to determine how benchmark reports were being used and interpreted and the resulting impact on practice change. Results from this survey guided data collection and reporting processes for the remainder of the project.

The Industry Steering Group was also an important resource for feedback and guidance through their annual monitoring of project outputs. The project team also consulted extensively with clients and stakeholders via Productivity Group meetings, annual processor meetings and direct collaboration with consultants, processors and farm managers. Key stakeholders prototyped data collection and reporting processes and guided their refinement prior to wider scale implementation.

Technology transfer

Results were communicated annually via personalised individual grower reports and also industry on-farm benchmark reports, which presented summaries of broad findings.

Summaries and interpretations of benchmark findings were also delivered in video form via the macSmart web site (MC09002). Case studies of leading farms and their production practices were also developed and delivered to growers in video form via macSmart.

A moderated e-mail based discussion forum (MacNet) facilitated reporting, discussion and information sharing for more than 240 subscribers throughout the term of the project.

Project findings were presented at conferences, consultants' workshops, processor field days and MacGroup meetings. Results were also published four times each year via a regular project column in the AMS News Bulletin.

Outputs

On-farm industry benchmarking

More than 1500 personalised ranking reports spanning six production seasons were produced during the project. All participants who submitted data were provided with a personalised report, which compared and ranked seasonal yield and quality outcomes for their farm with averages of other similar farms based on locality, region, tree age, farm size, management style and irrigation status (Appendix 1).

Five annual industry benchmark reports were also produced during the project. These included detailed analysis of benchmark findings for all seasons since 2009. Executive Summary reports were also published in later years to distil and present key findings.

Industry benchmark reports were distributed annually to all benchmark participants and subsequently made available to the wider industry via the AMS web site. Information from these reports formed the basis for 14 articles in the AMS News Bulletin.

A custom database was developed for this project. Data analysis and reporting tools in this database were progressively refined and expanded in each year of the project. This system is now capable of producing a wide range of reports for comparing and ranking productivity and quality parameters by farm, locality, season, region, post code, farm size, tree age, irrigation status, management style, planting density and organic status. A query engine also supports unlimited scope for ad-hoc analysis and export of data. In addition to planned reporting schedules, this facility has been used to produce ad-hoc reports for individual clients including growers, consultants and processors.

Key industry benchmarking results were featured in two summary videos and published via the macSmart web site. These videos included interpretations to help users understand causes, drivers and implications associated with these findings. These videos were rated highly by macSmart users in a 2014 evaluation. A further six productivity case studies were also produced in video format and published via the macSmart site. These highlighted on-farm practices and management approaches used on some of the leading farms in industry.

Productivity (best practice) groups

Productivity groups met at least annually within each production region during the project. A total of 40 meetings and farm walks were facilitated. Additionally, one field day and four study tours were organised to provide on-farm analysis of key issues covered at the meetings.

On average more than 80 growers participated in productivity groups each year. Facilitators collected data from participants prior to each meeting for comparison and analysis at the meeting. Tailored reports were also developed for each participant comparing their farm with others in the group.

Key meeting topics included:

- Farm productivity and quality
- Pest and disease identification and management
- Emerging pests (e.g. lace bugs and sigastus weevil)
- Fertiliser programs and application rates
- Crop inputs and costs (e.g. fertilisers and chemicals)
- Categorised labour inputs and costs
- Orchard floor management inputs and costs
- Soil health and erosion control
- Canopy management
- Irrigation rates and methods
- Harvest management and costs.

Productivity groups were also a conduit for extending and evaluating research results. Researchers from industry funded projects presented findings to many of the meetings and group members also provided valuable feedback and insight to researchers. Invited consultants also shared their knowledge and experience through participation in some group meetings. Key Productivity Group results were published in four AMS News Bulletin articles.

Financial forecasting and recording tools

Provision of these products and services included delivery and maintenance of software tools, training and technical support for registered users and assistance with development of economic profiles to model a range of farm business scenarios.

More than 110 economic profiles were developed by the project team for analysis of various macadamia farm business scenarios. These models included:

- Economics of newly planted and young orchards;
- Use of supplementary irrigation in marginal climates;
- Canopy management economics (tree and row removal, staged varietal replacement);
- Investment cash flows (greenfield vs established orchards);
- Economic potential of new varieties;
- Yield decline and tree replacement resulting from abnormal vertical growth (AVG);
- Whole industry production and economic forecasts
- Evaluation of economic impact of research projects

Some of these profiles were developed for confidential use by individual clients while others were published widely via industry conferences, workshops and industry media such as the AMS News Bulletin. The project team also trained or directly assisted approximately 18 clients to produce their own profiles for a range of purposes and outcomes.

On-farm benchmarking data was incorporated into profiles to provide current, realistic projections. Average yield data from the benchmarking study was, for example combined with age x yield models and analysed to model the economics of new planted orchards. The findings from this work were published in a 2013 report for the Australian Taxation Office that provided a more realistic estimation of early cash flows than existing ATO models (Appendix 3). Other profiles, such as those up-scaled to model the whole macadamia industry, were developed specifically to inform research project evaluation and development of the industry strategic investment plan.

Development and updating of the MacMan farm recording software continued until June 2012 by which time a further four revisions had been released. A total of 430 commercial MacMan and Financial Planner clients were registered by the end of the project. Unlimited technical support was provided to all registered users throughout the project. This comprised four formal training sessions, more than 280 logged support events and in excess of 157 hours of support.

Other communication

Project findings were presented at 1 international conference, 2 national conferences, 4 consultants' workshops, 3 research forums, 5 processor field days and workshops, 3 AMS Board and R&D committee meetings, 3 industry workshops, 4 steering group meetings and 2 rounds of MacGroup meetings. A total of 18 articles were also published via a regular project column in the AMS News Bulletin.

A dedicated e-mail discussion group, MacNet, was managed and moderated throughout the project term. This forum allows growers to communicate directly with each other and share questions, ideas and items of interest with other growers. By the end of the project 204 users remained subscribed to this group and a total of 1181 posts had been published.

Outcomes

On-farm industry benchmarking

Figure 1 shows industry participation rates in on-farm benchmarking by season. Participation increased steadily from 178 farms in 2009 to 265 farms in the 2014 season**. The final participation rate represents approximately 55% of the industry by both production and planted area**. This is significantly higher than the originally proposed participation rate of 20%. The data pool also reflects a broad cross section of the Australian industry by region, farm size and tree age.

This substantial and sustained participation over several seasons affords a high degree of confidence for dissecting and statistically analysing the data sample. For example, availability of sufficient data over multiple seasons allowed the project team to segregate and analyse the 20 farms with the highest average productivity over multiple seasons. Identification and further analysis of the approaches and practices used on these leading farms and subsequent publication of a series of productivity case studies provided compelling examples of industry best practice for all industry members.

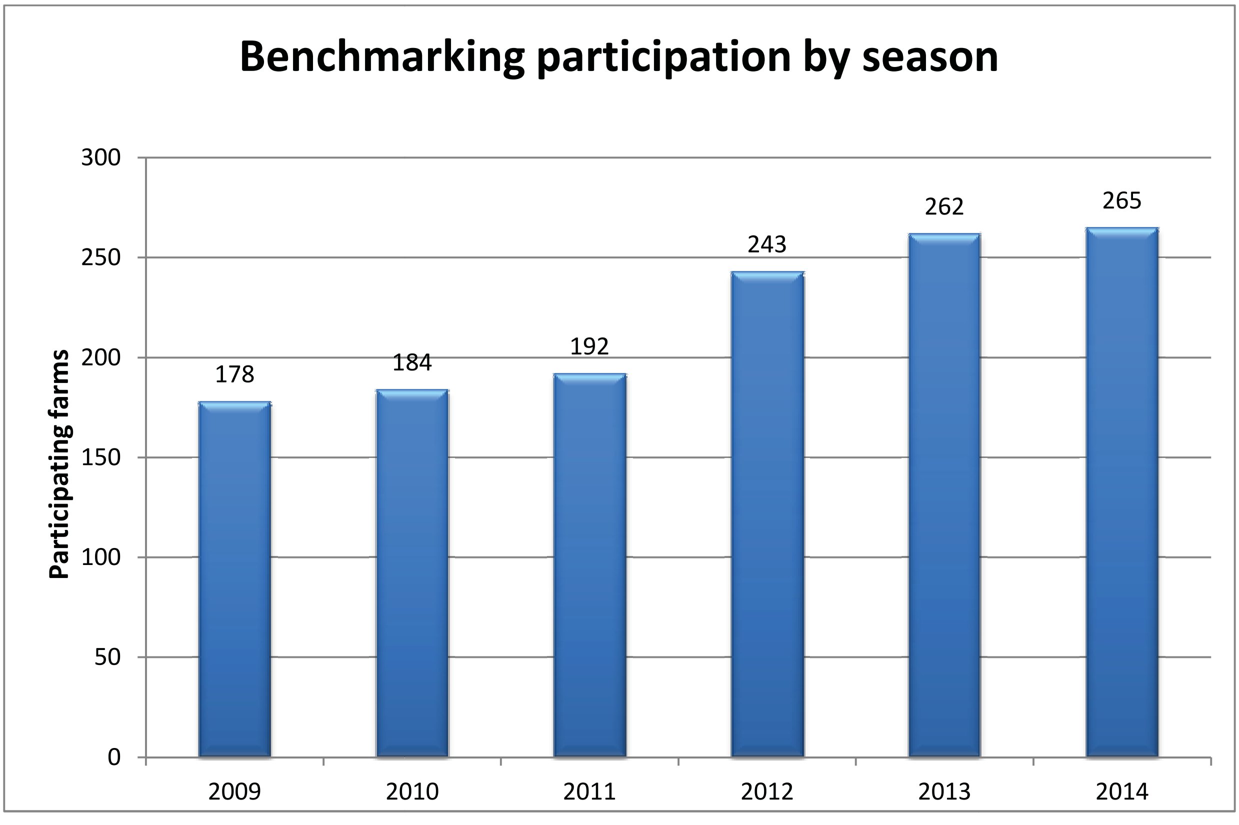

Figure 1 Number of farms participating in benchmarking by season

Data from industry benchmark reports has been referenced and republished widely via industry events and publications. For example, benchmarking results directly informed the development of the macadamia industry's Strategic Investment Plan (2014 to 2019). The project team reviewed industry production forecasts based on benchmarking results and presented findings to industry representatives at consultation workshops in 2013. A review of the subsequent economic cost benefit analysis was also conducted as part of the planning process. Continuation of annual on-farm benchmarking is listed as a key activity in the strategic investment plan to effectively monitor productivity improvements and practice change at the individual enterprise level.

Benchmarking results were important for identifying and monitoring levels of brown centres in kernels within the macadamia industry. Brown centres, also known as internal discolouration, is a major problem for the Australian macadamia industry. Benchmarking data identified differences in the levels of brown centres between seasons and regions and between farms of different sizes. High levels of brown centres were particularly prevalent on larger farms with bigger nut storage vessels with deeper nut storage bed depths. This provided a clearer picture to the kernel quality project team as to the potential causes of brown centres and the effect of farm management practices. Subsequent data also identified that adoption of improved drying and storage management practices as recommended by the kernel quality project contributed to a significant reduction in losses due to brown centres amongst the industry in 2015.

Benchmarking data identified insect damage as the major kernel quality defect amongst smaller farms and farms in South East Queensland, Northern Rivers of New South Wales and the Mid North Coast of New South Wales. This was a major driver for the macadamia industry deciding in 2014 to focus its extension strategy on improving pest management through better identification, timing and spray coverage. Part of this extension strategy included involvement of entomologists and pest consultants within productivity group meetings to share their knowledge, experience and research results with participating growers. The meetings also provided important feedback about changes in industry pest management practice as part of the fruitspotting bug management project (MT10049).

Benchmarking data subsequently confirmed a major reduction in reject losses due to insect damage in 2015 amongst farms where it had previously been a major problem and where the extension strategy had been particularly focused.

Benchmarking findings have also supported decision making in other agencies. For example, a report detailing expected annual yields and costs also prompted the Australian Taxation Office to alter its assessments of newly planted orchards in 2013. Productivity and quality data was also incorporated into an evidence framework for owner reimbursement costs for the macadamia industry, developed for Plant Health Australia in 2014.

Productivity (best practice) groups

Productivity groups have continued to evolve and although participation levels have not increased significantly during the project, existing groups continue to be well supported and highly valued by participants. The groups have also become an important resource for collection and interpretation of more detailed on-farm data that is not feasible to source from the wider benchmark pool. Due to the variability and complexity associated with costs of production for example, this data cannot easily be sourced via census alone. As Productivity Group members typically maintain excellent records, this group has been an important source of this type of data.

Productivity groups also tend to comprise farms whose performance is above the industry average so detailed analysis of their management practices has been valuable for identifying industry best practice. These results have been reported widely via case studies and news articles for the benefit of the whole industry.

Financial forecasting and recording tools

Although originally developed as an end user tool for macadamia growers, the *Financial Planner for Macadamia* software has been most popular with consultants and processors. Inclusion of an investment appraisal module in the software has suited the needs of investors wishing to assess the long term viability of investment in the industry. In several cases consultants or processor representatives have used the tool to produce analyses on behalf of investors or clients.

The relative complexity of this tool combined with the need for some knowledge of both economics and macadamia industry metrics have meant that it has been most effectively used by those skilled in these areas. End users have typically been more comfortable accessing the resulting information via reports.

The availability of a wide range of industry forecasts based on real data and robust yield and price models has provided investors with objective models of realistic farm performance that are more reliable and cost-effective than previously possible. The availability of this information is particularly important in the current climate in which the Australian industry is undergoing significant change and growth.

The *Financial Planner for Macadamia* software has played an important role in forecasting whole industry scenarios for strategic planning and evaluation of research outcomes. Incorporation of these realistic estimates in the industry's strategic investment plan and research project evaluations has added significant capacity for improved decision making.

Evaluation and Discussion

The 55% participation rate in benchmarking reinforces the assertion that many growers are focussed on improving productivity. The high participation rates in benchmarking compared with productivity groups (10%) also suggests that many growers and farm managers value the opportunity to anonymously compare and rank their own farm performance against others in the industry. Confidentiality, independence, trust and ease of participation were all critical factors in growing and sustaining these high participation rates throughout the project term.

A mid project cycle evaluation of benchmarking activities was conducted in May 2013. Benchmarking participants, non-participants, processors and industry stakeholders were invited to complete a web-based survey that was advertised via the Australian Macadamia Society. Evaluation results strongly influenced planning for the remainder of the project.

Almost all of the 83 responses received were from benchmarking participants. These accounted for approximately 33% of all benchmarking clients. The survey examined the relevance of benchmarking information and covered both individual grower ranking reports and industry reports. Results were presented to the project Steering Group and subsequently released to industry.

All survey respondents regarded improvement of productivity and quality on their farm as a priority and 65% suggested it was extremely important. More than 65% of respondents indicated that they had sought information since receiving their personal benchmark report to see how they may be able to improve their farm yield and quality results. More than 62% indicated that their personal benchmark report had directly contributed to their decision to make changes to their farm management practices. Practice change cited included nutrition rates and timing, harvest frequency, nut sorting and storage, record keeping, pollination, soil health and canopy management. At current participation rates this practice change has effectively spanned more than one third of farms across the whole Australian industry.

More than 79% of respondents indicated that they had read the industry benchmark report. The most important learnings respondents identified from this report included:

- understanding the importance of yield per unit area for driving productivity;
- identifying the extent of variability in on-farm productivity between farms; and
- the ability to compare individual farm performance against industry averages.

Survey participants were asked to suggest areas for improvement within the benchmarking service and reports. Responses included more verification of planted areas, assessment of the top 25% of farms, differentiation of nut in husk suppliers and inclusion of additional data such as input costs.

Verification of collected data remains vital for confidence in benchmark outcomes. Additional verification steps were incorporated into the data collection process to minimise error, particularly among planting data. Planting information continues to be verified annually to capture both new plantings and changes to existing plantings resulting from tree removal or replacement.

Segregation of the benchmark data pool now includes analysis of the top 25%, middle 50% and bottom 25% of farms. These percentile based analyses are now integral to the industry benchmark report as they provide clear evidence of the extent of variability in farm productivity across industry. Analysis of the top 20 farms over multiple seasons has also been added in recent rounds to further differentiate and identify industry-leading farm management practices. Case studies resulting from these analyses have provided compelling models for practice change and productivity improvement for all industry members.

Differentiation of nut in husk could become a significant issue if the recent trend of increasing supply of nut in husk to markets such as China continues. This will continue to be reviewed if further project work is undertaken.

The value and robustness of the benchmark data resource has grown significantly with each additional season. The ability to analyse trends for so many farms over multiple seasons is significantly helping to distinguish factors that can be managed from those that are beyond the control of growers and farm managers. Similarly, analysis of individual farm performance over multiple seasons has been critical to identifying farms that are consistently productive and subsequently on-farm practices that are both profitable and sustainable.

Productivity Groups continued to be strongly supported during this project term despite static participation rates. An evaluation of these groups undertaken in a previous project term found that meetings were rated very highly by participants for generating ideas, sharing information and comparing and analysing practices.

"It's the ultimate to compare facts and figures of farms, locations and costs. It is the driver for our improved cost changes." (Grower / Productivity Group member)

Through direct discussions with group members it seems strong support for the groups and regular meetings still exists. The sense of ownership developed by group members and the focus on both local and industry-wide farm management issues has sustained participation in this part of the project.

From a project perspective the group meetings provide valuable contact with growers and stakeholders at a level not afforded by wider industry benchmarking. The groups are also a valuable conduit for collecting and verifying detailed agronomic and financial data that is not feasible to source via survey based collection methods.

If productivity groups are to continue as part of future work, it is important that they are reviewed in collaboration with group members to ensure they continue to service the needs of participants and also continue to provide data that is relevant to wider scale benchmarking activities. Productivity Groups are a relatively resource intensive part of the project but this service has great capacity to add significant value to the wider project as long as key learnings continue to be made available to the wider industry.

The integration of complementary products and services within the one project has afforded significant efficiencies. Development of standardised recording and reporting tools for industry assisted with and provided standardised approaches to data collection. Data collected via benchmarking and productivity groups informed development of industry profiles, which subsequently underpinned farm business and whole industry models. These models supported and informed industry investment, practice change, strategic planning and the industry extension strategy. The end result was efficient delivery of extensive, high quality information supporting decision making for growers, investors and industry stakeholders.

Recommendations

Summary

- Continue on-farm benchmarking at current or higher participation rates;
- Expand scope to include collection of additional empirical and quantitative data to support finer data segregation and analysis;
- Review Productivity Groups to ensure continued relevance and ongoing value to benchmarking activities and wider industry;
- Continue production of benchmarking summaries and productivity case studies to guide practice change;
- Continue update of *Financial Planner for Macadamia* templates from benchmark data;
- Continue to support analyses for specific farm business investment and practice change scenarios;
- Discontinue sales of the MacMan software but continue limited support for existing users;
- Discontinue the MacNet e-mail discussion group.

The macadamia strategic investment plan recommends continuation of on-farm benchmarking with a minimum 50% participation and expansion of the data recorded. A strong focus on promoting benchmarking and extending seasonal findings is included in the proposal for a future project.

Further value could be added to on-farm benchmarking by expanding the scope of data collected. This could include both empirical and quantitative agronomic indicators to allow finer segregation and categorisation for analysis and reporting. Examples may include approaches to pest and disease management, crop nutrition, soil and canopy management, use of pollinators, irrigation, on-farm nut drying and storage systems. Additional planting metrics such as canopy volume, tree height and light interception could also provide further insight. The inclusion of these data in subsequent benchmarking rounds should be considered by the industry Steering Group.

Participation currently represents approximately 55% of the industry by planted area and production. Promoting additional participation is recommended to ensure at least 50% of future industry production is sustained. The current high turnover of macadamia farms driven by strong global demand and corresponding high nut prices will mean that resources will need to be dedicated to engaging with new farm owners and managers to encourage ongoing participation.

Cost of production benchmarking began in the current project with 42 farms participating in the first round. These farms represent a cross section of industry for region, farm size, tree age and management structure. Analyses of costs provided an excellent opportunity for farm owners and managers to compare their heads of expenditure and costs of production per tree, per hectare and per tonne of nut-in-shell and kernel with similar farms in the industry. Collection of these data and reporting of findings is providing a clear picture of typical farm expenditure and profitability margins.

This information was last collected and reported as part of the "On-farm economic analysis in the Australian macadamia industry" project (MC03023) between 2003 and 2006.

Although annual input costs are typically more stable than productivity, this project has identified significant variability between farms. Collection of data over additional seasons and further analysis of on-farm circumstances is needed to clarify the causes of this variability. Early indications suggest potential for efficiency gains in this area. Expanding participation in cost recording will enable more farm owners and managers to gain a clearer picture of their comparative costs and margins. Increased participation will also provide the industry and other key stakeholders with a fuller, up-to-date understanding of macadamia farm economics.

Productivity groups provided networks for collection and comparison of intensive data that was impractical to collect across the whole benchmarking pool. Productivity groups should continue and evolve to ensure that this detailed data continues to complement benchmarking services and also that subsequent learnings are extended to the broader industry.

Based on a very positive response to a short video summary of the 2013 benchmarking production season, we recommend continued delivery of seasonal interpretations of results and detailed explanation of what these mean for growers. These may be provided in various formats including fact sheets, media articles and video. This will be important to ensure the learnings from each benchmarking season are captured and disseminated widely throughout the industry.

The *Financial Planner for Macadamia software* is considered a useful tool for farm business and industry investment scenario modelling. Existing templates that depict realistic farm business scenarios are used as the starting point for all analyses produced within this system. These templates will require updating with the latest agronomic and economic data, such as costs of production, as these become available.

Additional industry investment scenarios are likely to be required in response to specific forecasting requests. Continued provision of these services to the macadamia industry and other associated stakeholders is recommended to support informed industry investment, positive practice change and reliable evaluation of research beyond the current project.

Over 40 updates to the MacMan farm recording software were released between 1999 and 2012 to satisfy strong industry demand. This demand was met following its release to more than 400 clients. Project resources were subsequently directed towards supporting existing registered users. This support has included assistance with setup, function and data maintenance with the broader goal of supporting data collection for benchmarking purposes. With this ongoing objective in mind, we recommend continuation of some support in future projects with an expectation of limited and diminishing demand. Given the multitude of technology platforms and data-keeping solutions now available, no further development of this product is recommended. It is also recommended that MacMan sales should be discontinued at the end of the current project.

The MacNet e-mail discussion group has provided a moderated forum for over 240 subscribers to share information and ideas, including growers, researchers and consultants. This service was highly regarded by this audience as a platform for sharing knowledge and experience. With the availability of alternative services now supporting information exchange within industry, participation rates and frequency of use have decreased in recent years. We therefore recommend discontinuation of this service beyond the current project.

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Australian Farm Business Management Journal. Volume 9 No. 2, pp57-69

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Published via DAF and AMS web sites, May 2013, 21 pages

Benchmarking report: The Australian macadamia industry (2009-2011 seasons)

Published via DAF and AMS web sites, September 2012, 130 pages

Benchmarking executive summary: The Australian macadamia industry (2009-2011 seasons)

Published via DAF and AMS web sites, September 2012, 19 pages

Benchmarking report: The Australian macadamia industry (2009-2010 seasons)

Published via DAF and AMS web sites, November 2011, 117 pages

Video stories and case studies

Video: *Productivity study of mature macadamia orchards*
Published via macSmart (July 2014)

Video: *Lessons that can be learned from the 2013 season*
Published via macSmart (June 2014)

Video: *Productivity case study, Wirrimbi Orchard*
Published via macSmart (June 2014)

Video: *Macadamia on-farm benchmarking for the 2013 season*
Published via macSmart (December 2013)

Video: *Productivity case study, Plantation Lorna Orchard*
Published via macSmart (November 2013)

Video: *Summary of industry on-farm benchmarking results (2009-2012)*
Published via macSmart (August 2013)

Video: *Productivity case study, Merraldan Farm (Part 1, Overview)*
Published on the macSmart web site (April 2013)

Video: *Productivity case study, Merraldan Farm (Part 2 Canopy and orchard floor management)*
Published on the macSmart web site (April 2013)

Video: *Productivity case study, Merraldan Farm (Part 3 Harvesting and post-harvest handling)*
Published on the macSmart web site (April 2013)

AMS News Bulletin articles

Improving drying and handling systems can reduce your losses

AMS News Bulletin, Volume 38 No. 2 (March 2010)

How efficient is your farm?

AMS News Bulletin, Volume 38 No. 3 (May 2010)

Feature on brown centres

AMS News Bulletin, Volume 38 No. 4 (July 2010)

Financial Planner for Macadamia now available

AMS News Bulletin, Volume 38 No. 5 (September 2010)

How do you make important financial decisions for your macadamia farm?

AMS News Bulletin, Volume 39 No. 1 (January 2011)

What is benchmarking all about?

AMS News Bulletin, Volume 39 No. 2 (March 2011)

Benchmarking rankings and regional summaries

AMS News Bulletin, Volume 39 No. 4 (August 2011)

Benchmarking industry summary

AMS News Bulletin, Volume 39 No. 5 (October 2011)

Best practice groups helping macadamia growers make better farm decisions

AMS News Bulletin, Volume 40 No. 2 (May, 2012)

Benchmarking study analyses yield and quality results

AMS News Bulletin, Volume 40 No. 4 (November, 2012)

Industry benchmarking 2009-2012

AMS News Bulletin, Vol 41 No. 3 (August, 2013)

Benchmarking for the 2013 season now underway

AMS News Bulletin, Vol 41 No. 4 (November, 2013)

Industry benchmarking update 2009-2013
AMS News Bulletin, Volume 42 No. 2 (May, 2014)

Learning lessons from high productivity farms
AMS News Bulletin, Volume 42 No. 3 (August, 2014)

2014 benchmarking underway
AMS News Bulletin, Volume 42 No. 4 (November, 2014)

Productivity Groups compare costs of production
AMS News bulletin, Volume 43, No. 1 (February 2015)

Benchmarking shows yield and quality trends
AMS News bulletin, Volume 43, No. 2 (May 2015)

Northern Rivers Productivity Group goes to Nambucca
AMS News bulletin, Volume 43, No. 2 (May 2015)

Benchmarking shows major difference in tree age performance
Submitted for AMS News Bulletin, Volume 43, No. 3 (August 2015)

Labour still the major cost in growing macadamias
Submitted for AMS News Bulletin, Volume 43, No. 3 (August 2015)

Other reports

Evidence framework for owner reimbursement costs for the macadamia industry

Produced for Plant Health Australia, March 2014

Macadamia industry farm financial information report

Produced for the Australian Taxation Office, February 2013

Macadamia farm cash flow analysis 2003-06 with 2008-09 estimates

Produced for macadamia growers and investors, March 2010

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- Grant Bignell, Department of Agriculture and Fisheries
- Jeremy Bright, NSW Department of Primary Industries
- Robbie Commens, Australian Macadamia Society
- Ingrid Jenkins, Department of Agriculture and Fisheries
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- Paul O'Hare, Department of Agriculture and Fisheries
- Geoff Slaughter, University of Southern Queensland

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- Lindsay Bryen
- Jolyon Burnett
- Paul Chapman
- Chris Searle
- Andrew Starkey
- Kim Wilson

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We also wish to thank members of the Bundaberg, Gympie, Glasshouse Mountains, Lismore, Alstonville, Rosebank and Nambucca Productivity Groups for their participation in the groups and for their commitment to improvement within their businesses and also the wider industry.

We would also like to thank the many researchers and consultants who shared their time and expertise in participating in Productivity Group activities.

Appendix 1

Industry on-farm benchmarking Grower Report for 2014 (sample only)

Dear benchmarking participant

Thank you for participating in the macadamia industry on-farm benchmarking. This work is part of the levy funded project "*Improving farm productivity and competitiveness in the Australian macadamia industry*" (MC09001). This is a joint initiative of DAF Queensland, the University of Southern Queensland and NSW DPI, with funding and support from the Australian Macadamia Society and Horticulture Innovation Australia Limited.

A total of 266 macadamia farms participated in this latest round of the benchmarking study, which covers the 2009 to 2014 production seasons. These farms represent over 50% of production and planted area for the 2014 season.

This report includes the following:

- A summary comparing yield and nut quality for your farm with all farms in the survey sample, other farms in your locality and region, other farms of a similar size, similar age and similar management system;
- Charts ranking the performance of your farm against all others in the survey sample for production and kernel recovery;
- Productivity rankings within each of the major production regions;
- Charts ranking average productivity over the last six seasons, both within your region and also the whole survey sample;
- A comparison of your reject analysis with other farms in the survey sample;
- Trend charts showing production and kernel recovery for your farm and averages for other farms in your region over the last six seasons.
- A summary of the original data that you, or your processor(s) with your consent on your behalf, provided to us.

It is important to note that your individual farm data and reports are confidential. Only summary data has or will be used in publications and summary reports.

There are some key points to consider when analysing the reports:

- Although some farms start harvesting small amounts of nuts from younger trees, we have not included plantings less than 5 years of age when calculating bearing hectares. This is important for uniformity within the benchmarking study.
- We have tried to use standard terms to describe kernel recovery and reject analysis categories. We acknowledge that different processors sometimes use different terminology to describe similar quality categories.
- In the enclosed reports the sum of the reject kernel analysis categories equal the total reject kernel recovery % rather than adding to 100%. This is also important for uniformity within the benchmarking study.

Please contact the project team at macman@daf.qld.gov.au or 07 5453 5800 if you have any questions about your results or anything else associated with the on-farm benchmarking project.

Yours sincerely

The benchmarking project team

Benchmark report on yield and quality for 2014

Farm: Sample Mac Farm **Owner / Manager: Farm Manager**

Your yield results compared with the averages of bearing farms in the survey	Total farms	Bearing farms *	Planted hectares	Bearing hectares *	NIS yield (t / bearing ha) **	Moisture content %	Whole kernel %	Saleable kernel (t / bearing ha)	Total kernel (t / bearing ha)
Your farm	1	1	28.27	28.27	2.88	18		0.93	0.98
All farms in the benchmark pool	267	266	38.01	37.04	2.49	14.64	53.76	0.82	0.87
Far NNSW region	143	143	22.77	22.34	2.77	17.2	54.44	0.91	0.97
Lismore locality (2480)	74	74	23.39	23.09	2.56	16.97	52.47	0.82	0.88
Similar bearing tree age (25+ years)	65	65	31.51	31.3	3.03	15.8	51.77	0.94	1
Similar farm size (20 to 30 ha.)	33	33	25.37	25.28	2.69	15.26	53.64	0.86	0.93
All owner operated farms	192	191	24.65	23.88	2.51	15.28	53.41	0.83	0.88
All non-irrigated farms	194	194	23.26	22.93	2.65	15.85	54.97	0.88	0.93

* Plantings less than 5 years old are not considered to be bearing in this analysis.
** Nut-in-shell (NIS) yield is reported at 10% moisture content.

Your quality results compared with the averages of bearing farms in the survey	Kernel recoveries ^			Reject kernel analysis % ^^					
	Premium KR%	Commercial KR%	Reject KR%	Insect damage %	Mould %	Discoloured %	Internal disc. %	Immature %	Germinated %
Your farm	32.4	2.1	2.1	0.4	0.2	0.4	0.2	0.4	0.4
All farms in the benchmark pool	31.09	3.61	2.76	0.73	0.51	0.26	0.42	0.74	0.08
Far NNSW region	30.71	4.22	2.56	0.78	0.54	0.3	0.4	0.43	0.09
Lismore locality (2480)	29.77	4.08	2.79	0.81	0.63	0.35	0.44	0.43	0.1
Similar bearing tree age (25+ years)	29.58	3.3	2.47	0.66	0.49	0.22	0.48	0.5	0.1
Similar farm size (20 to 30 ha.)	30.83	3.54	2.58	0.59	0.5	0.32	0.42	0.64	0.08
All owner operated farms	31.28	3.41	2.73	0.72	0.54	0.25	0.32	0.83	0.08
All non-irrigated farms	30.81	4.03	2.75	0.74	0.53	0.26	0.38	0.73	0.09

^ Standard terms have been used to describe kernel recovery and reject analysis categories. Some processors use different terms to describe similar quality categories.
^^ The sum of all reject analysis categories reported equals the total unsound (or reject) kernel recovery % rather than adding up to 100%.
Wherever fewer than 10 farms are available in any given group, no average will be shown for that group. These are marked as "n/a".

Summary of data submitted for benchmarking (2014 season)

Please review this information and report any errors to the benchmarking team

Grower and farm details

Grower name Mr Farm Manager

Company Macadamia Farm

Address 550 Sample Lane ALSTONVILLE NSW 2480

E-mail sample@macadamia.com.au

Farm name Sample Mac Farm

Irrigated ✖ Organic ✖

Consignment details for this farm

NIS tonnes	81.5	**Insect %**	0.4
Consigned MC %	18	**Mould %**	0.2
Premium KR %	32.4	**Discoloured %**	0.4
Commercial KR %	2.1	**Brown centres %**	0.2
Reject KR %	2.1	**Immature %**	0.4
Whole kernel %		**Germinated %**	0.4

Planted areas as applied to the current season

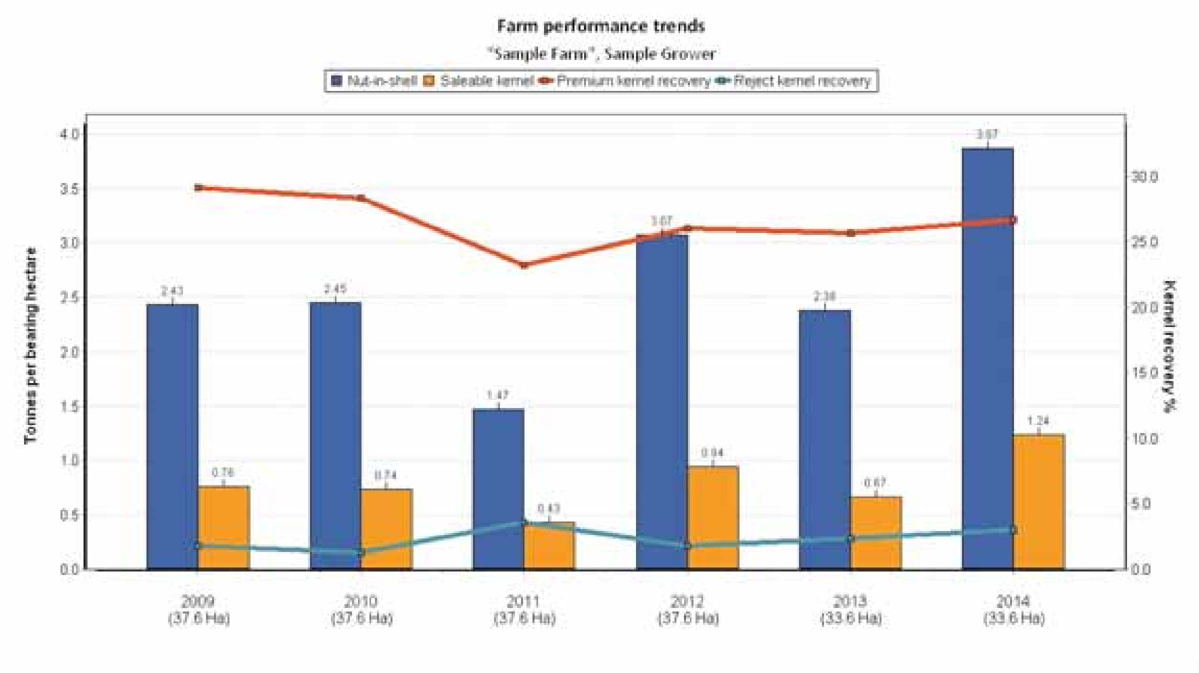
Total hectares 28.27

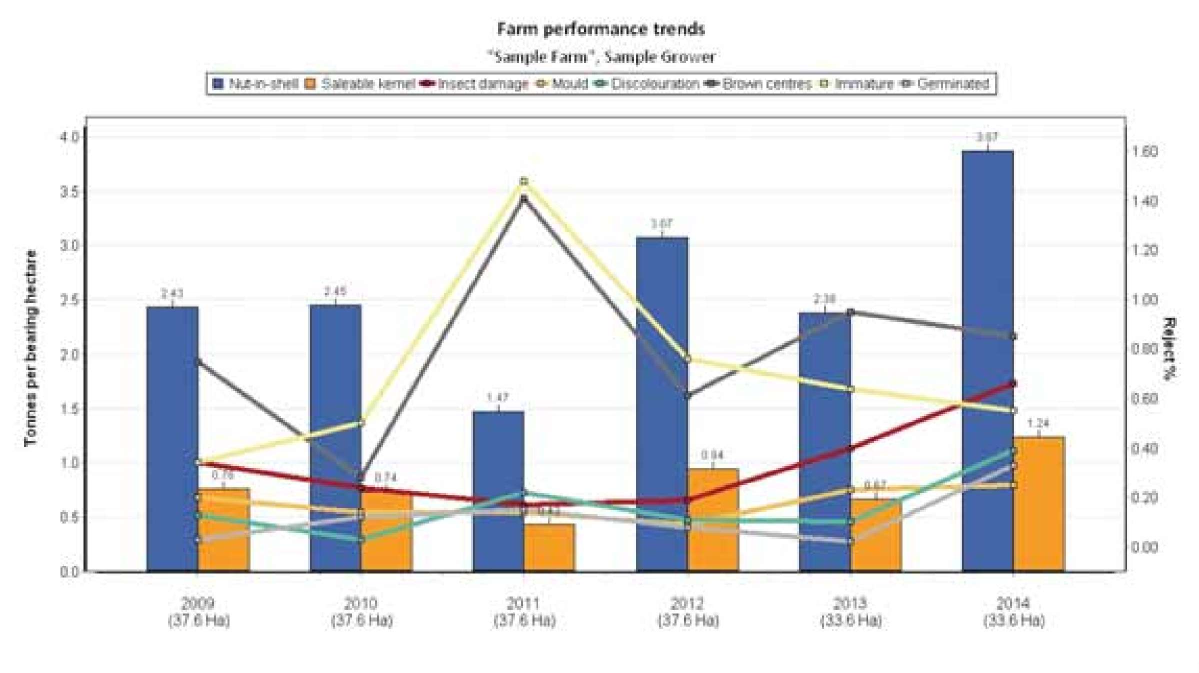
Bearing hectares 28.27 *

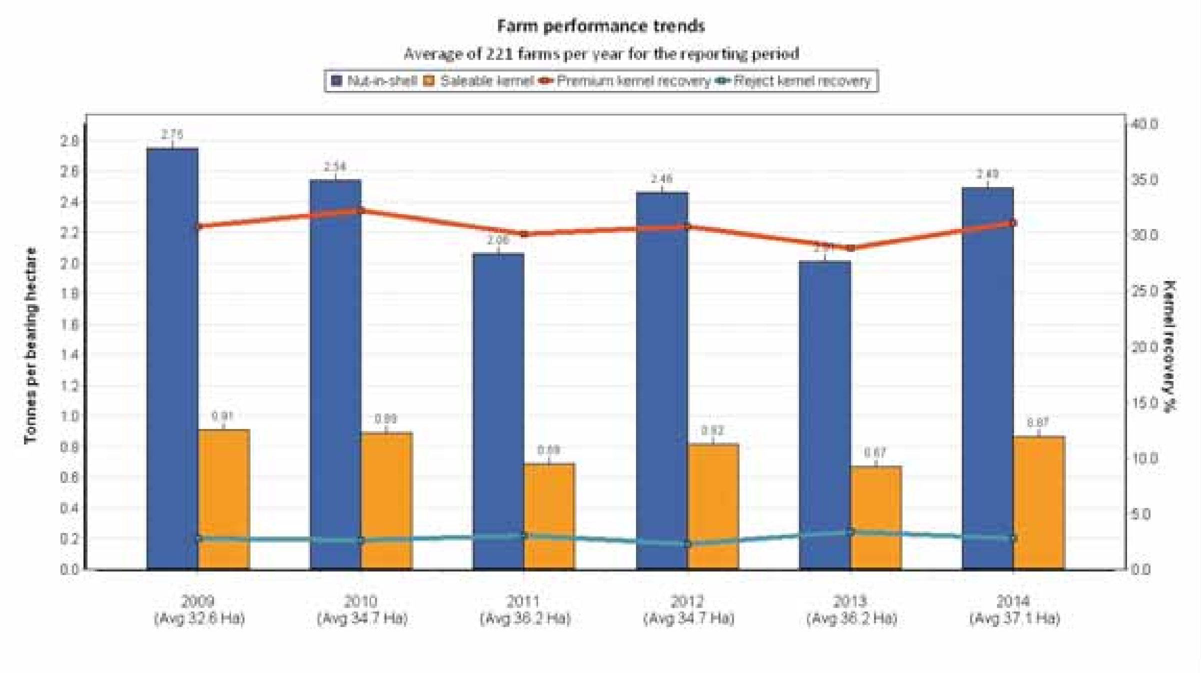
* Note that trees must be aged 5 years or older to be considered bearing

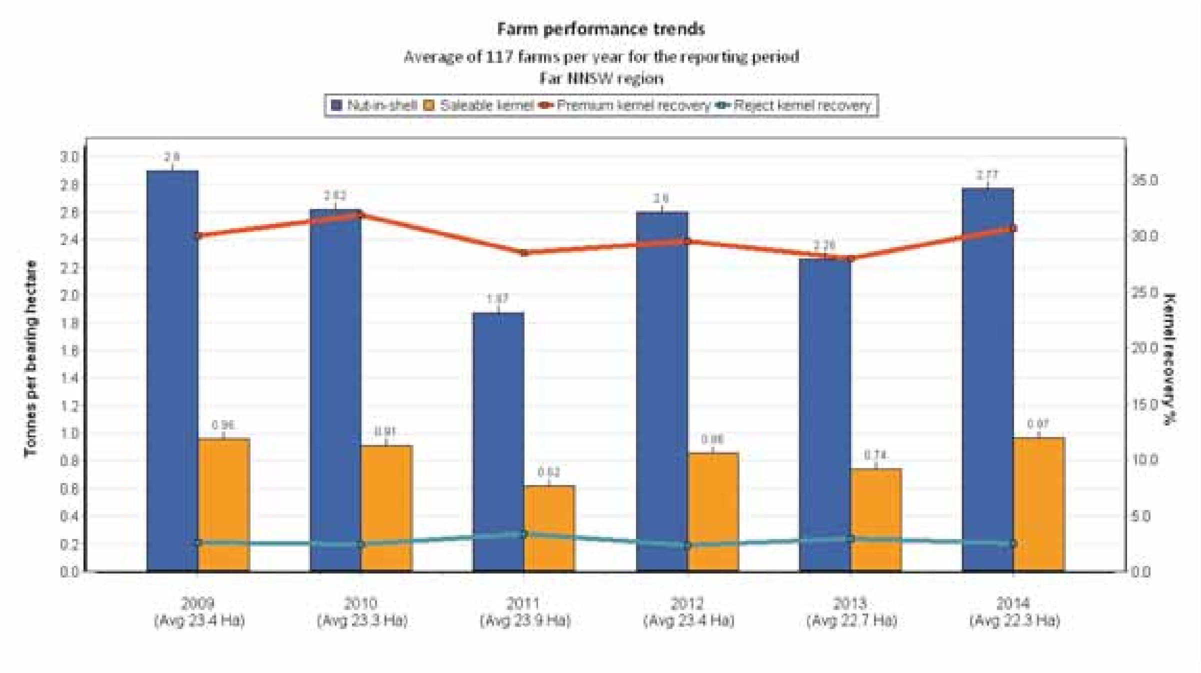
Planting details recorded for this farm (Please update or add information as required)

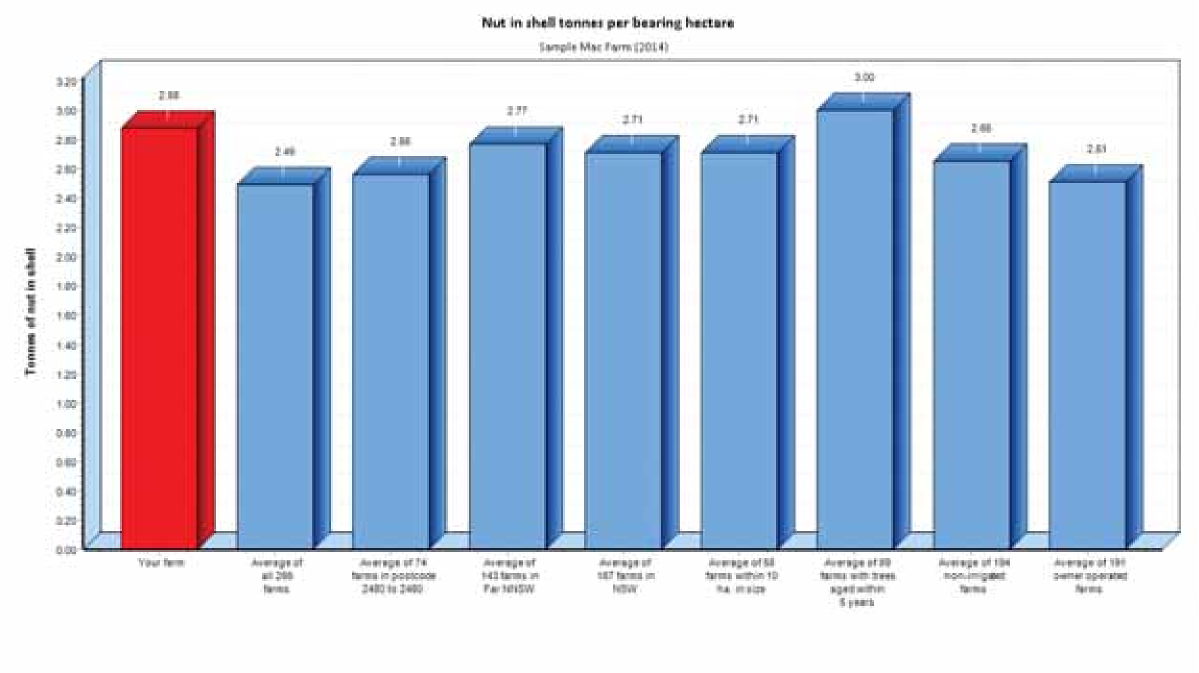
Year planted	Trees	Spacing	Variety	Hectares	Your notes
1980	5000	8 x 4 m	Mixed	16.03	
2000	3500	7 x 5 m	Mixed	12.24	
Totals	**8500**			**28.27**	

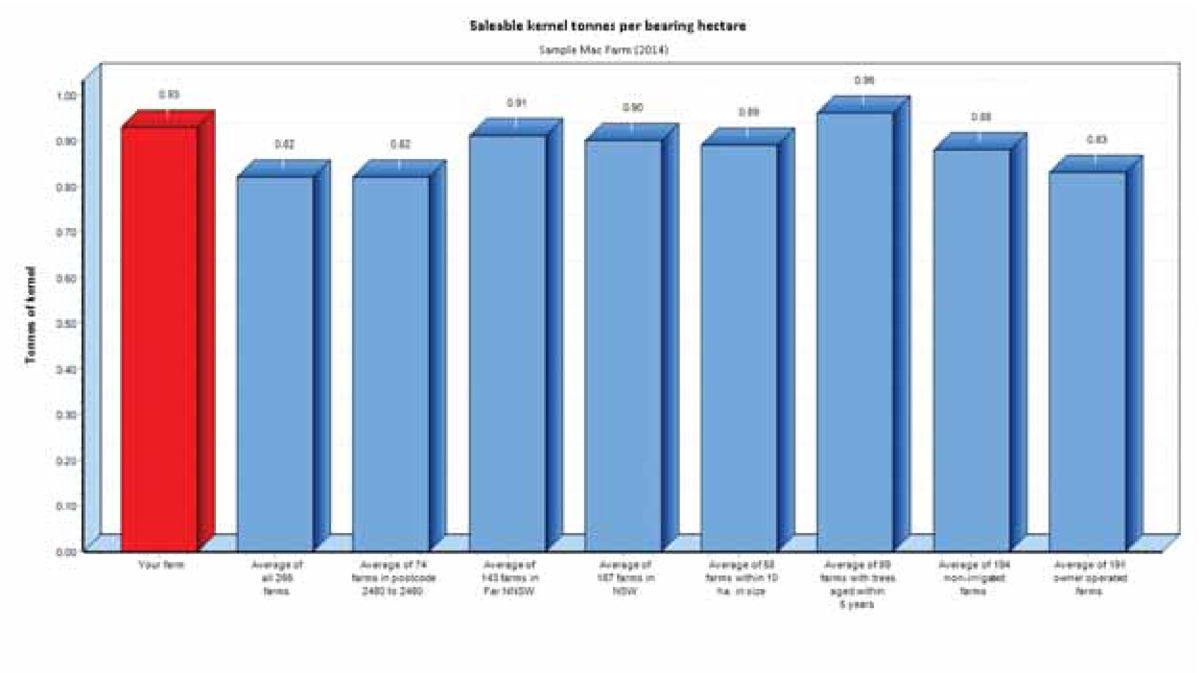

Farm performance trends
"Sample Farm", Sample Grower
Nut-in-shell
Saleable kernel
Premium kernel recovery
Reject kernel recovery
Tonnes per bearing hectare
Kernel recovery %
2.43
2.45
1.47
3.07
2.38
3.87
0.76
0.74
0.43
0.94
0.67
1.24
2009 (37.6 Ha)
2010 (37.6 Ha)
2011 (37.6 Ha)
2012 (37.6 Ha)
2013 (33.6 Ha)
2014 (33.6 Ha)

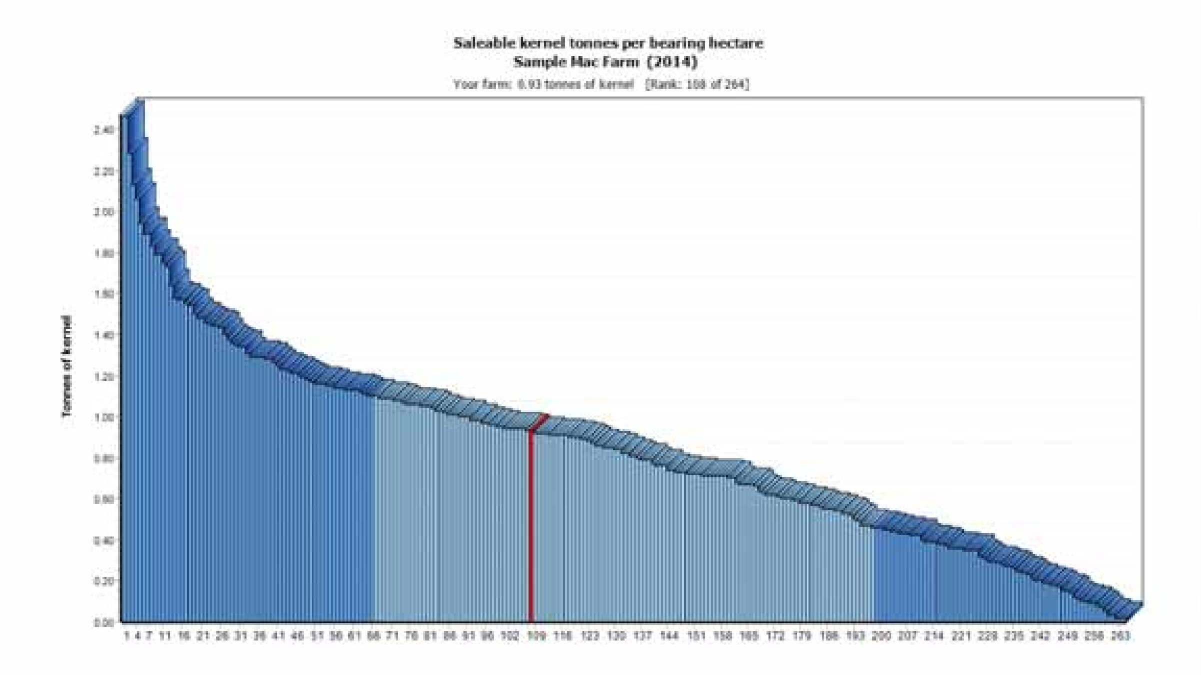

Farm performance trends
"Sample Farm", Sample Grower
Nut-in-shell
Saleable kernel
Insect damage
Mould
Discolouration
Brown centres
Immature
Germinated
Tonnes per bearing hectare
Reject %
2.43
2.45
1.47
3.07
2.38
3.87
0.76
0.74
0.43
0.94
0.67
1.24
2009 (37.6 Ha)
2010 (37.6 Ha)
2011 (37.6 Ha)
2012 (37.6 Ha)
2013 (33.6 Ha)
2014 (33.6 Ha)

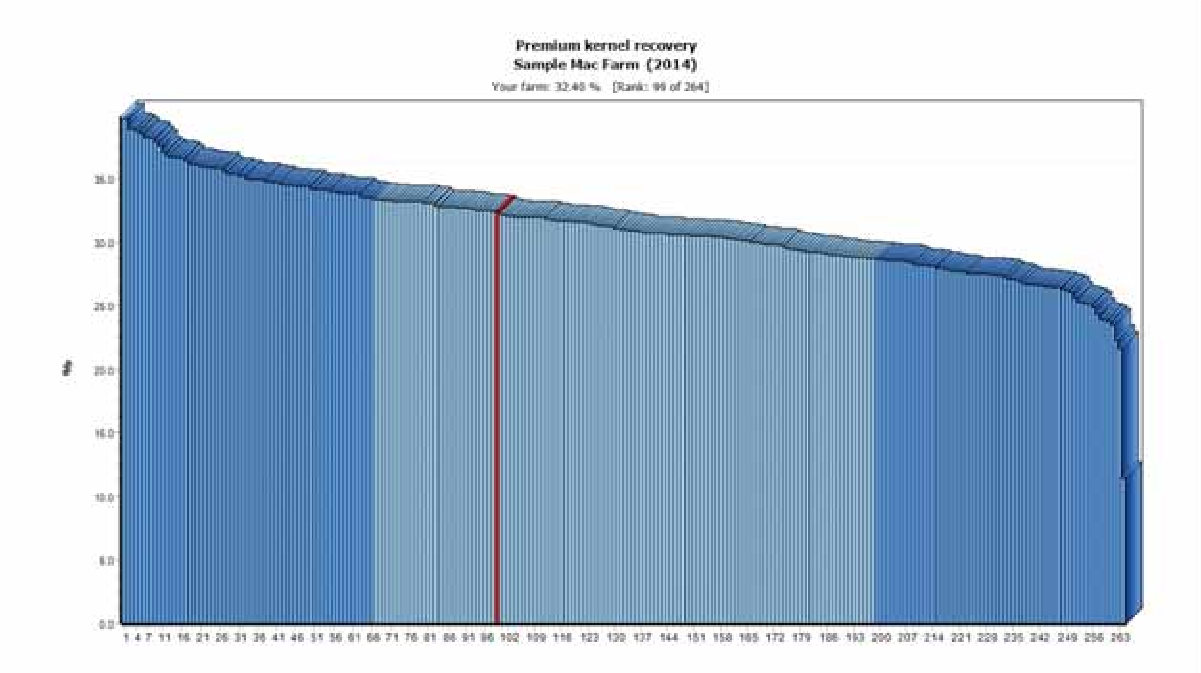

Farm performance trends
Average of 221 farms per year for the reporting period
Nut-in-shell
Saleable kernel
Premium kernel recovery
Reject kernel recovery
Tonnes per bearing hectare
Kernel recovery %
2.75
2.54
2.06
2.46
2.01
2.49
0.91
0.89
0.69
0.82
0.67
0.87
2009 (Avg 32.6 Ha)
2010 (Avg 34.7 Ha)
2011 (Avg 36.2 Ha)
2012 (Avg 34.7 Ha)
2013 (Avg 36.2 Ha)
2014 (Avg 37.1 Ha)

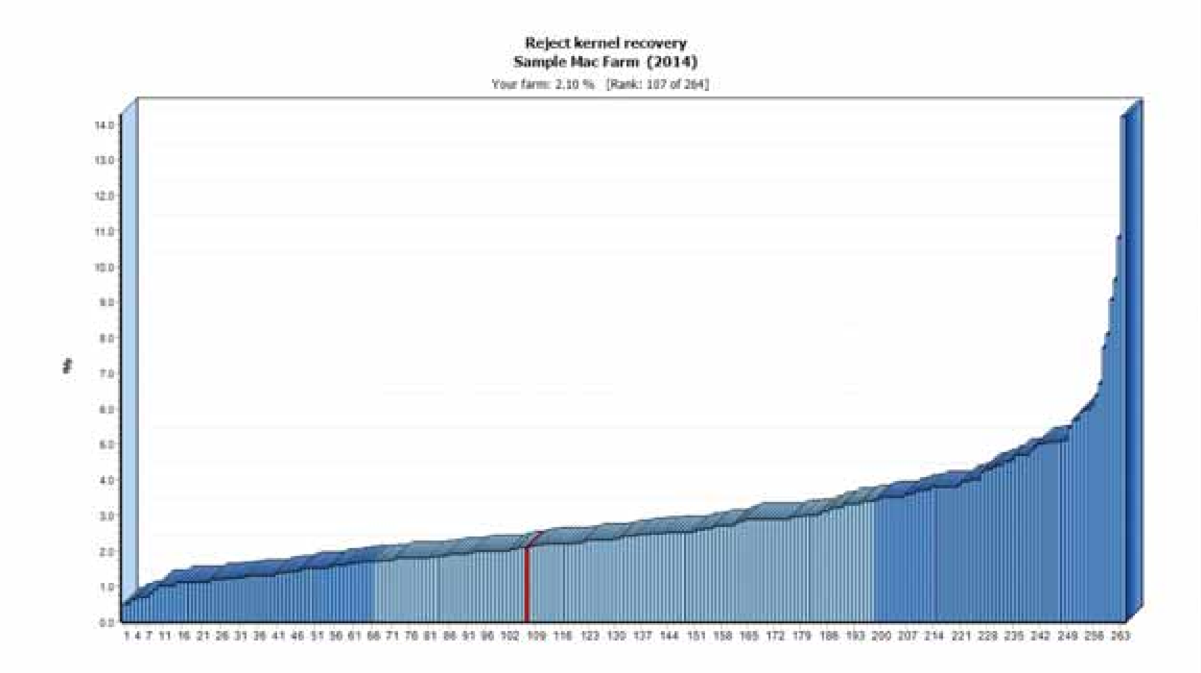

Farm performance trends
Average of 117 farms per year for the reporting period
Far NNSW region
Nut-in-shell
Saleable kernel
Premium kernel recovery
Reject kernel recovery
Tonnes per bearing hectare
Kernel recovery %
2.9
2.62
1.87
2.6
2.26
2.77
0.96
0.91
0.62
0.86
0.74
0.97
2009 (Avg 23.4 Ha)
2010 (Avg 23.3 Ha)
2011 (Avg 23.9 Ha)
2012 (Avg 23.4 Ha)
2013 (Avg 22.7 Ha)
2014 (Avg 22.3 Ha)

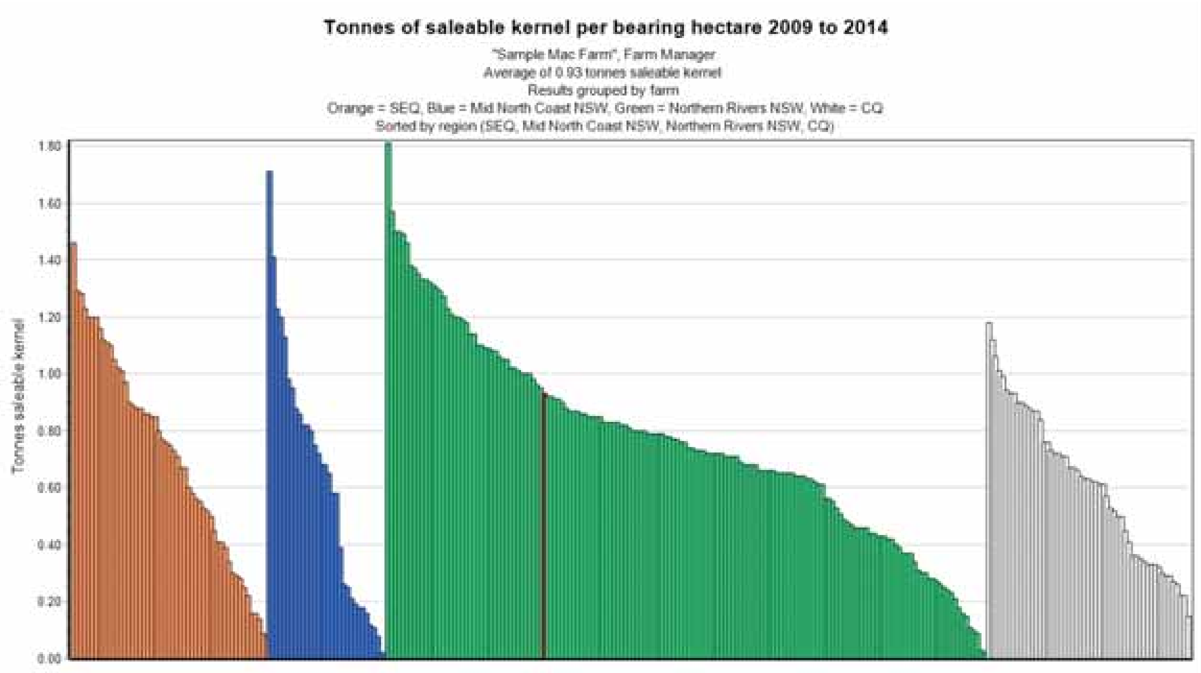

Nut in shell tonnes per bearing hectare
Sample Mac Farm (2014)
Tonnes of nut in shell
2.88
2.49
2.56
2.77
2.71
2.71
3.00
2.66
2.51
Your farm
Average of all 266 farms
Average of 74 farms in postcode 2480 to 2490
Average of 143 farms in Far NNSW
Average of 187 farms in NSW
Average of 58 farms within 10 ha. in size
Average of 89 farms with trees aged within 5 years
Average of 184 non-irrigated farms
Average of 191 owner operated farms

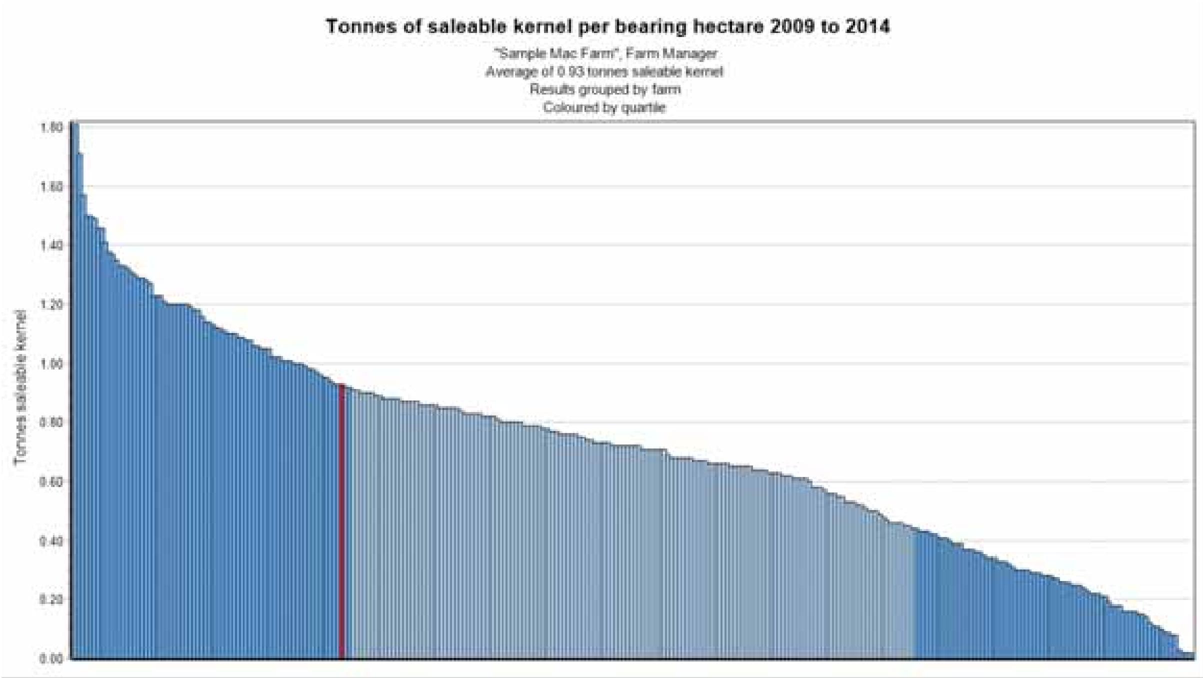

Saleable kernel tonnes per bearing hectare
Sample Mac Farm (2014)
Tonnes of kernel
0.93
0.82
0.82
0.91
0.90
0.89
0.96
0.88
0.83
Your farm
Average of all 266 farms
Average of 74 farms in postcode 2480 to 2490
Average of 143 farms in Far NNSW
Average of 187 farms in NSW
Average of 58 farms within 10 ha. in size
Average of 89 farms with trees aged within 5 years
Average of 184 non-irrigated farms
Average of 191 owner operated farms

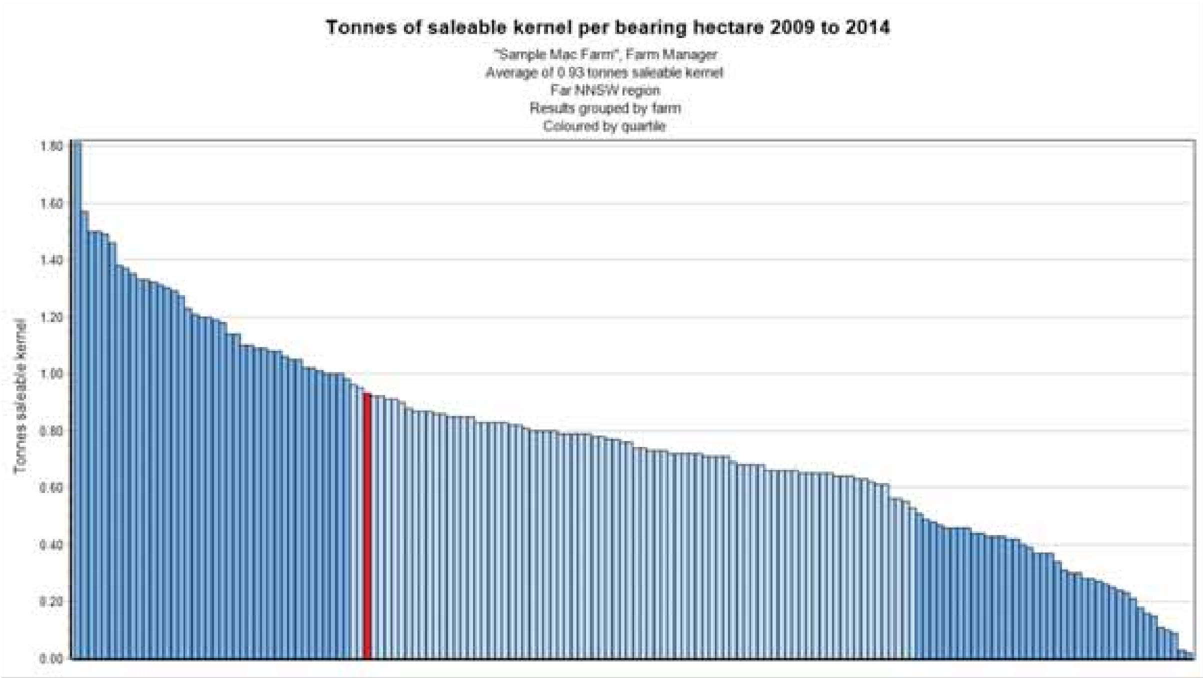

Saleable kernel tonnes per bearing hectare
Sample Mac Farm (2014)
Your farm: 0.93 tonnes of kernel [Rank: 108 of 264]
Tonnes of kernel

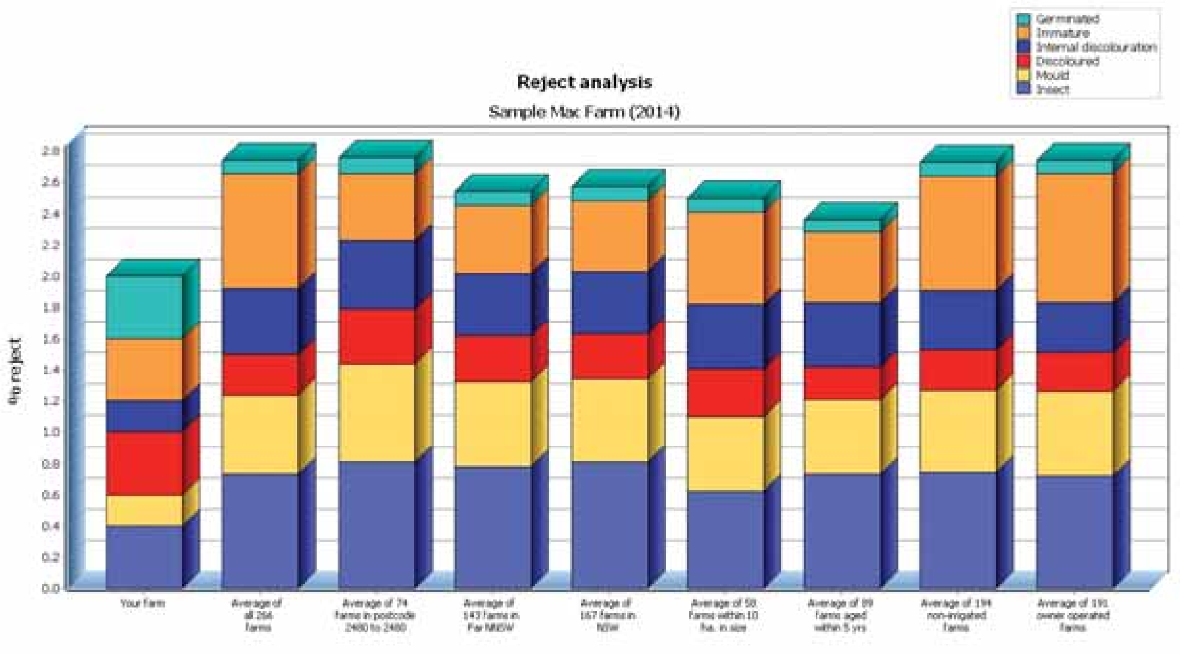

Premium kernel recovery
Sample Mac Farm (2014)
Your farm: 32.40 % [Rank: 99 of 264]
%


Reject kernel recovery
Sample Mac Farm (2014)
Your farm: 2.10 % [Rank: 107 of 264]
%


Tonnes of saleable kernel per bearing hectare 2009 to 2014
"Sample Mac Farm", Farm Manager
Average of 0.93 tonnes saleable kernel
Results grouped by farm
Orange = SEQ, Blue = Mid North Coast NSW, Green = Northern Rivers NSW, White = CQ
Sorted by region (SEQ, Mid North Coast NSW, Northern Rivers NSW, CQ)
Tonnes saleable kernel


Tonnes of saleable kernel per bearing hectare 2009 to 2014
"Sample Mac Farm", Farm Manager
Average of 0.93 tonnes saleable kernel
Results grouped by farm
Coloured by quartile
Tonnes saleable kernel
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00


Tonnes of saleable kernel per bearing hectare 2009 to 2014
"Sample Mac Farm", Farm Manager
Average of 0.93 tonnes saleable kernel
Far NNSW region
Results grouped by farm
Coloured by quartile
Tonnes saleable kernel
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00


Reject analysis
Sample Mac Farm (2014)
Germinated
Immature
Internal discolouration
Discoloured
Mould
Insect
% reject
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
Your farm
Average of all 266 farms
Average of 74 farms in postcode 2480 to 2480
Average of 143 farms in Far NNSW
Average of 167 farms in NSW
Average of 58 farms within 10 ha. in size
Average of 89 farms aged within 5 yrs
Average of 194 non-irrigated farms
Average of 191 owner operated farms

Appendix 2

Industry on-farm benchmark report (2009-2014 seasons)

Benchmarking report

The Australian macadamia industry

Improving farm productivity
and competitiveness in the
Australian macadamia industry

2009 – 2014 seasons

Project: MC09001

Project Team

The “Improving farm productivity and competitiveness in the Australian macadamia industry” project team include:

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- Chris Noble, Research Officer,
  University of Southern Queensland
- Jeremy Bright, Development Officer - Macadamia,
  NSW Department of Primary Industries
- Robbie Commens, Productivity Development Officer,
  Australian Macadamia Society

Contents

1. Disclaimer

Yield and quality results presented in this report are based on data provided by industry participants. To ensure the confidentiality of raw data collected, this report includes group averages only. Figures presented are based on summary statistics using underlying data that are not included in this report.

The findings from this data are intended to be indicative rather than prescriptive. While every care has been taken to ensure the validity of information collected and analyses produced, neither the Department of Agriculture and Fisheries Queensland nor any of its project partners or persons acting on its behalf, makes any promise, representation, warranty or undertaking in relation to the appropriateness of findings in this report.

Horticulture Innovation Australia Limited (HIA Ltd), Department of Agriculture and Fisheries Queensland, University of Southern Queensland and New South Wales Department of Primary Industries make no representations and expressly disclaim all warranties (to the extent permitted by law) about the accuracy, completeness, or currency of information in this report.

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2. Acknowledgements

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3. Summary

This report summarises the findings of the latest round of on-farm benchmarking conducted as part of the MC09001 project *"Improving farm productivity and competitiveness in the Australian macadamia industry"*. The benchmarking study now covers the six production seasons from 2009 to 2014.

Variation in yield per hectare has a major bearing on farm profitability. The *"On-farm economic analysis in the Australian macadamia industry"* project (MC03023) found a very strong correlation between farm productivity and profitability.

The focus of the study has been on analysing, comparing and reporting yield and quality results. This is consistent with the key objective from the Macadamia Industry Strategic Investment Plan for 2014 to 2019 to "sustainably increase the productivity of Australian macadamia farms".

Benchmarking was expanded in 2014 to also cover an analysis of macadamia farming costs of production. The results of the costs of production study are covered in a separate report.

3.1 Sample description

Farm details and production data were collected following the 2014 harvest season from 265 bearing farms. Most of these farms also provided data in the previous years of the benchmarking. These farms represented approximately 55% of the Australian macadamia industry by planted area and production. They also represented a cross section of farms in the Australian macadamia industry for location, farm size, tree age, irrigation status and management structure. The number of participating farms has increased in each round of the benchmarking.

Participating farms were categorised into the four major production regions:

- Central Queensland, including Bundaberg (CQ)
- South East Queensland (SEQ)
- Northern Rivers of New South Wales (NRNSW)
- Mid North Coast of New South Wales (MNNSW)

Figure 3.1-1 shows the average planting and bearing hectares in the different regions for participating farms in 2014. Central Queensland farms had an average planted area in 2014 of 95.83 hectares. This was more than three times the average planted area of the farms from the other three regions. The Mid North Coast of New South Wales farms had the smallest average planted area (16.42 hectares in 2014).

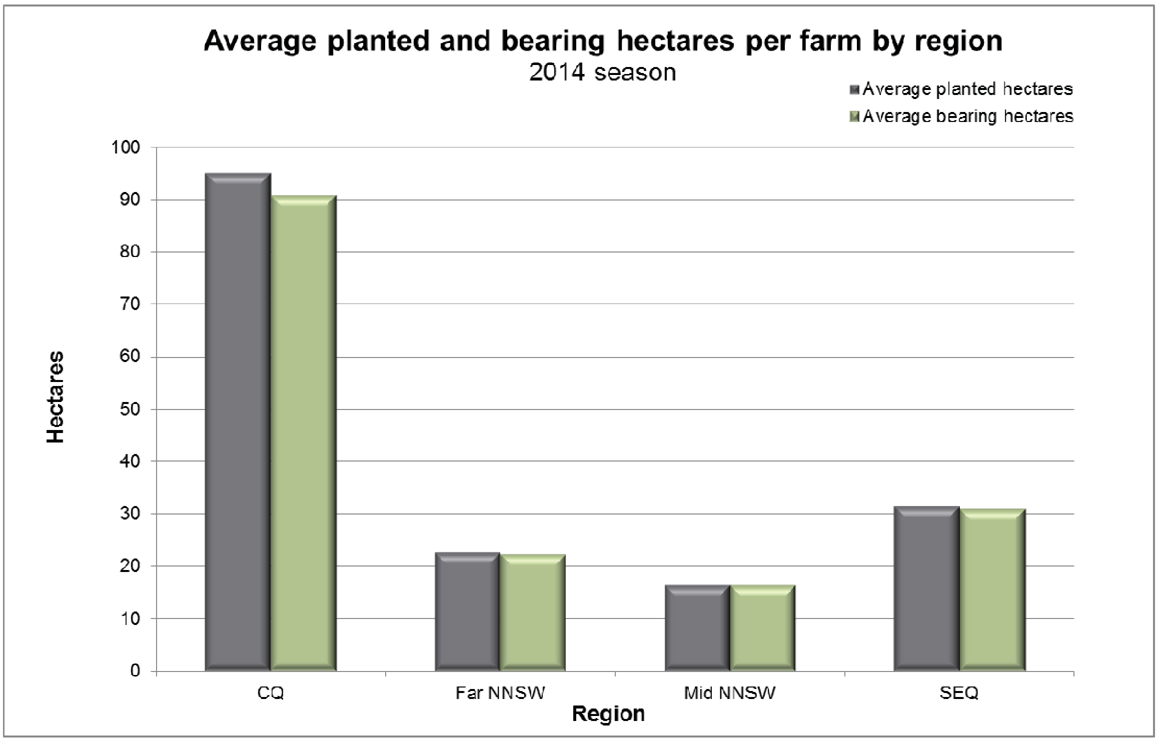


Figure 3.1-1: Average area of planted and bearing hectares per farm in the different regions for the 2014 season

Farms were divided into farm size categories for statistical analysis. Figure 3.1-2 shows the greatest concentration of farms was in the group with less than 10 bearing hectares. Most of these farms were in New South Wales.

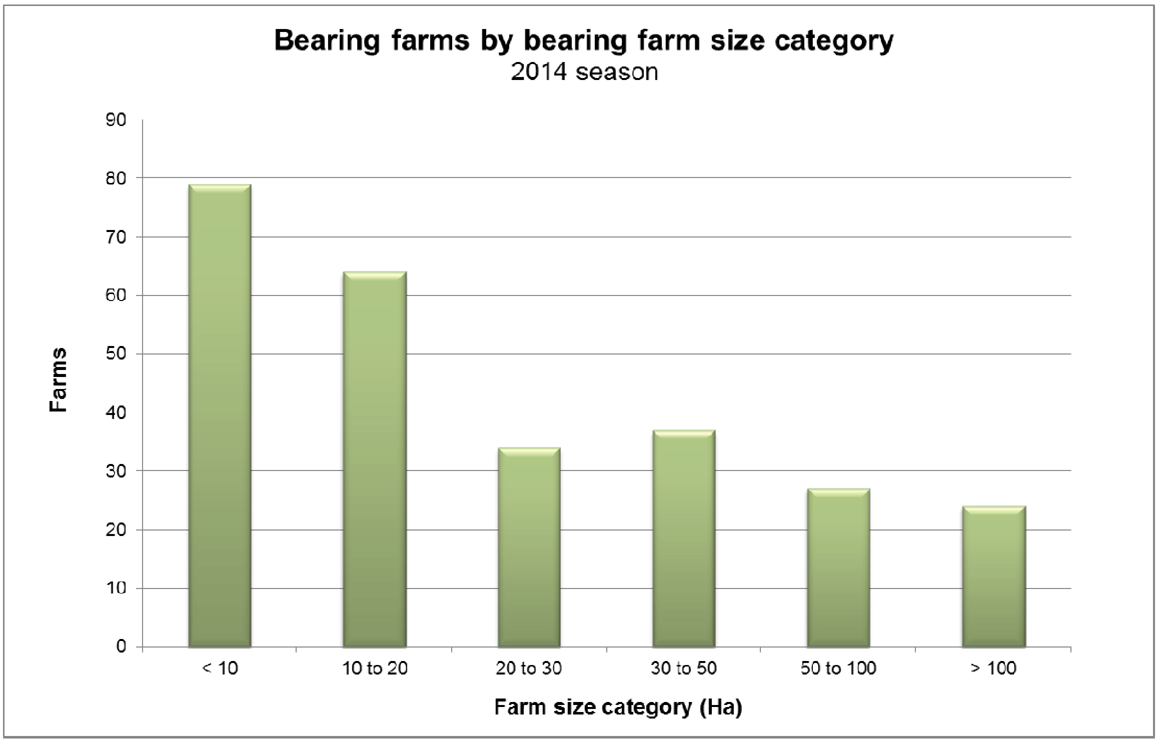


Figure 3.1-2: Number of bearing farms in each farm size category for the 2014 season

Figure 3.1-3 shows the average age of bearing trees from Central Queensland farms was 11.3 years. This was much younger than the average tree age from the farms in the other three regions. The Northern Rivers of New South Wales farms had the oldest average bearing tree age at 23.3 years.

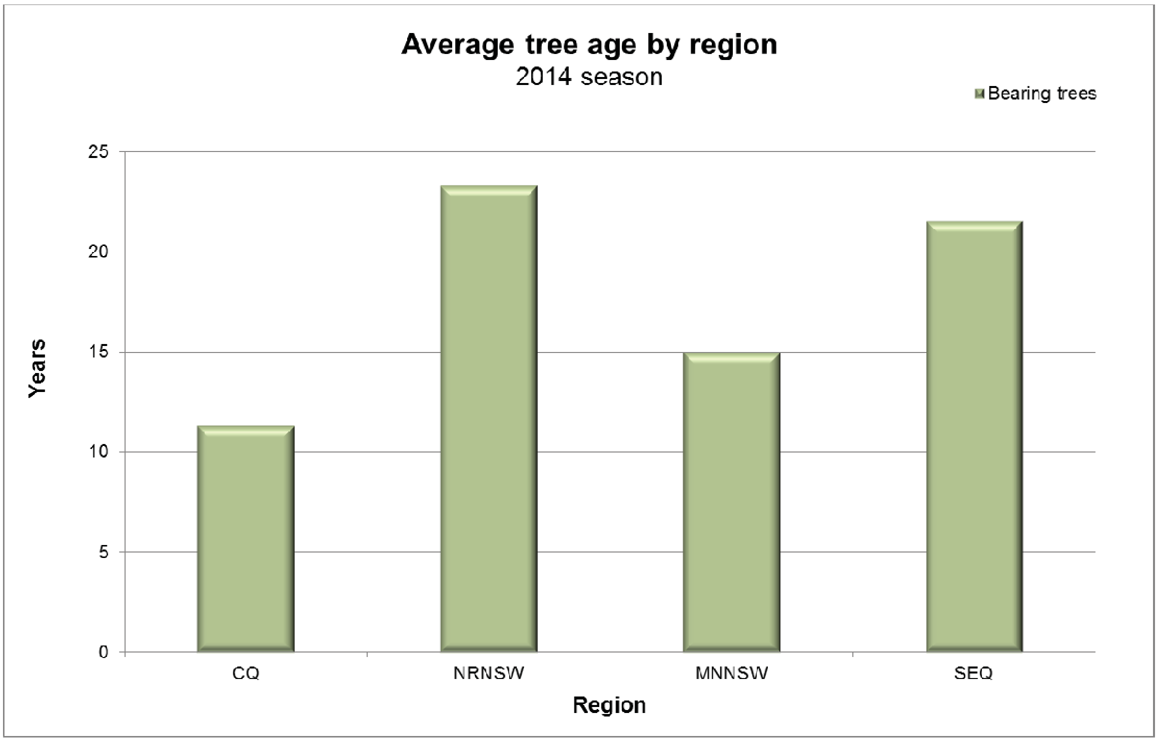


Figure 3.1-3: Average age of bearing trees in the different regions for the 2014 season

Figure 3.1-4 provides a breakdown of the average tree age for all farms involved in the benchmarking in 2014. The oldest farms in the benchmarking had an average tree age of 39 years. This corresponds to trees planted on average in 1975.

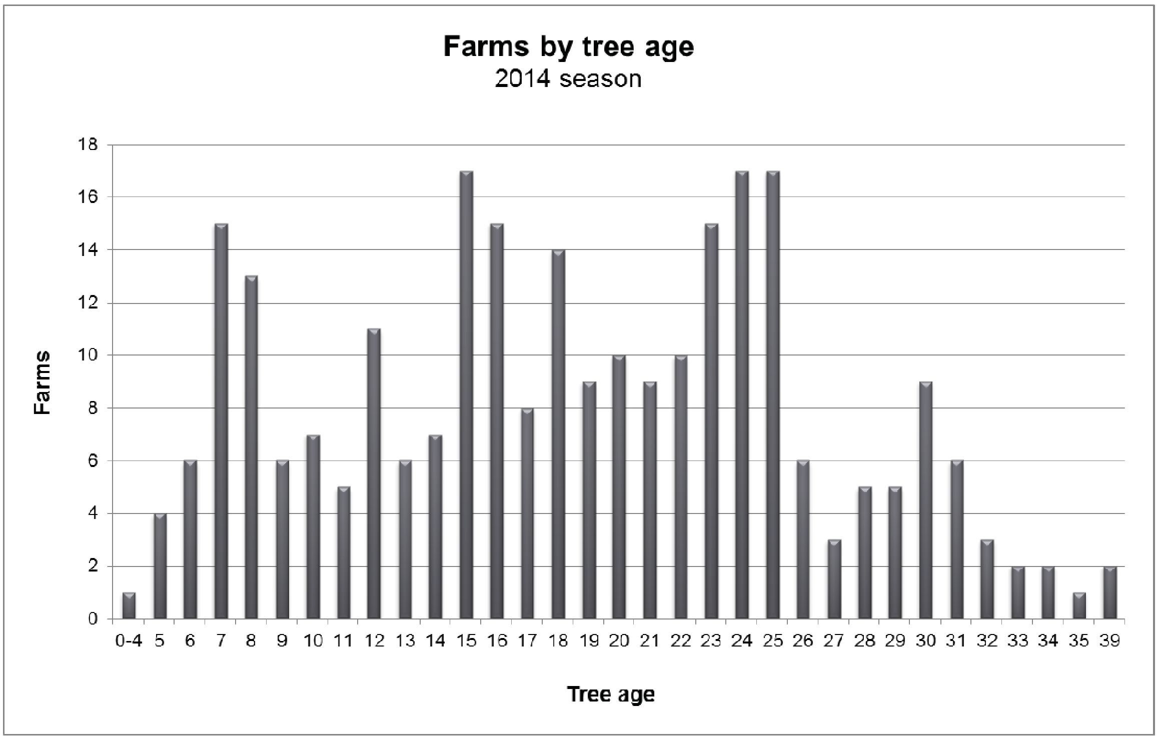


Figure 3.1-4: Number of farms of different average tree ages in the benchmarking sample in 2014

Figure 3.1-5 shows that the youngest bearing farms with an average tree age from 5 to 7 years were on average much larger (24,962 bearing trees and 67.72 bearing hectares in 2014) than the older farms. Most of the farms with an average tree age from 5 to 7 years were in the Central Queensland region.

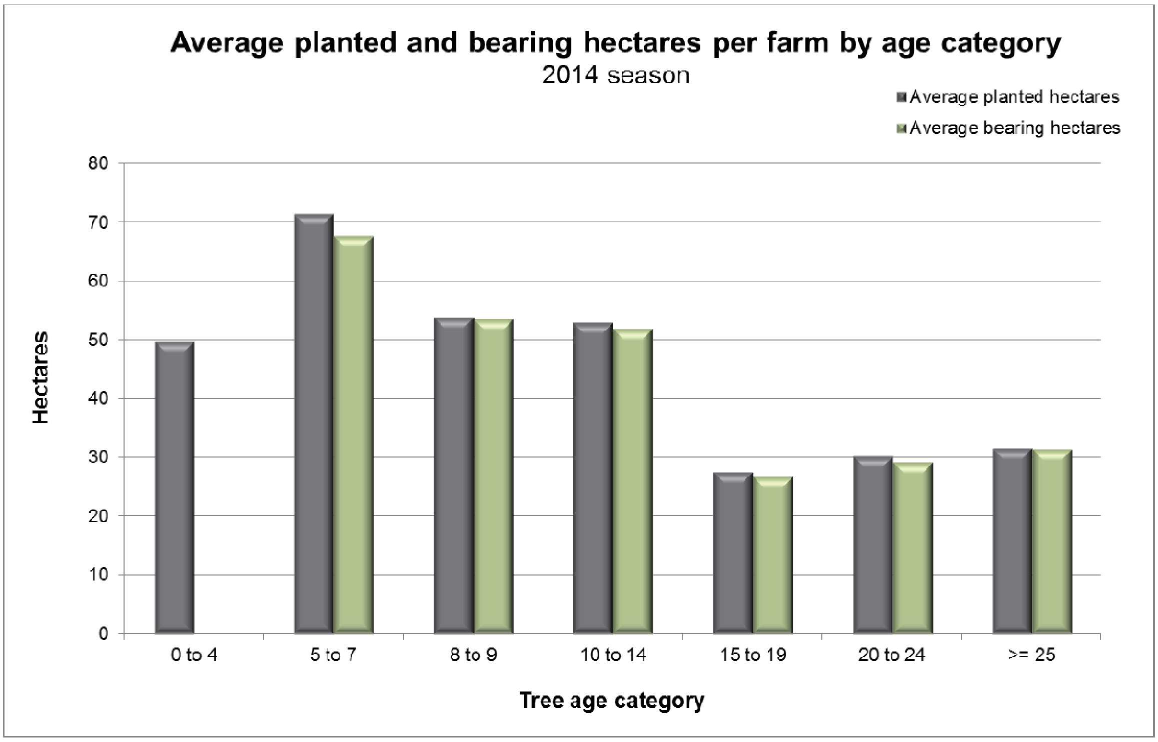


Figure 3.1-5: Average planted and bearing hectares per farm within the different tree age categories for the 2014 season

Farms were also divided into irrigated and non-irrigated, owner managed and non-owner managed and organic and non-organic. The irrigated, non-owner managed and non-organic farms were on average approximately three times larger than the non-irrigated, owner managed and organic farms. Most of the irrigated farms and many of the non-owner managed farms were in the Central Queensland region. All of the organic farms were in New South Wales. Farms were also analysed by planting density.

3.2 Combined yield and quality results

Yield and kernel recovery results have been charted together for each participating farm in the benchmarking sample with an average tree age of ten years or older. The age of ten years or older was chosen to exclude young farms where yield per hectare is expected to be less than that of mature farms. The results show the average for each farm over all the years that farm participated in the benchmarking.

Figure 3.2-1 shows the saleable kernel yield per hectare rankings (bars) and the corresponding average SKR (line) for each farm. The straight trend line represents the linear line of best fit for SKR.

There were 254 farms with an average tree age of ten years or older that participated in the benchmarking between 2009 and 2014. These farms participated for an average of 4.31 farm years during that time.

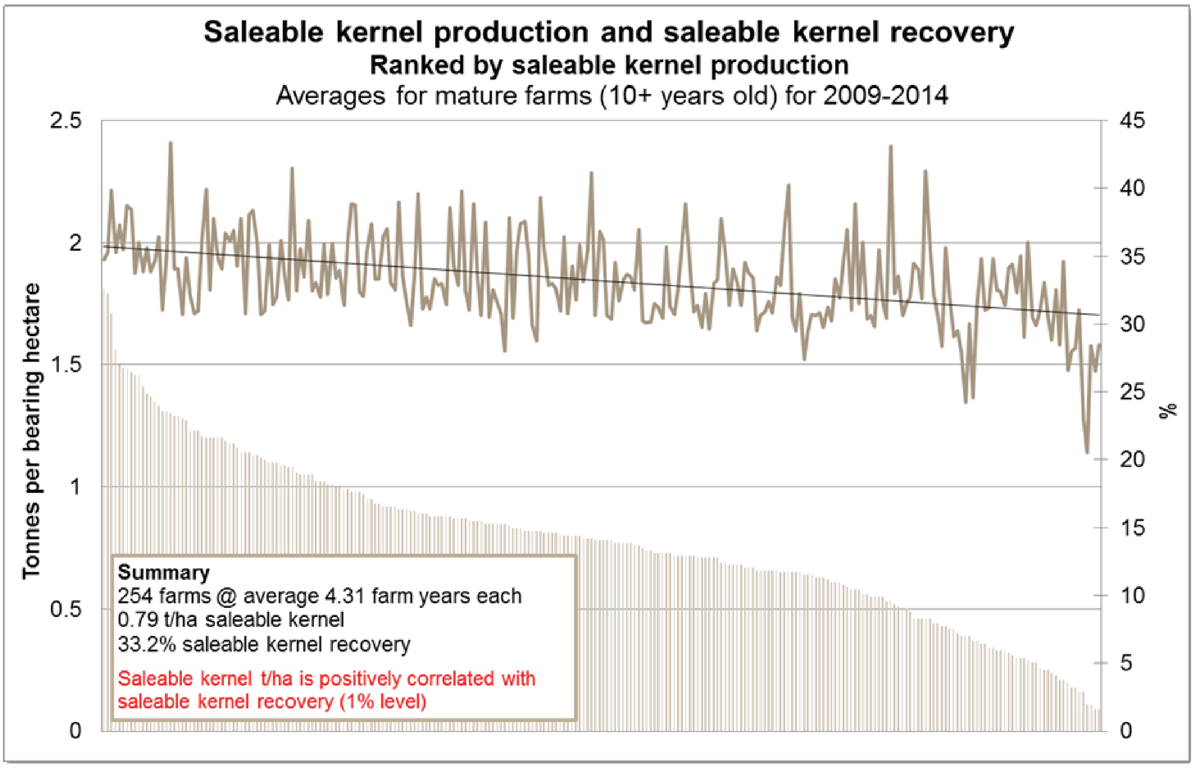


Figure 3.2-1: Average saleable kernel yield rankings and corresponding saleable kernel recoveries for farms older than 10 years (2009-2014)

The average annual farm yield for the 2009 to 2014 seasons was 0.79 tonnes of saleable kernel per bearing hectare and the average SKR was 33.2%.

There is considerable variation in SKR between the farms. Despite this variation, the line of best fit through the kernel recovery results shows that SKR tends to increase as saleable kernel yield per bearing hectare increases. Statistical analysis also shows that yield of saleable kernel per bearing hectare and SKR are positively correlated. This means that more productive farms also tend to achieve better kernel quality results and a subsequent higher price per kilogram of NIS.

Figure 3.2-2 compares rankings for productivity and quality for farms in 2014 with the averages from 2009 to 2014 for all farms involved in the benchmarking. It is important to note that quality is ranked independently of productivity in this chart, whereas productivity and quality results are ranked together in figure 3.2-1. This leads to the more uniform SKR lines compared with the highly variable line in figure 3.2-1.

The rankings have been overlaid to show the differences between the 2014 season and the averages from 2009 to 2014. Tonnes of saleable kernel per hectare and SKR results were higher in 2014 compared to the averages from 2009 to 2014 across the chart. This is reflected in the better average yield and quality benchmarking results for the 2014 season.

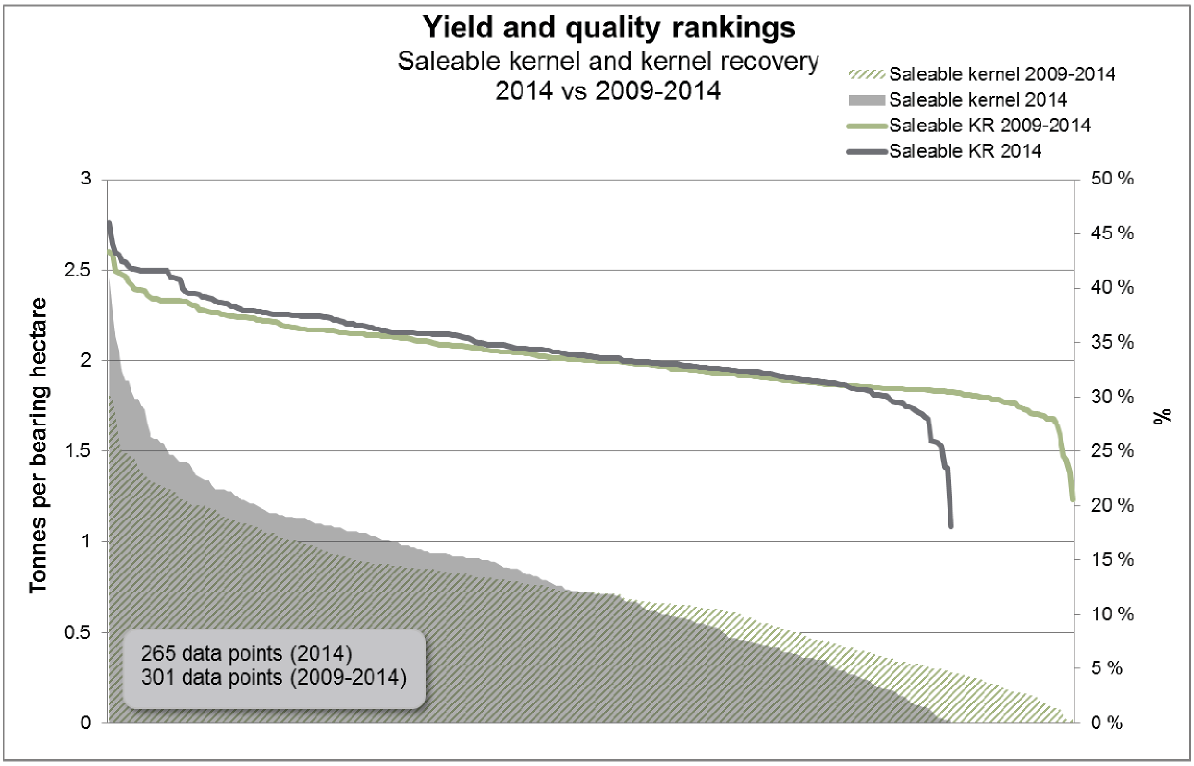


Figure 3.2-2: Saleable kernel production and saleable kernel recovery rankings for 2014 and 2009-2014 (independently ranked).

The rankings have also been overlaid in figure 3.2-3 to show the differences between the 2013 and 2014 seasons. Tonnes of saleable kernel per bearing hectare and SKR results were consistently higher in 2014 compared to 2013. The yield and quality results for the 2013 season were well below the averages from 2009 to 2014.

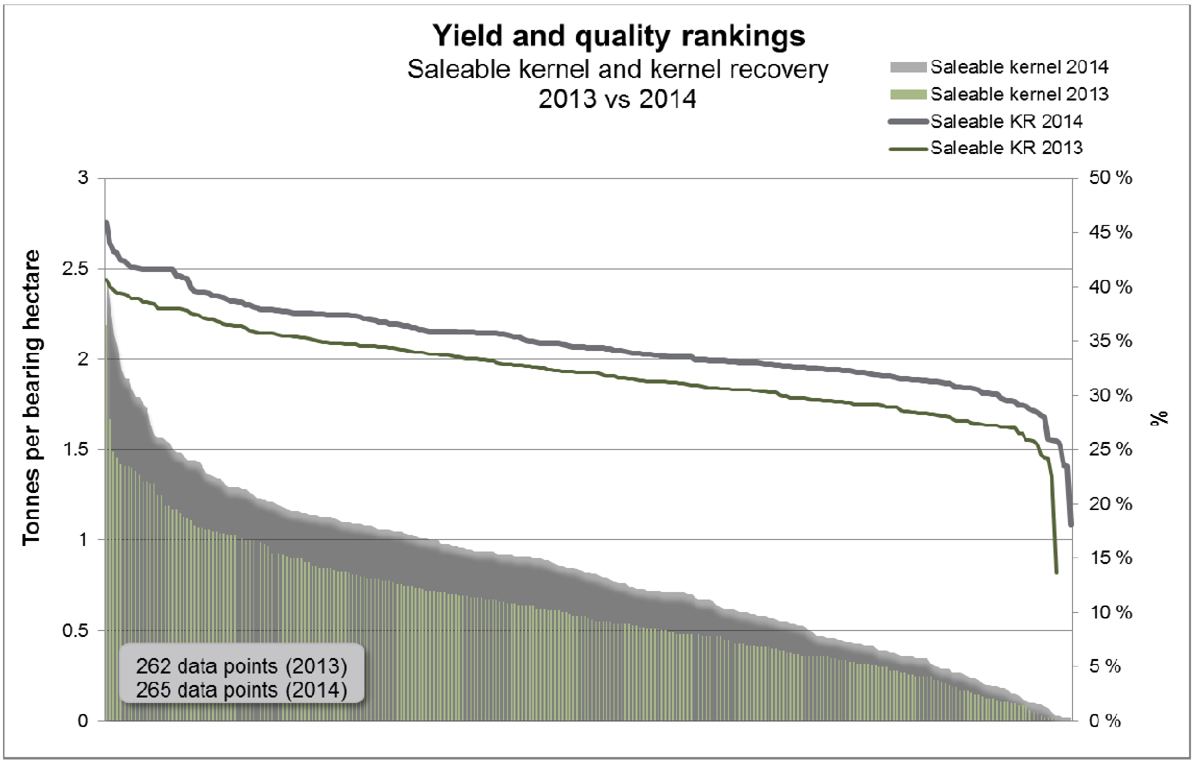


Figure 3.2-3: Saleable kernel production and saleable kernel recovery rankings for 2013 vs 2014 (independently ranked).

Figure 3.2-4 shows the average NIS and saleable kernel yield per bearing hectare and reject category trends from 2009 to 2014. An average of 221 farms participated per year during this period with increasing numbers of farms each year of the benchmarking.

Both the average NIS and saleable kernel yield per hectare increased from 2013 to 2014 and were the highest averages in the benchmarking since the 2010 season. There were increases in yield from 2013 to 2014 in each of the four regions. The largest increases in yield occurred amongst farms in the Northern Rivers of New South Wales and the Mid North Coast of New South Wales.

There was a decrease in the average level of rejects due to insect damage, immaturity, brown centres and discolouration from 2013 to 2014. There was an increase in the average level of rejects due to mould. The average level of rejects due to germination was consistently the lowest of all reject categories.

Insect damage remains a serious cause of losses despite a significant decrease in the level of rejects in 2014. There was a concerted campaign to improve insect spray timing and coverage amongst New South Wales macadamia farms leading up to the 2014 harvest.

Immaturity was a major cause of reject losses amongst farms in the South East Queensland region in 2013 and 2014. These high levels of immaturity have largely been attributed to very dry conditions leading to moisture stress during nut growth and development and oil accumulation in the latter parts of 2012 and 2013 following very wet conditions earlier in 2012.

Brown centres have been the major cause of reject losses amongst larger farms in previous years. The *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008) found that the average level of brown centres increased with increasing farm size, maximum silo size and nut storage bed depth.

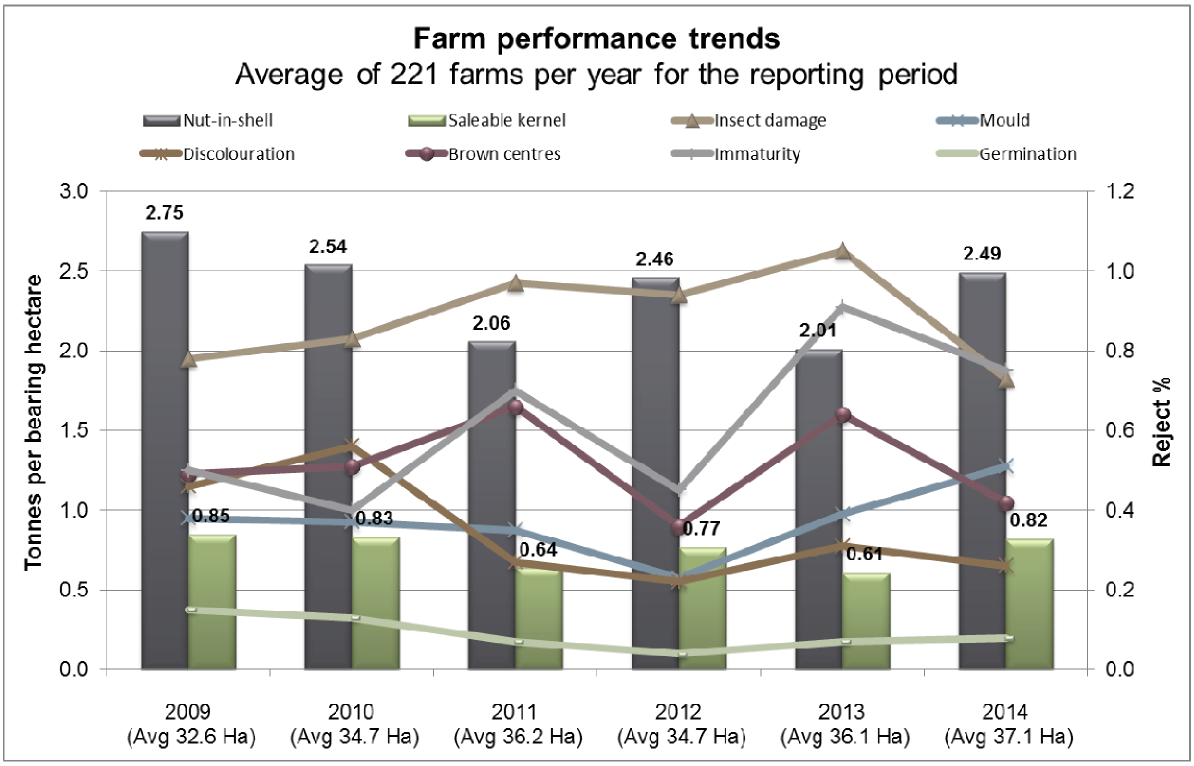


Figure 3.2-4: Seasonal comparison of yield and quality farm performance trends

Both nut-in-shell (NIS) and saleable kernel tonnes per bearing hectare are positively correlated with saleable kernel recovery (SKR) and premium kernel recovery (PKR) and negatively correlated with reject kernel recovery (RKR). SKR is equivalent to the sum of premium and commercial kernel recovery (PKR + CKR). This means that as yield per hectare increases, SKR and PKR also tend to increase and RKR tends to decrease. This supports the observation that the more productive farms also tend to achieve better kernel quality results and subsequently a higher relative price per kilogram of NIS.

Average NIS and saleable kernel tonnes per bearing hectare and SKR results were higher in 2014 than the six seasons from 2009 to 2014. By comparison, the corresponding yield and quality averages in 2013 were well below the averages from 2009 to 2014.

3.3 Top 20 farms

The top 20 farms in the benchmarking sample were identified based on their average yield of saleable kernel per bearing hectare from 2009 to 2014. It is important to note that top 20 farms must have participated in at least five years of the benchmarking study to qualify and their yield of saleable kernel per bearing hectare was based on their average performance over this period.

Figures 3.3-1 to 3.3-5 show the following breakdown of the top 20 farms:

- Thirteen farms were in the Northern Rivers of New South Wales, six in South East Queensland and one in the Mid North Coast of New South Wales region.
- Three farms were non-owner managed and 17 were owner managed.
- Three farms were irrigated and 17 were not irrigated.
- Nine farms had an average tree age between 20 and 24 years, four between 15 and 19 years, four 25 years and older and three between 10 and 14 years.
- Eight farms had less than 10 bearing hectares, six had between 10 and 20 hectares, three had between 20 and 30 hectares, two had between 30 and 50 hectares and one farm had between 50 and 100 hectares.

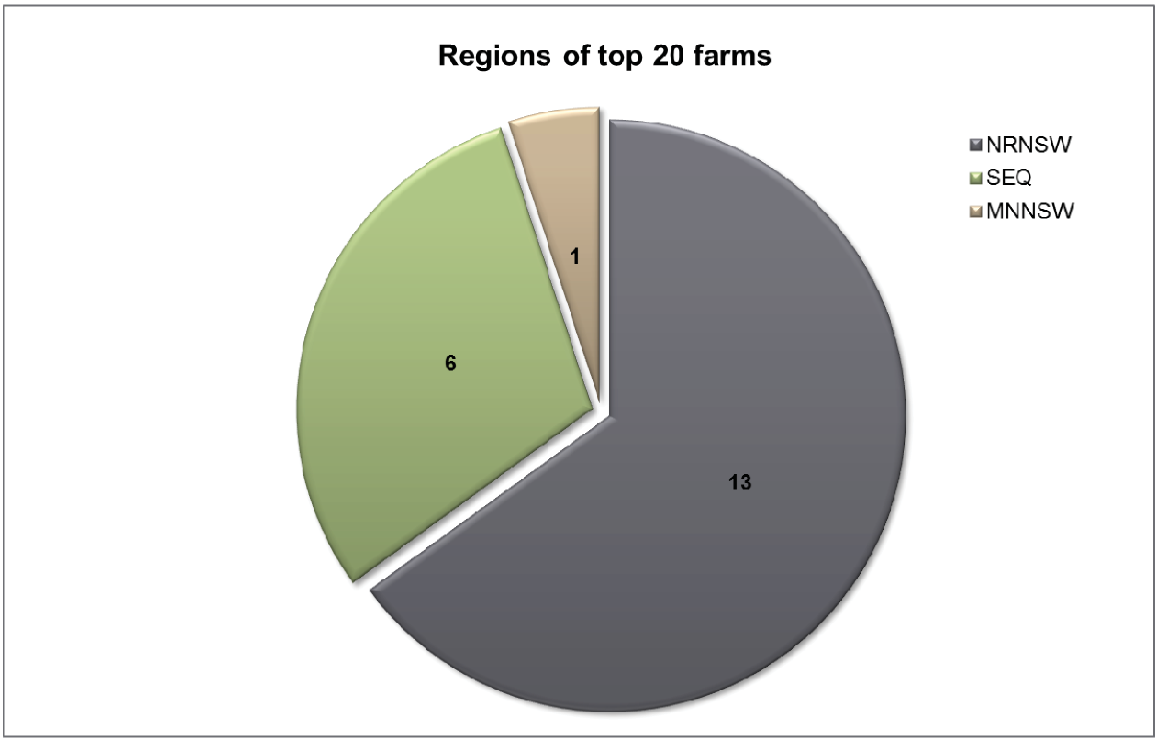


Figure 3.3-1: Locations of the top 20 farms in the benchmarking sample

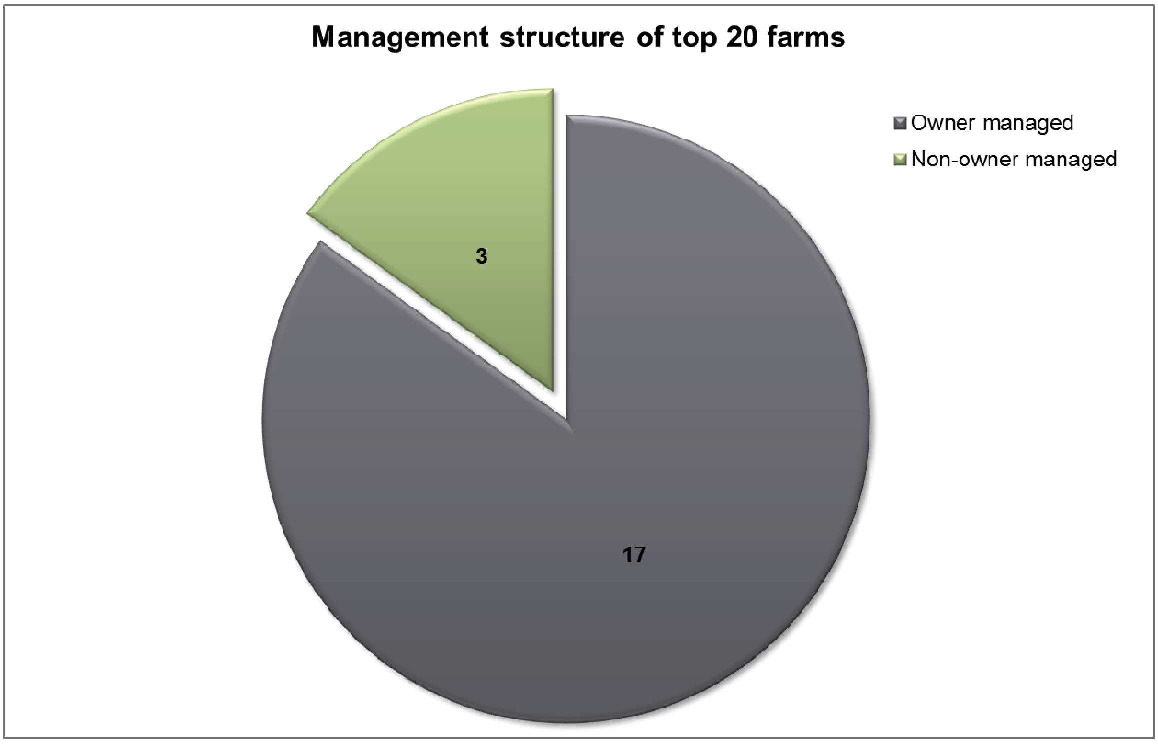


Figure 3.3-2: Management structure of the top 20 farms in the benchmarking sample

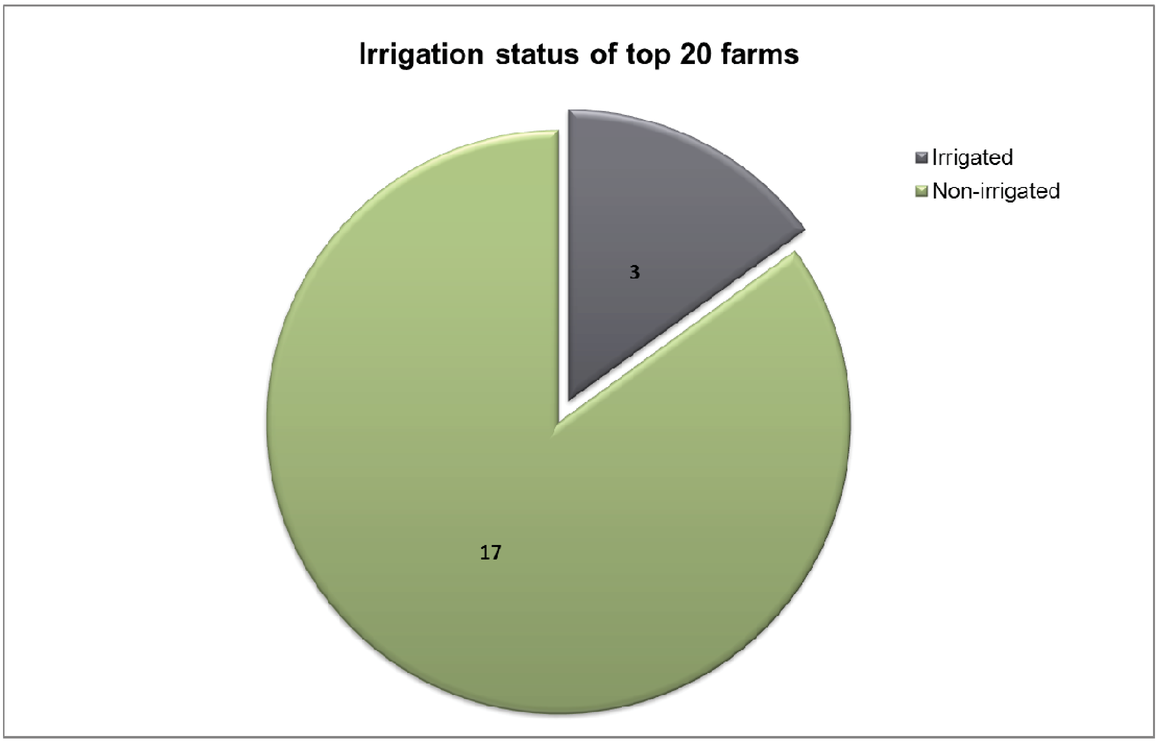


Figure 3.3-3: Irrigation status of the top 20 farms in the benchmarking sample

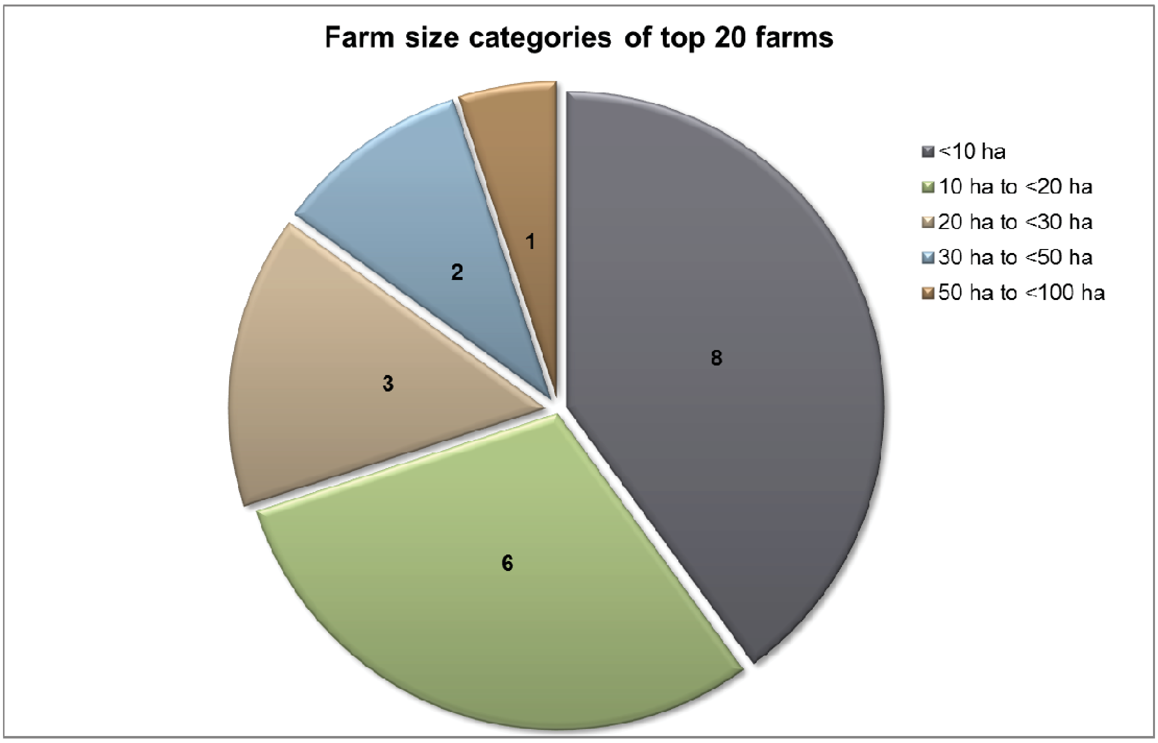


Figure 3.3-4: Farm size categories of the top 20 farms in the benchmarking sample

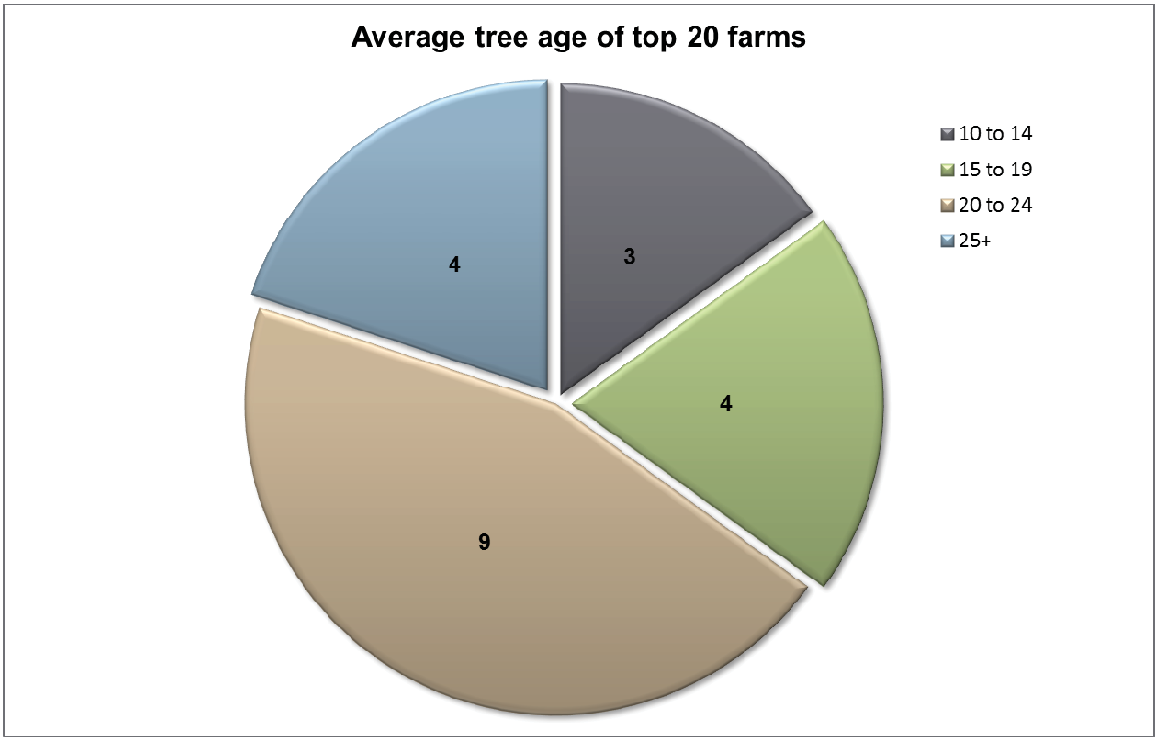


Figure 3.3-5: Average tree age of the top 20 farms in the benchmarking sample

Figure 3.3-6 shows the average yield of saleable kernel per hectare from the top 20 farms from 2009 to 2014 compared with all farms in the benchmarking sample. Averages for the top 25% and bottom 25% of all farms in the benchmarking sample are also shown.

The top 20 farms averaged 1.53 tonnes in 2014 compared to 1.08 tonnes in 2013 and 1.34 tonnes of saleable kernel per bearing hectare over the six years from 2009 to 2014. This represents an increase of 0.45 tonnes per hectare from 2013 to 2014

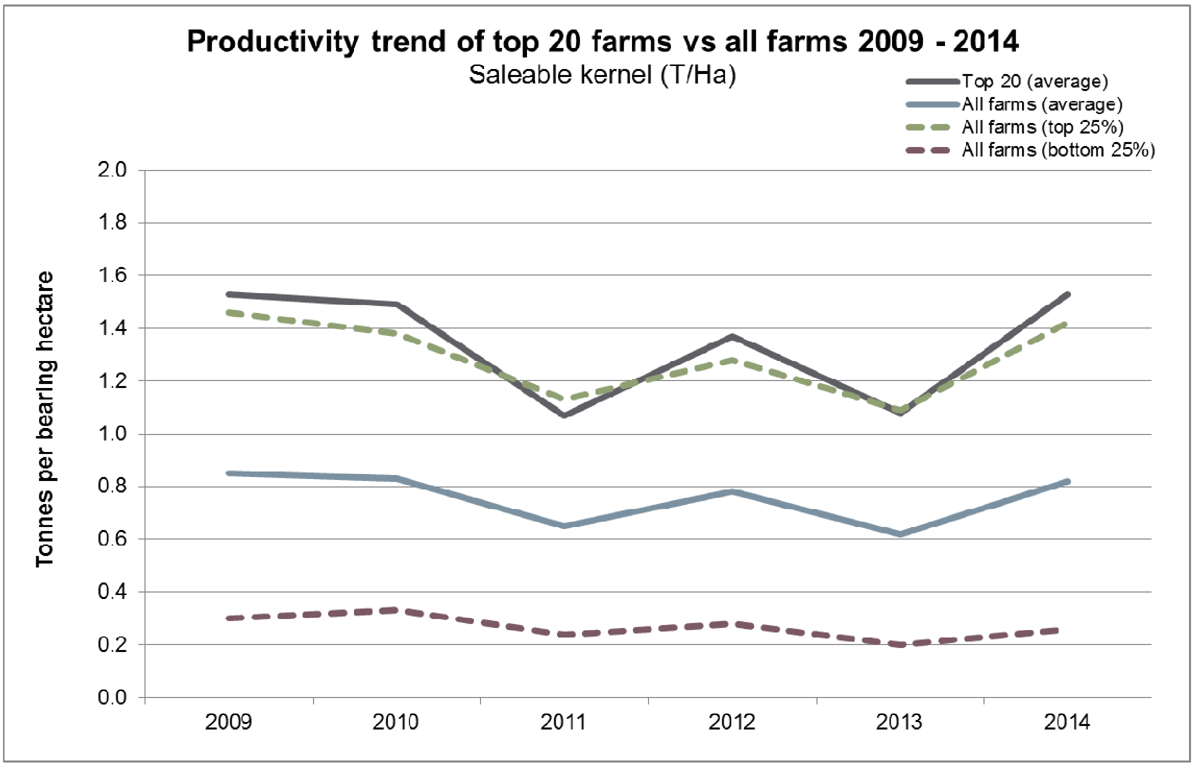


Figure 3.3-6: Average saleable kernel per bearing hectare for top 20 farms vs all farms in the benchmarking sample for 2009-2014.

By comparison to the top 20 farms, the average yield for all farms was 0.82 tonnes in 2014, 0.62 tonnes in 2013 and 0.75 tonnes of saleable kernel per bearing hectare from 2009 to 2014. This represents a difference of 0.71 tonnes per hectare in 2014 between the average yield per bearing hectare for the top 20 farms and all the farms in the benchmarking sample.

The productivity trend of the top 20 farms is similar to that of the top 25% of all farms in the benchmarking sample.

Figure 3.3-7 shows the average SKR for the top 20 farms. It is important to note that these top 20 farms are ranked according to their average yield of saleable kernel per bearing hectare over a minimum of five seasons, rather than according to their SKR result.

The top 20 farms averaged 36.23% SKR in 2014, 33.68% in 2013 and 35.1% from 2009 to 2014. This represents an increase of 2.55% in the average SKR amongst the top 20 farms from 2013 to 2014.

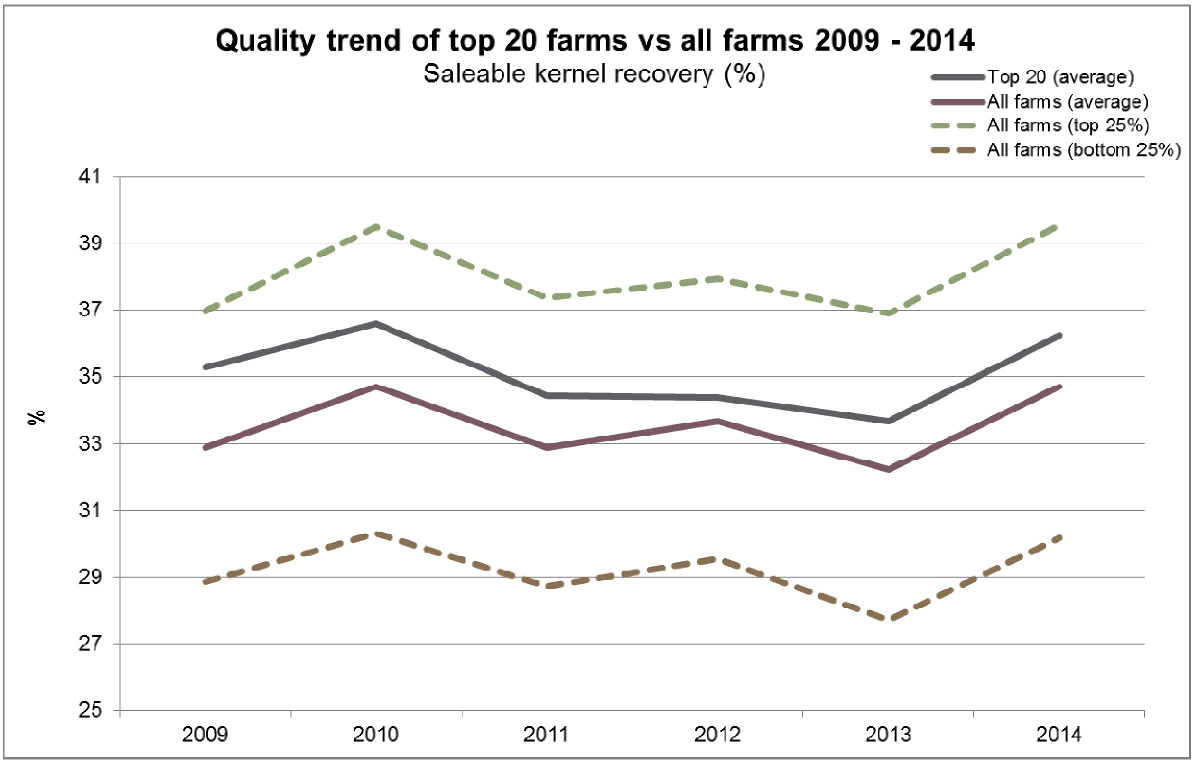


Figure 3.3-7: Average saleable kernel recovery (%) for the top 20 farms (by productivity) vs all farms in the benchmarking sample for 2009-2014

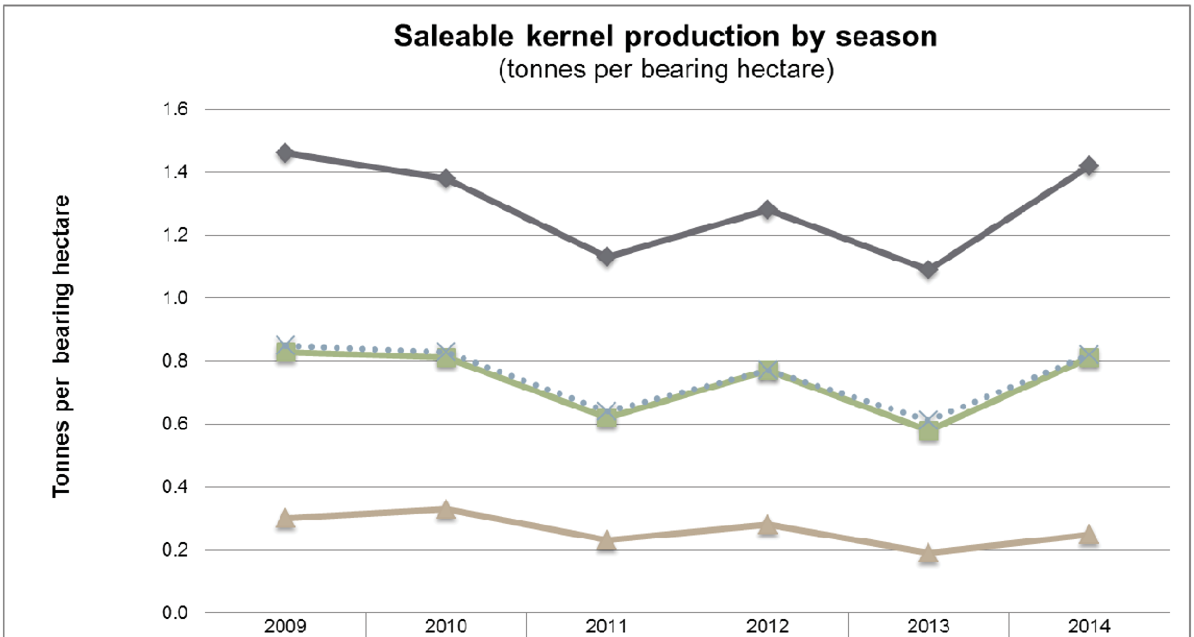
By comparison to the top 20 farms, the average SKR of all farms in the benchmarking sample was 34.7% in 2014 (1.57% less than the top 20 farms), 32.22% in 2013 and 33.52% from 2009 to 2014.

This shows that the 20 most productive farms also achieve, on average, a higher SKR than the average of all farms within the benchmarking sample.

3.4 Seasons

Figure 3.4-1 shows that there were significant differences in the yield and quality results between 2014 and the previous five seasons. There were also major differences in the seasonal yield and quality results between the top 25%, middle 50% and bottom 25% of farms within the benchmarking sample.

The average yield of saleable kernel for all the farms in the benchmarking sample in 2014 was 0.82 tonnes per bearing hectare. This compares with an average yield of 0.61 tonnes in 2013 and 0.75 tonnes for 2009 to 2014.

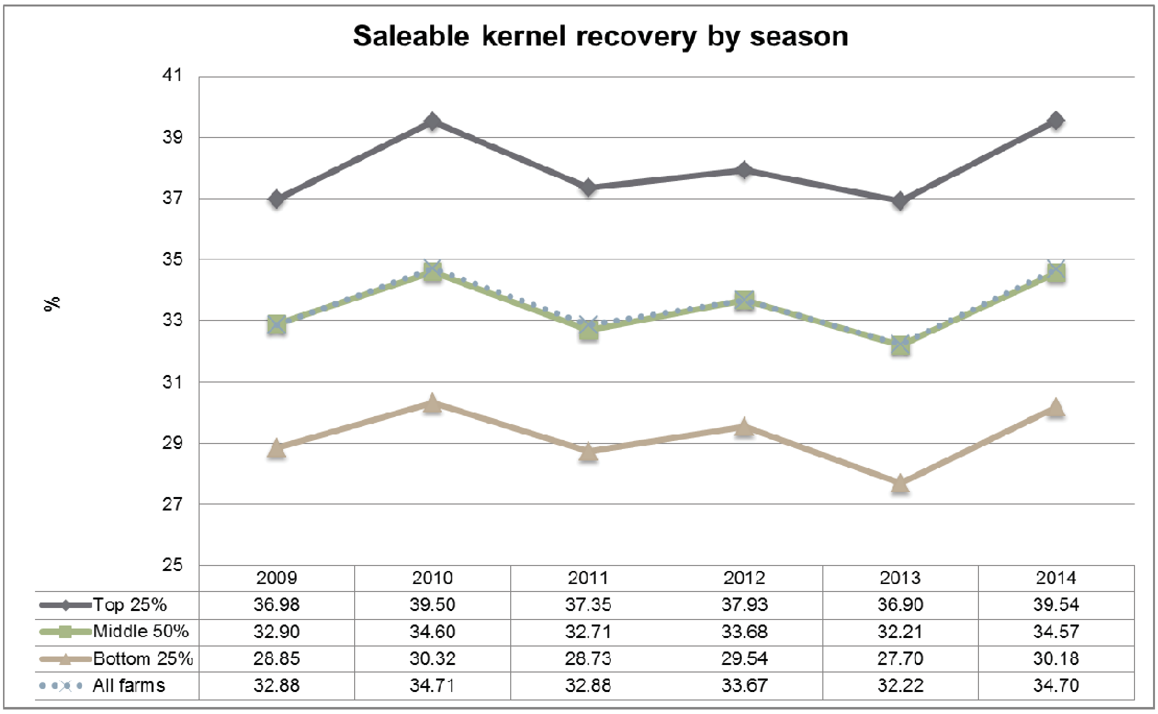


	2009	2010	2011	2012	2013	2014
Top 25%	1.46	1.38	1.13	1.28	1.09	1.42
Middle 50%	0.83	0.81	0.62	0.77	0.58	0.81
Bottom 25%	0.30	0.33	0.23	0.28	0.19	0.25
All farms	0.85	0.83	0.64	0.77	0.61	0.82

Figure 3.4-1: Comparison of average tonnes of saleable kernel per bearing hectare (2009 to 2014)

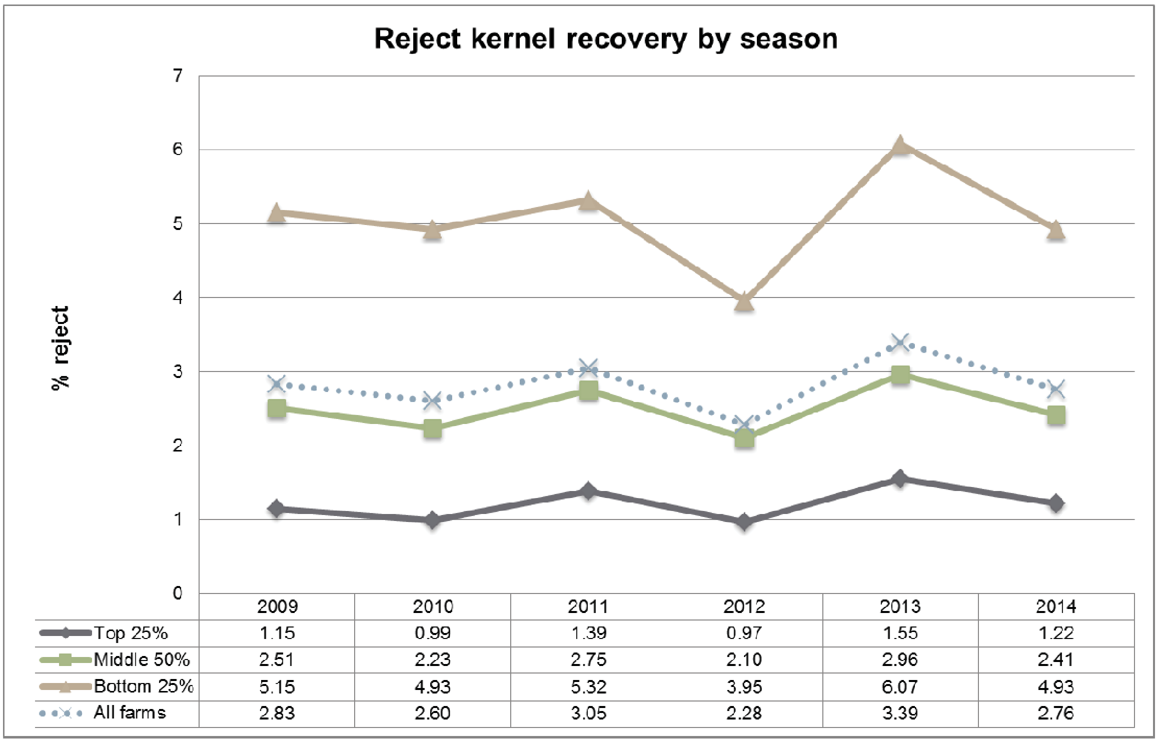
Average yields of NIS, saleable kernel and total kernel per bearing hectare increased from 2013 to 2014 amongst the top 25%, middle 50% and bottom 25% of farms within the benchmarking sample. The average yield of NIS and saleable and total kernel per bearing hectare in 2014 was significantly more than in 2011 and 2013 but not significantly different to 2010 and 2012. The average yield of NIS per bearing hectare was less in 2014 than in 2009 but the average yields of saleable and total kernel per bearing hectare were not significantly different between the two seasons. This was due to the greater average SKR amongst farms in the benchmarking sample in 2014 compared with 2009.

Figures 3.4-2 and 3.4-3 show that average SKR increased from 2013 to 2014 and average RKR decreased from 2013 to 2014 amongst the top 25%, middle 50% and bottom 25% of farms. Average PKR also increased amongst the top 25%, middle 50% and bottom 25% of farms. Average CKR increased amongst the top 25% of farms from 2013 to 2014 but there was a slight decrease in the average CKR amongst the middle 50% and bottom 25% of farms from 2013 to 2014.



	2009	2010	2011	2012	2013	2014
Top 25%	36.98	39.50	37.35	37.93	36.90	39.54
Middle 50%	32.90	34.60	32.71	33.68	32.21	34.57
Bottom 25%	28.85	30.32	28.73	29.54	27.70	30.18
All farms	32.88	34.71	32.88	33.67	32.22	34.70

Figure 3.4-2: Comparison of average saleable kernel recovery (2009 to 2014)



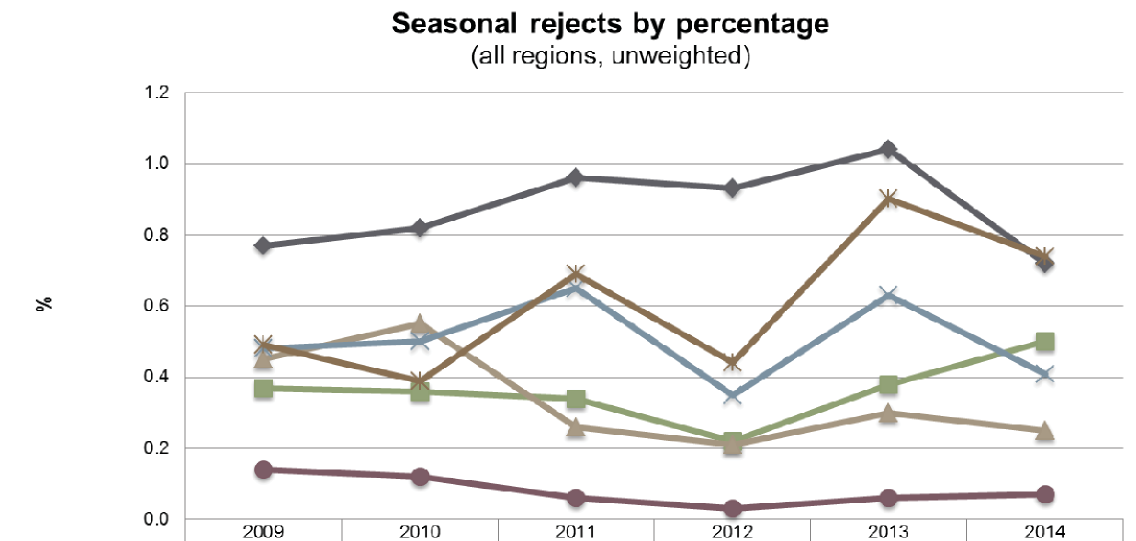
	2009	2010	2011	2012	2013	2014
Top 25%	1.15	0.99	1.39	0.97	1.55	1.22
Middle 50%	2.51	2.23	2.75	2.10	2.96	2.41
Bottom 25%	5.15	4.93	5.32	3.95	6.07	4.93
All farms	2.83	2.60	3.05	2.28	3.39	2.76

Figure 3.4-3: Comparison of average reject kernel recovery (2009 to 2014)

The average SKR in 2014 and 2010 was significantly higher than in each of the other seasons. The average PKR in 2014 was significantly more than in 2011 and 2013 and significantly less than in 2010 but not significantly different to 2009 and 2012. The average RKR in 2014 was significantly less than in 2011 and 2013 and significantly more than in 2012 but not significantly different from 2009 and 2010. The average CKR in 2013 and 2014 was significantly more than in each of the other seasons.

Figure 3.4-4 shows that there were also significant differences in the average reject analysis levels between 2014 and the previous five seasons.

When viewed as an unweighted average (all farms having an equal influence on the average), immaturity (0.75%) represented the highest average percentage of rejects in 2014. Insect damage accounted for the highest average percentage of rejects from 2009 to 2013.



	2009	2010	2011	2012	2013	2014
Insect	0.78	0.83	0.97	0.94	1.05	0.73
Mould	0.38	0.37	0.35	0.23	0.39	0.51
Discoloured	0.46	0.56	0.27	0.22	0.31	0.26
Brown centres	0.49	0.51	0.66	0.36	0.64	0.42
Immature	0.50	0.40	0.70	0.45	0.91	0.75
Germinated	0.15	0.13	0.07	0.04	0.07	0.08

Figure 3.4-4: Seasonal comparison of reject categories based on average consignment percentage (2009 to 2014).

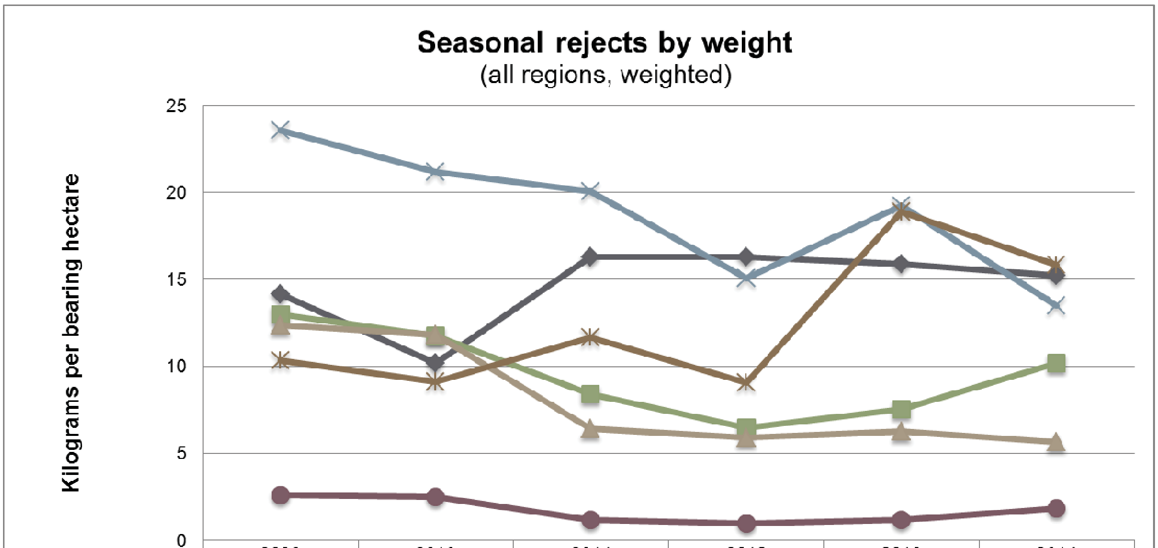
Major seasonal differences amongst the reject analysis categories from 2009 to 2014 include:

- The average level of rejects due to insect damage in 2014 was significantly less than from 2011 to 2013 but not significantly different to 2009 and 2010.
- The average level of rejects due to mould in 2014 was significantly more than in each of the other seasons.
- The average level of rejects due to discolouration in 2014 was significantly less than in 2009 and 2010 but not significantly different from 2011 to 2013.
- The average level of rejects due to brown centres in 2014 was significantly less than in 2010, 2011 and 2013 but not significantly different to 2009 and 2012.
- The average level of rejects due to immaturity in 2014 was significantly more than in 2009, 2010 and 2012, significantly less than in 2013 and not significantly different to 2011.
- The average level of rejects due to germination in 2014 was significantly less than in 2009 and 2010 and significantly more than in 2012 but not significantly different to 2011 and 2013.
- The average nut-in-shell moisture content (NIS MC) for the top 25%, middle 50% and bottom 25% of farms was lower in 2014 than in 2013. The average NIS MC in 2014 was

significantly more than in 2009 and 2010, not significantly different to 2011 and 2012 and significantly less than in 2013. The higher average NIS MC in recent years reflects a trend, particularly amongst Northern Rivers farms, to reduce the time spent drying and storing nuts on farm prior to consignment for processing.

- The average percentage of whole kernels in 2014 was significantly more than in 2009, 2011 and 2012 but not significantly different from 2010 and 2013.

Figure 3.4-5 shows that when the rejects are viewed as a weighted average (farms with larger yields and reject levels having a greater influence on the average), immaturity (15.83 kg) also represented the highest weight of reject kernel per bearing hectare in 2014. Brown centres accounted for the highest average weight of rejects per bearing hectare from 2009 to 2011 and 2013. Insect damage was the highest weighted reject in 2012.



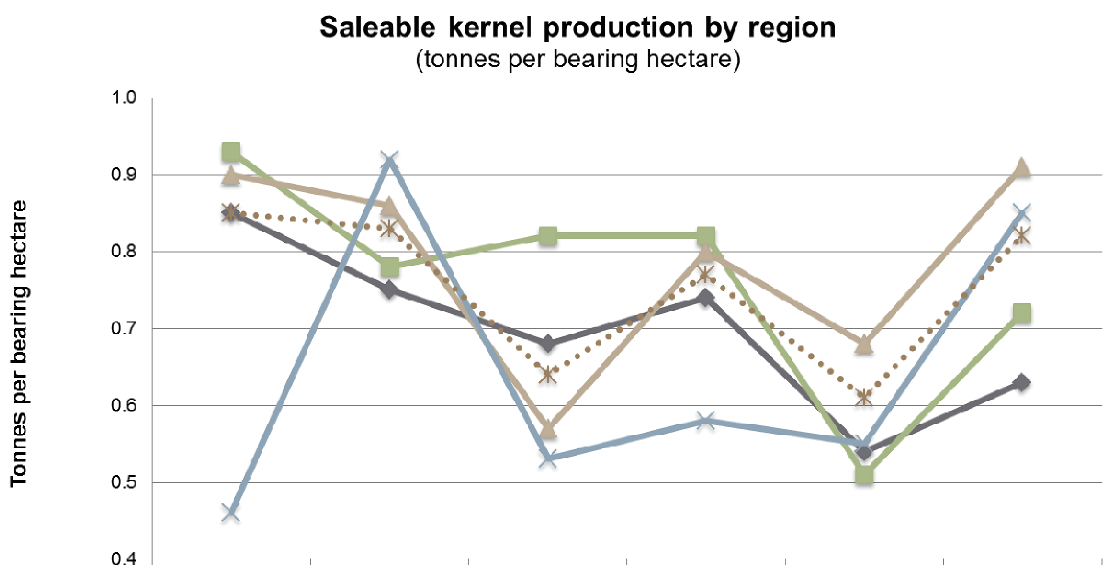
	2009	2010	2011	2012	2013	2014
Insect	14.16	10.19	16.28	16.32	15.90	15.25
Mould	12.99	11.77	8.39	6.45	7.55	10.17
Discoloured	12.40	11.80	6.43	5.91	6.28	5.68
Brown centres	23.56	21.17	20.05	15.05	19.24	13.51
Immature	10.35	9.12	11.64	9.07	18.90	15.83
Germinated	2.60	2.49	1.20	0.96	1.18	1.86

Figure 3.4-5: Seasonal comparison of reject categories based on average weighted kilograms of kernel per bearing hectare (2009 to 2014).

3.5 Regions

The average yields of NIS, saleable kernel and total kernel per bearing hectare were higher amongst the Northern Rivers and Mid North Coast farms and lower amongst the Central and South East Queensland farms in 2014 than the averages for the six seasons from 2009 to 2014.

Figure 3.5-1 shows that farms in each of the production regions had higher average yield of NIS, saleable kernel and total kernel per bearing hectare in 2014 than in 2013 after each region had a decrease in yield from 2012 to 2013. Farms in the Central Queensland region had the smallest increase in average yield per hectare in 2014. Farms in the Northern Rivers had their largest average yield of saleable kernel per hectare (0.91 tonnes) since the benchmarking began in 2009. Mid North Coast farms had their largest average yield of saleable kernel per bearing hectare (0.85 tonnes) since the 2010 season.



	2009	2010	2011	2012	2013	2014
CQ	0.85	0.75	0.68	0.74	0.54	0.63
SEQ	0.93	0.78	0.82	0.82	0.51	0.72
NRNSW	0.90	0.86	0.57	0.80	0.68	0.91
MNNSW	0.46	0.92	0.53	0.58	0.55	0.85
All regions	0.85	0.83	0.64	0.77	0.61	0.82

Figure 3.5-1: Comparison of average regional yields of tonnes of saleable kernel per bearing hectare (2009 to 2014)

Northern Rivers and South East Queensland farms had a significantly higher average yield of NIS, saleable kernel and total kernel per bearing hectare than Central Queensland and Mid North Coast farms over the six seasons from 2009 to 2014.

Central Queensland farms were more concentrated in the middle 50% from 2009 to 2014 for NIS and saleable kernel tonnes per hectare. South East Queensland farms and Northern Rivers farms had higher relative proportions in the top 25% and the Mid North Coast of New South Wales farms were more concentrated in the bottom 25% of farm years for yield per hectare.

Figure 3.5-2 shows average tonnes of saleable kernel per bearing hectare rankings for farms in each of the four major macadamia production regions for 2009 to 2014.

There were farms within each of the four regions that averaged more than one tonne of saleable kernel per bearing hectare over the six seasons from 2009 to 2014. This chart shows that highly productive farms are not restricted to any one region.

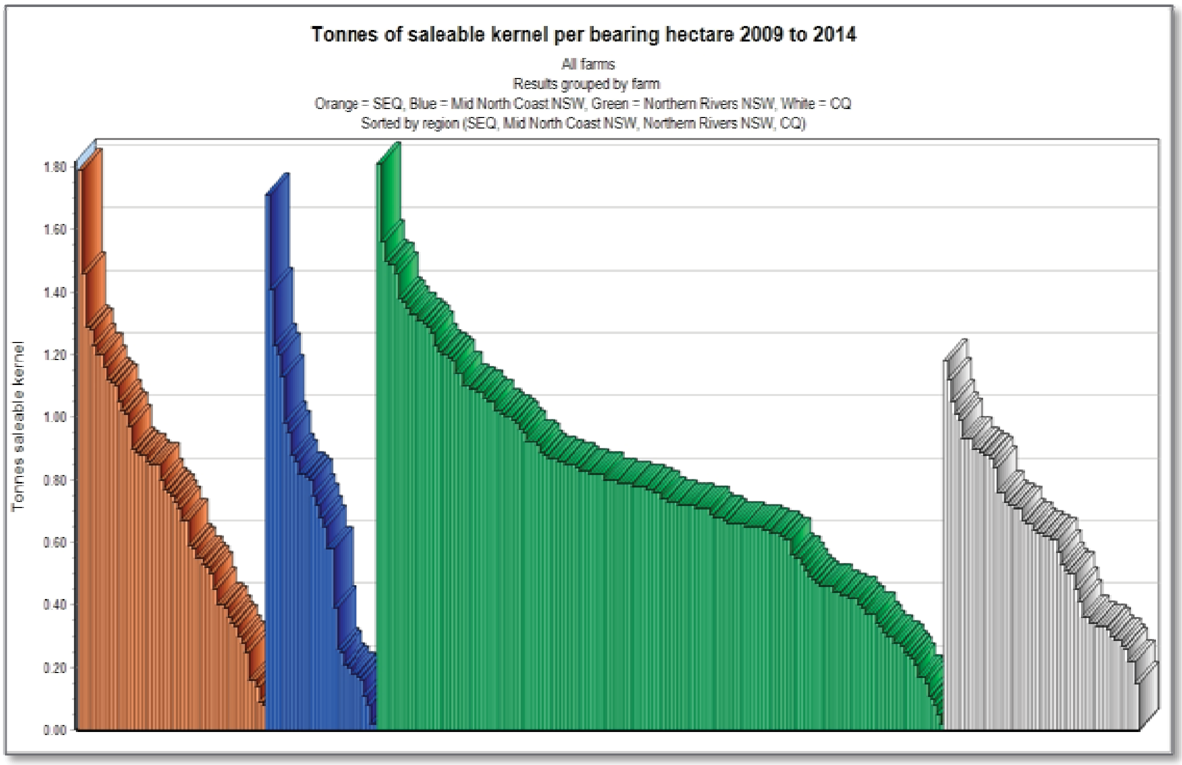
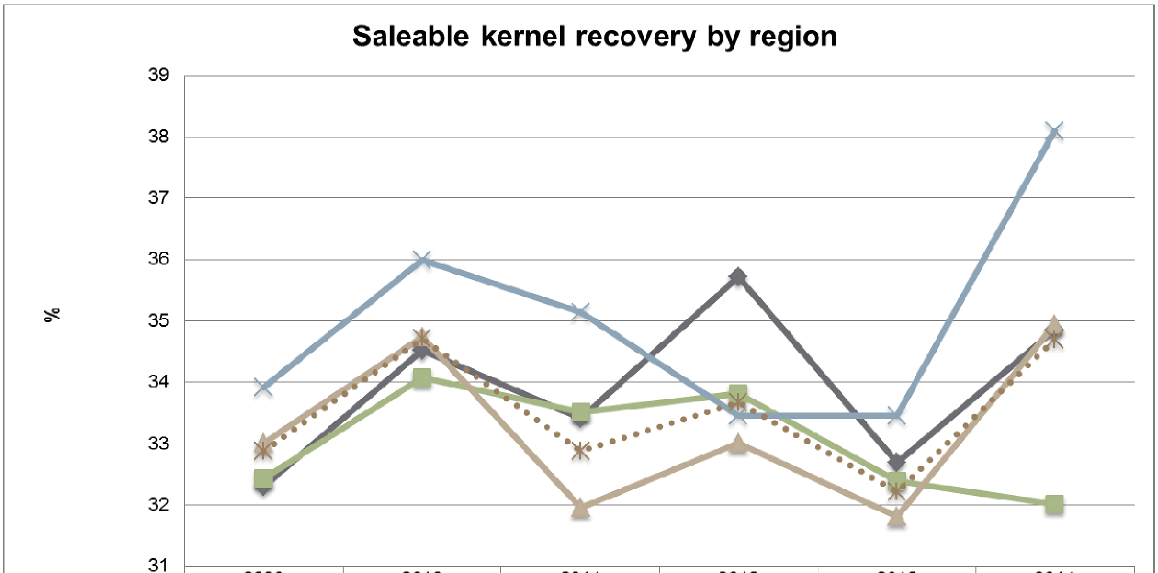


Figure 3.5-2: Saleable kernel per bearing hectare yield trends for farms in different regions for 2009-2014

Figure 3.5-3 shows that average SKR was higher amongst Central Queensland, Northern Rivers and Mid North Coast farms and lower amongst South East Queensland farms in 2014 than in 2013 and over the six seasons from 2009 to 2014. Average PKR was also higher amongst Central Queensland, Northern Rivers and Mid North Coast farms and lower amongst South East Queensland farms in 2014.

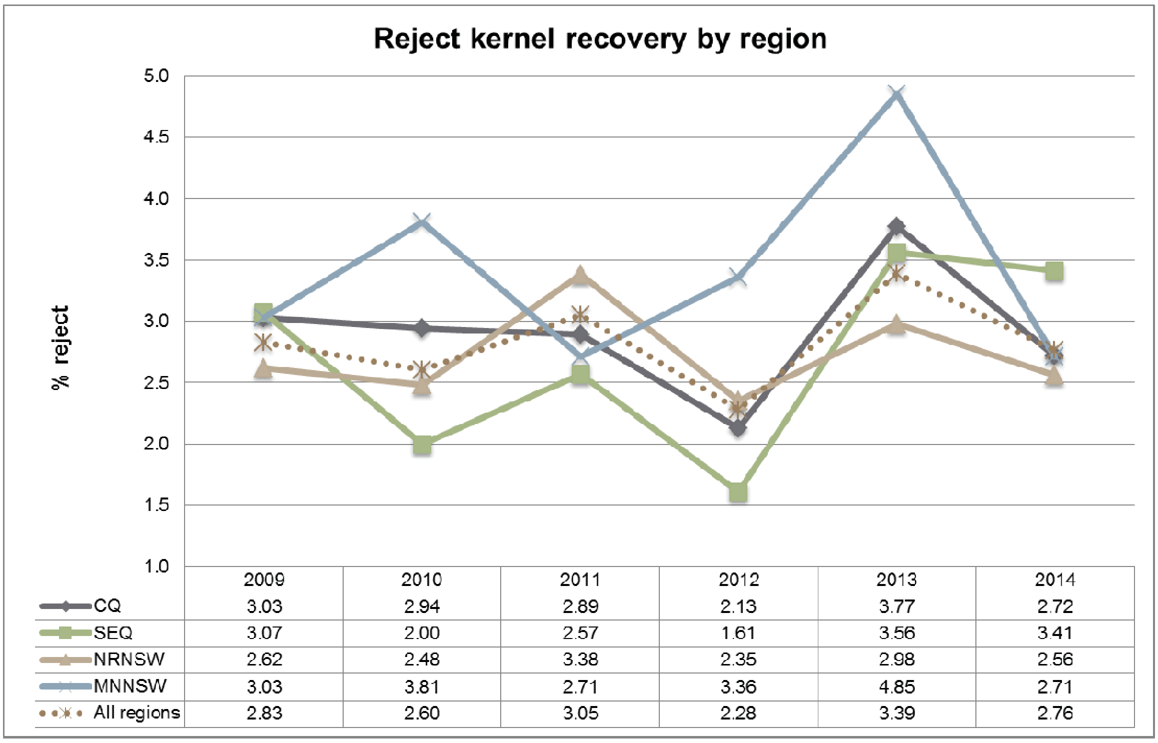
Average CKR was higher amongst farms in each production region in 2014 than the averages for 2009 to 2014.



	2009	2010	2011	2012	2013	2014
CQ	32.30	34.53	33.42	35.72	32.69	34.86
SEQ	32.44	34.07	33.52	33.81	32.39	32.02
NRNSW	33.01	34.74	31.96	33.01	31.81	34.94
MNNSW	33.92	35.99	35.14	33.45	33.45	38.10
All regions	32.88	34.71	32.88	33.67	32.22	34.70

Figure 3.5-3: Comparison of average regional saleable kernel recoveries (2009 to 2014)

Figure 3.5-4 shows that average RKR was lower amongst farms in each production region in 2014 than in 2013. Average RKR was also lower amongst Central Queensland, Northern Rivers and Mid North Coast farms in 2014 than for 2009 to 2014.



	2009	2010	2011	2012	2013	2014
CQ	3.03	2.94	2.89	2.13	3.77	2.72
SEQ	3.07	2.00	2.57	1.61	3.56	3.41
NRNSW	2.62	2.48	3.38	2.35	2.98	2.56
MNNSW	3.03	3.81	2.71	3.36	4.85	2.71
All regions	2.83	2.60	3.05	2.28	3.39	2.76

Figure 3.5-4: Comparison of average regional reject kernel recoveries (2009 to 2014)

Mid North Coast farms had a significantly higher average SKR than farms from the other three regions over the six seasons from 2009 to 2014. South East Queensland farms had a significantly higher average PKR than farms from Northern Rivers and Mid North Coast. The Mid North Coast of New South Wales farms had a significantly higher average CKR and South East Queensland farms had a significantly lower average CKR than farms in the other regions. Mid North Coast farms also had a significantly higher average RKR than farms in the other regions from 2009 to 2014.

Northern Rivers farms had a significantly higher average NIS MC from 2009 to 2014 than farms in the other three regions. There was a reduction in the average NIS MC from 2013 to 2014 amongst farms in each of the four regions following an increase in the average NIS MC in each region from 2012 to 2013.

Mid North Coast farms had a significantly higher average percentage of whole kernels from 2009 to 2014 than farms in the other three regions. There was a decrease in the average percentage of whole kernels from 2013 to 2014 amongst Central Queensland farms and an increase in the average percentage amongst farms in the other three regions.

Figures 3.5-5 to 3.5-8 show the differences in the levels of rejects amongst farms in the different regions over the six seasons from 2009 to 2014:

- Mid North Coast farms had a significantly higher average level of rejects due to insect damage, mould and germination than farms in the other three regions.
- Insect damage was the reject analysis category causing the highest average level of losses amongst Mid North Coast and Northern Rivers farms.
- Central Queensland farms had a significantly higher average level of rejects due to discolouration and brown centres than farms in the other three regions.
- South East Queensland farms had a significantly higher average level of rejects due to immaturity than farms in the other three regions due to very high immaturity levels in 2013 and 2014 in particular.

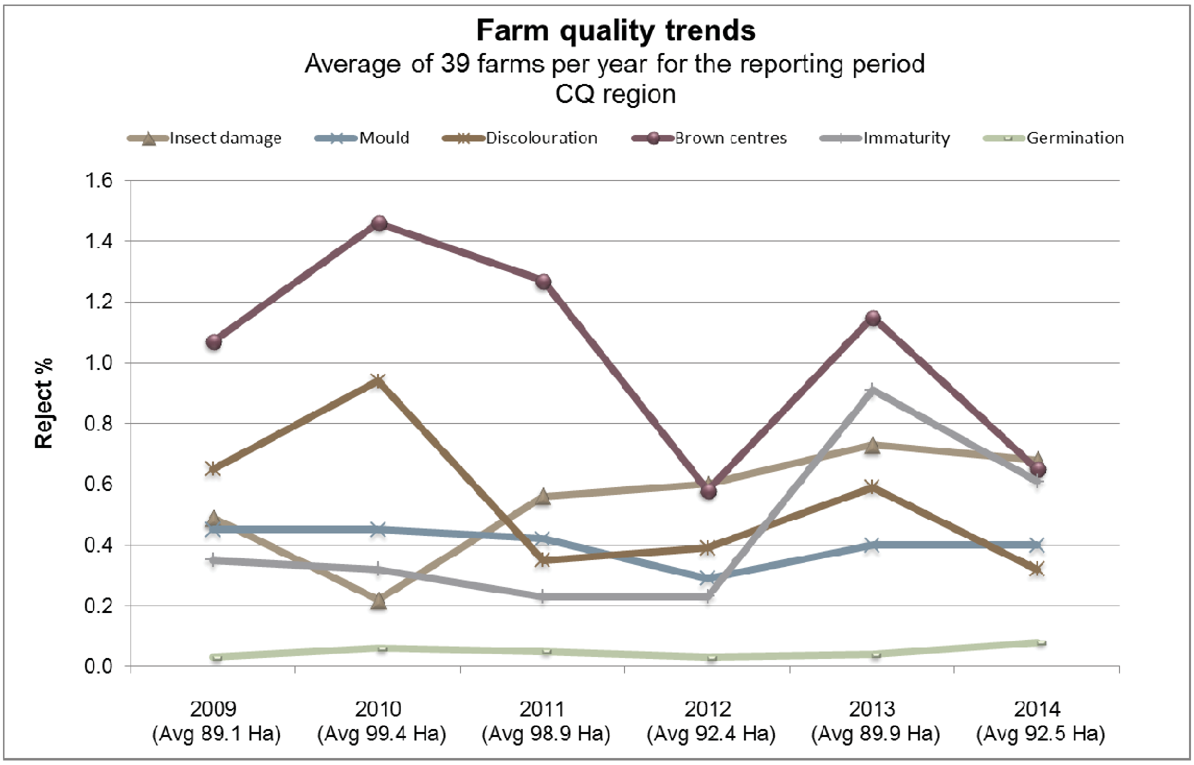


Figure 3.5-5: Comparison of consigned reject analysis for farms in Central Queensland region (2009 to 2014 seasons)

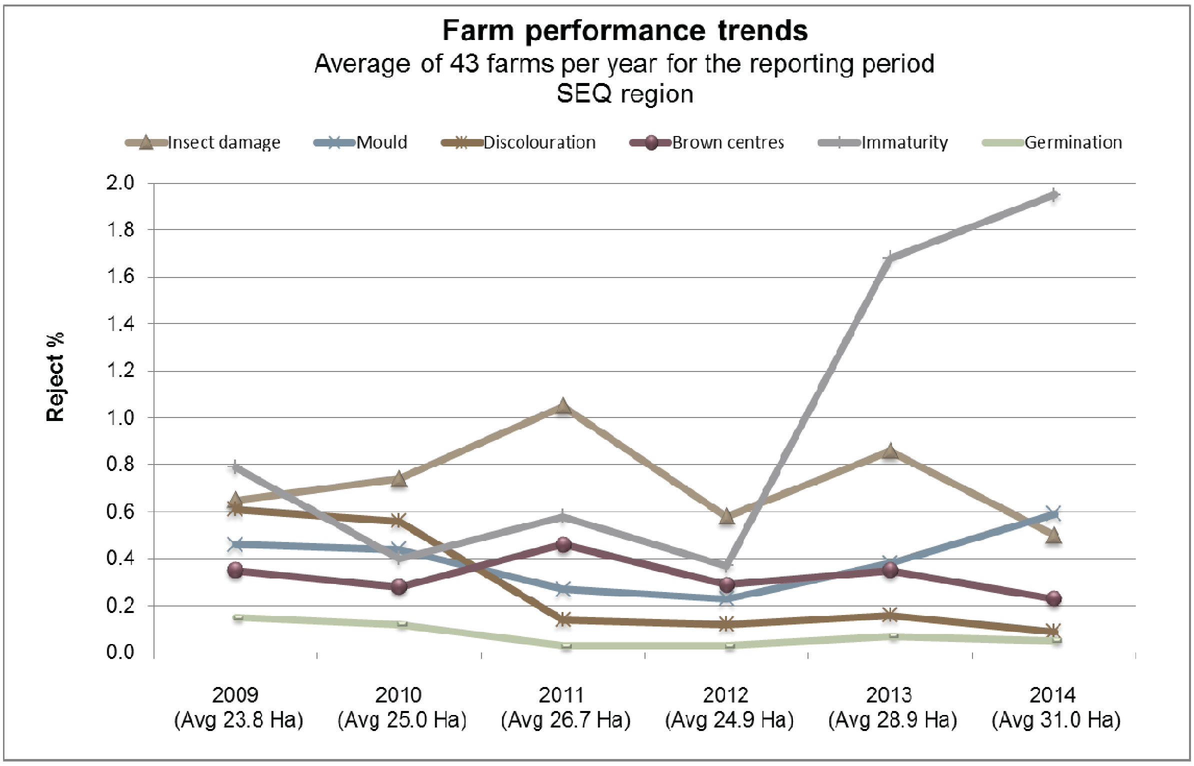


Figure 3.5-6: Comparison of consigned reject analysis for farms in South East Queensland region (2009 to 2014 seasons)

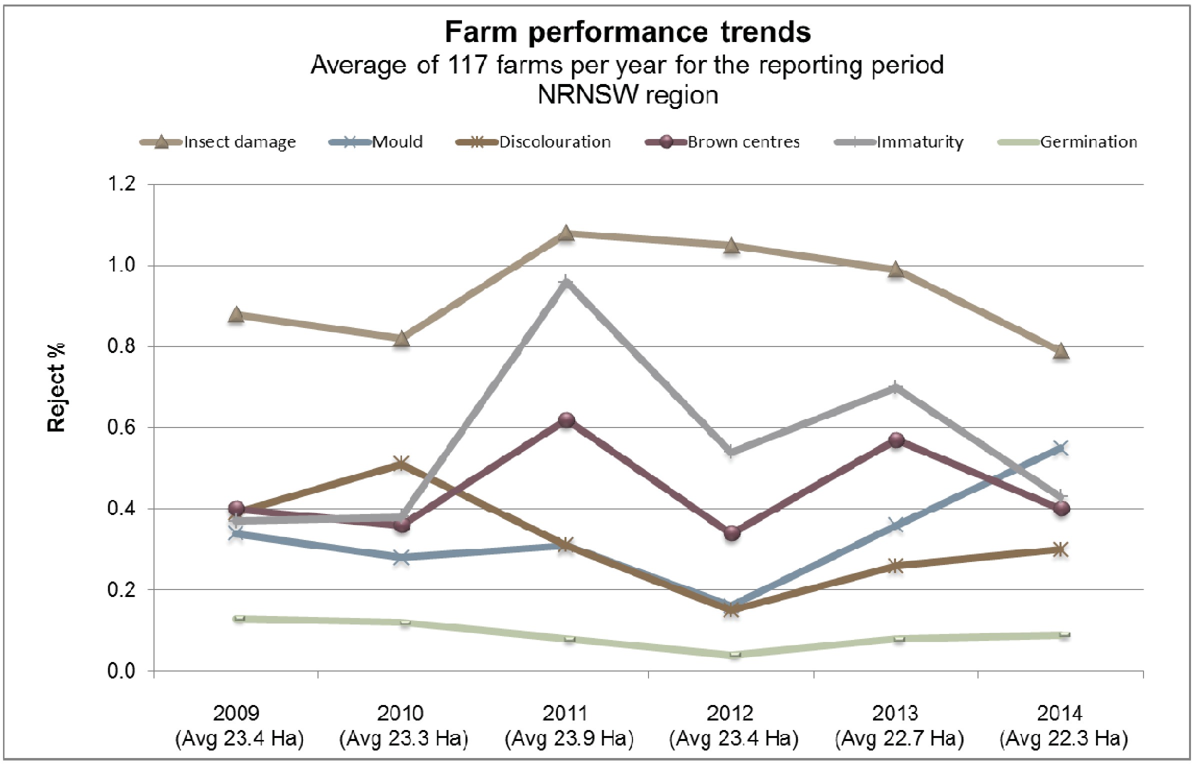


Figure 3.5-7: Comparison of consigned reject analysis for farms in Northern Rivers New South Wales region (2009 to 2014 seasons)

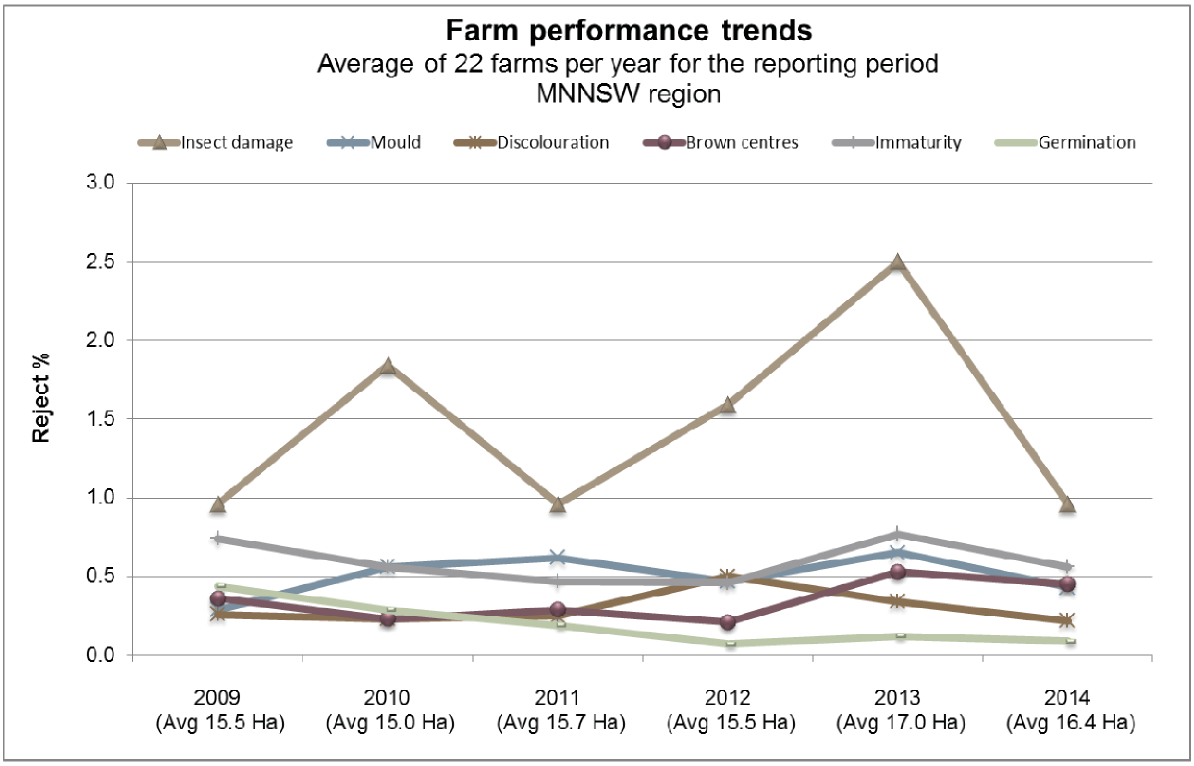


Figure 3.5-8: Comparison of consigned reject analysis for farms in Mid North Coast New South Wales region (2009 to 2014 seasons)

3.6 Tree age

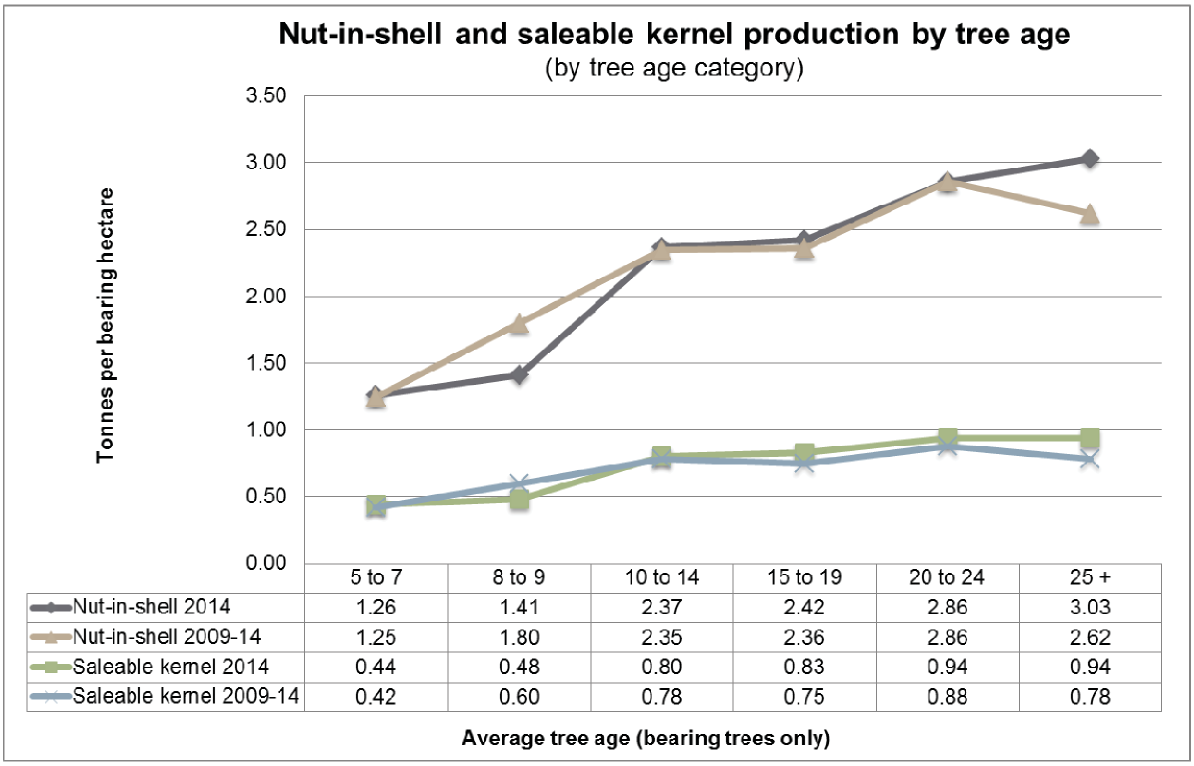
Farms were divided into categories based on the weighted average tree age.

Farms with an average tree age from 20 to 24 years had a significantly higher average yield of NIS, saleable kernel and total kernel per bearing hectare than farms in all the other tree age groups over the six years from 2009 to 2014. Farms with an average tree age 25 years and older had a significantly higher average yield of NIS per hectare than farms in all the tree age groups younger than 20 years but not significantly different yields of saleable kernel and total kernel per hectare than farms between 10 and 19 years.

Figure 3.6-1 shows that the rate of yield increase was greatest in the early bearing stages. This rate of increase slowed by the time farms reached an average tree age of between 10 and 14 years.

Farms aged 20 to 24 years had the highest average yield of saleable kernel per bearing hectare in each year from 2009 to 2013. Farms 25 years and older had an equivalent yield of saleable kernel and a higher yield of NIS per bearing hectare but a lower SKR than 20 to 24 year old farms in 2014.

Farms in all the tree age categories had an increase in yield of saleable kernel per bearing hectare from 2013 to 2014. Farms aged 25 years and older had the largest increase in yield per hectare in 2014.



	5 to 7	8 to 9	10 to 14	15 to 19	20 to 24	25 +
Nut-in-shell 2014	1.26	1.41	2.37	2.42	2.86	3.03
Nut-in-shell 2009-14	1.25	1.80	2.35	2.36	2.86	2.62
Saleable kernel 2014	0.44	0.48	0.80	0.83	0.94	0.94
Saleable kernel 2009-14	0.42	0.60	0.78	0.75	0.88	0.78

Figure 3.6-1: Comparison of tonnes of nut-in-shell (NIS) and saleable kernel per bearing hectare for farms of different average tree ages for 2014 and for all years from 2009-2014.

Figure 3.6-2 shows that farms aged 25 years and older averaged the highest yields of saleable kernel per bearing hectare over the six years from 2009 to 2014 in the South East Queensland and Central Queensland regions. Farms aged 20 to 24 years averaged the highest yield of saleable kernel per bearing hectare for the six years from 2009 to 2014 in the Northern Rivers and Mid North Coast regions.

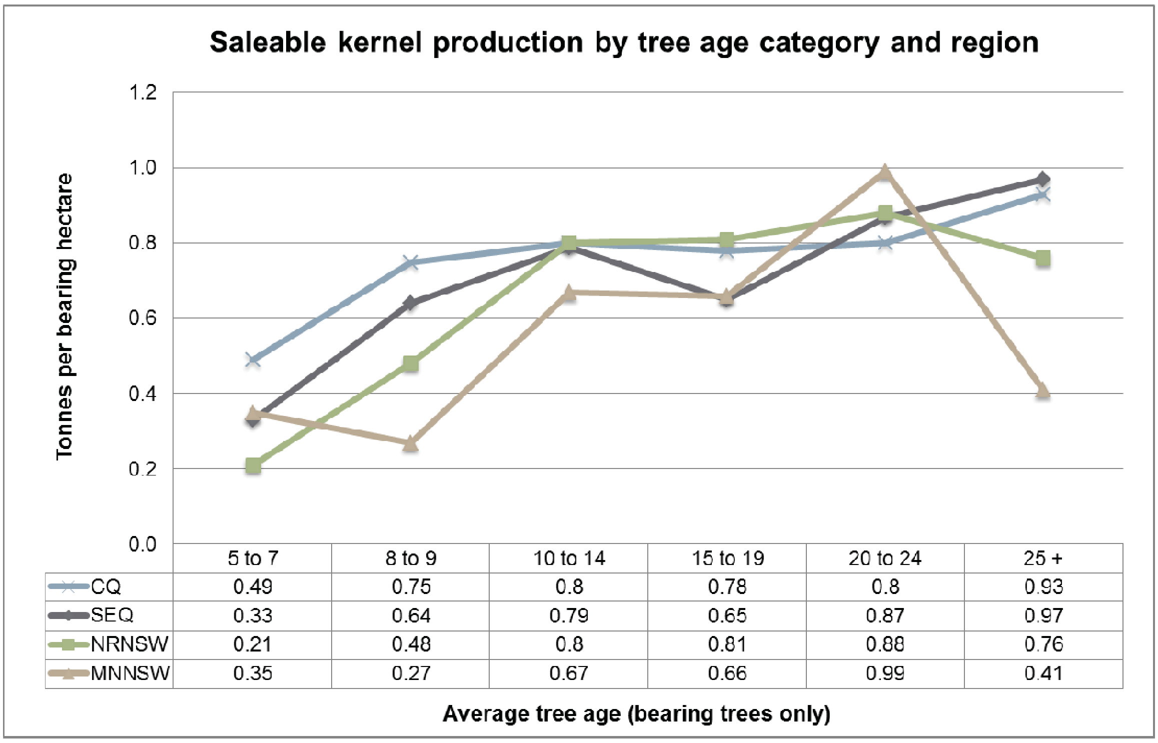
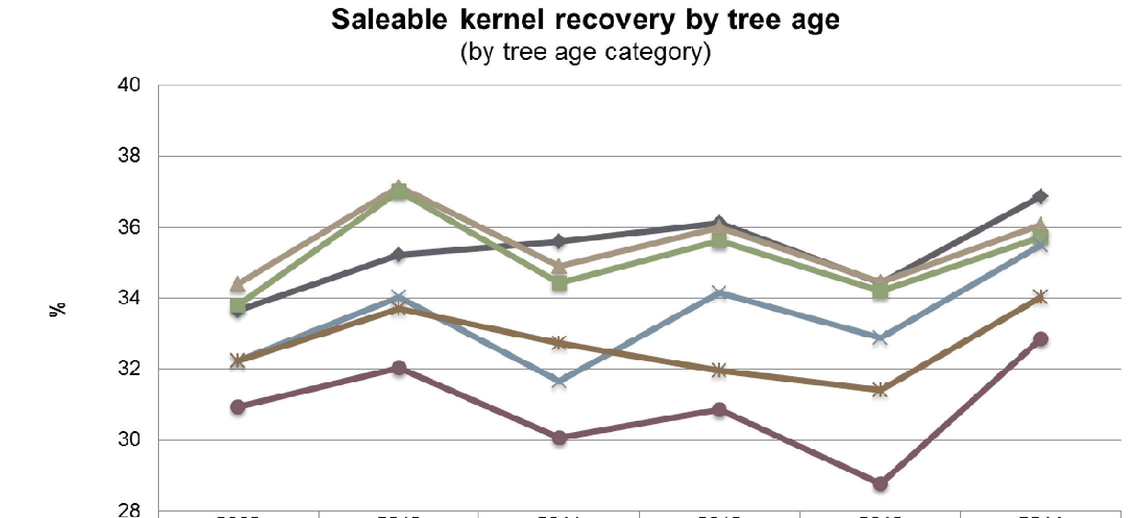


Figure 3.6-2: Saleable kernel production by tree age category and region for all years from 2009 to 2014.

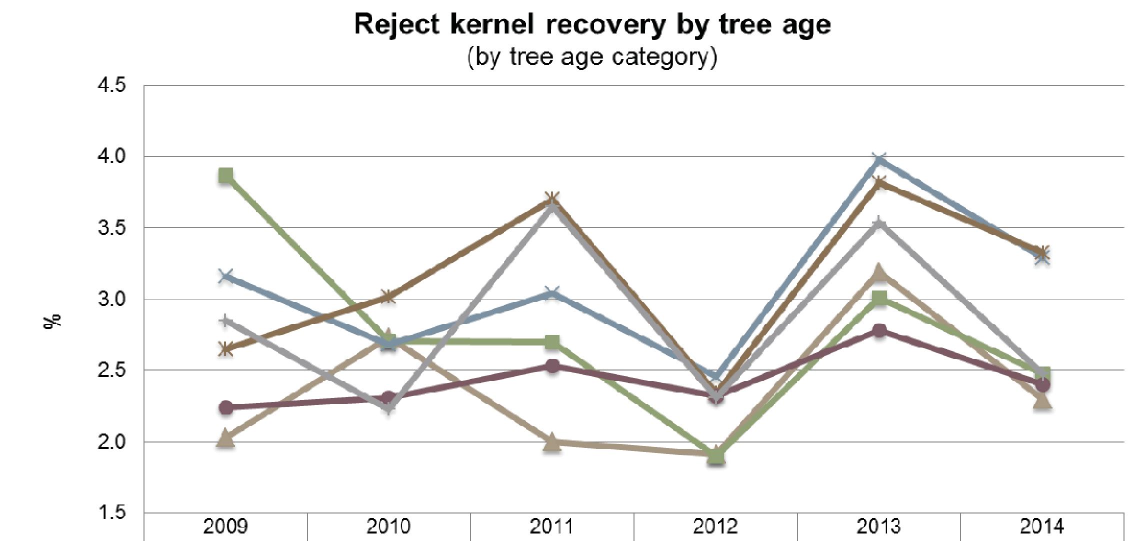
Figure 3.6-3 shows that there was an increase in average SKR from 2013 to 2014 amongst farms in all the tree age categories. The farms in the tree age category 25 years and older had the lowest average SKR in each year of the benchmarking study. By comparison, the farms in each of the tree age categories younger than 15 years had a higher average SKR each year than the farms in each of the tree age categories 15 years or older. Much of this difference is due to many of the cultivars planted on the older farms having a lower potential kernel recovery than many of the cultivars planted on the younger farms.



	2009	2010	2011	2012	2013	2014
5 to 7	33.66	35.23	35.60	36.13	34.43	36.87
8 to 9	34.40	37.14	34.89	36.00	34.45	36.06
10 to 14	33.80	37.02	34.42	35.62	34.20	35.71
15 to 19	32.24	34.02	31.67	34.16	32.88	35.49
20 to 24	32.24	33.71	32.72	31.95	31.41	34.02
25 +	30.93	32.03	30.07	30.86	28.77	32.85

Figure 3.6-3: Saleable kernel recovery by tree age category for each year from 2009 to 2014.

Figure 3.6-4 shows that there was also a decrease in average RKR amongst farms in all the tree age categories.



	2009	2010	2011	2012	2013	2014
5 to 7	2.03	2.73	2.00	1.91	3.19	2.30
8 to 9	3.87	2.71	2.70	1.90	3.01	2.48
10 to 14	3.16	2.68	3.04	2.46	3.98	3.29
15 to 19	2.65	3.02	3.70	2.34	3.82	3.33
20 to 24	2.24	2.31	2.53	2.32	2.78	2.40
25 +	2.85	2.23	3.65	2.31	3.54	2.48

Figure 3.6-4: Reject kernel recovery by tree age category for each year from 2009 to 2014.

There were also major differences in the levels of rejects between the different tree age categories over the six seasons from 2009 to 2014:

- Farms with an average tree age from 10 to 19 years had a significantly higher average level of rejects due to insect damage than younger farms and farms 25 years and older.
- Farms with an average tree age from 15 to 19 years had a significantly higher average level of rejects due to mould than younger and older farms.
- Farms with an average tree age older than 20 years had a significantly lower average level of rejects due to discolouration than younger farms.
- Farms with an average tree age from 20 to 24 years had a significantly lower average level of rejects due to brown centres than farms in all other tree age groups. Farms with an average tree age of 8 to 9 years had a significantly higher average level of rejects due to brown centres than farms in all other tree age groups.
- Farms aged 25 years and older had a significantly higher average level of rejects due to immaturity than farms younger than 10 years and farms between 15 and 24 years.
- Farms aged 8 to 19 years had significantly higher average levels of rejects due to germination than younger and older farms.
- Farms with an average tree age of 5 to 7 years had a significantly lower average NIS MC than farms in all the other tree age categories. Most of the 5 to 7 year old farms are located in the Central Queensland region where it is drier than the other regions during the harvest season. Farms with an average tree age 25 years and older had a significantly higher average NIS MC than farms younger than 10 years and farms between 15 and 24 years.

3.7 Farm size

Farms within the benchmarking sample were also divided into categories depending on the area of macadamia trees planted.

All farms less than 50 hectares had greater average yields of NIS, saleable kernel and total kernel per bearing hectare in 2014 compared to the average of the six years from 2009 to 2014. Farms larger than 50 hectares had similar average yields per hectare in 2014 compared to the averages from 2009 to 2014. Most of the farms larger than 100 hectares are in the Central Queensland region.

Farms less than 20 hectares had a higher relative representation in the benchmarking sample amongst the top 25% and bottom 25% for NIS and saleable kernel tonnes per hectare. Farms larger than 30 hectares had a higher relative representation amongst the middle 50% for NIS and saleable kernel tonnes per hectare.

Farms between 20 and 30 hectares had a significantly higher average NIS tonnes per bearing hectare than farms in all the other farm size categories and a significantly higher average saleable and total kernel per bearing hectare than farms between 10 and 20 hectares and farms larger than 50 hectares. The farms between 50 and 100 hectares had a significantly lower average NIS and saleable and total kernel tonnes per bearing hectare than farms less than 50 hectares.

Figure 3.7-1 shows ranking trends for farms in the different size categories for tonnes of saleable kernel per hectare. Each bar in the chart represents the average yield per hectare from an individual farm over the six seasons from 2009 to 2014.

The farms are grouped by size with the largest farms represented by the dark blue bars on the left of the chart and the smallest farms represented by the pale blue bars on the right. The red line represents the smoothed moving average of the 20 previous bars to the left of the chart.

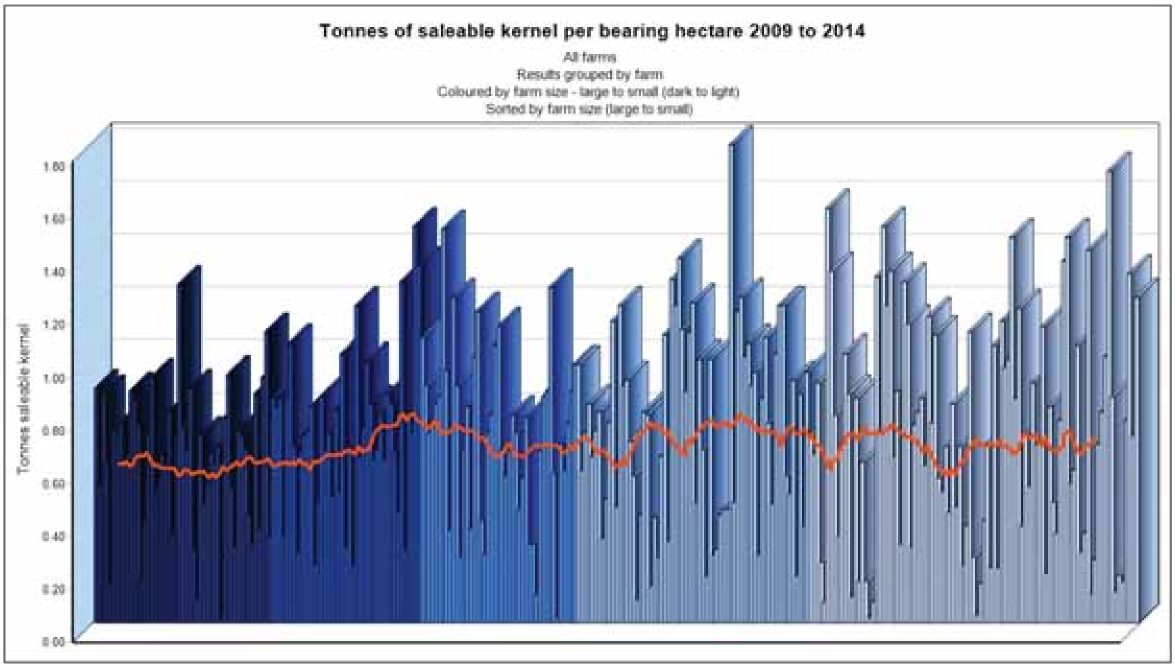


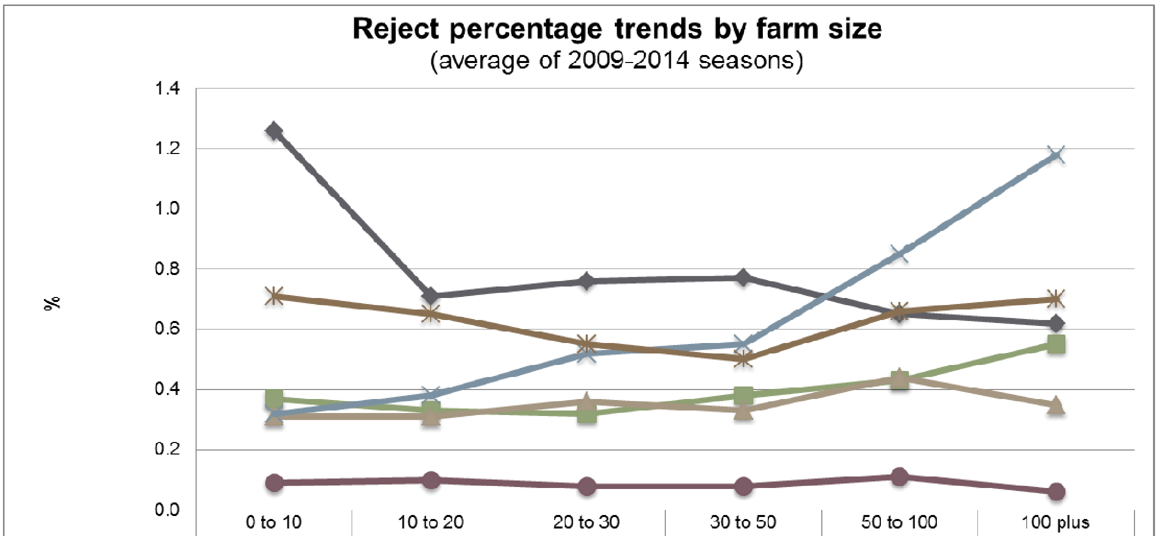
Figure 3.7-1: 20 point moving average for saleable kernel per bearing hectare for different farm size categories for 2009 to 2014

Figure 3.7-2 shows the differences in the reject analysis results between the different farm size categories over the six seasons from 2009 to 2014.

Brown centres represent a significantly greater level of reject amongst larger farms and insect damage represents a significantly greater level of reject amongst smaller farms.

Brown centres was the major reject category amongst larger farms over the six years of the benchmarking study from 2009 to 2014. The grower surveys from the *“Macadamia kernel quality:*

understanding brown centres and other kernel quality defects" project (MC07008) found that the average level of brown centres significantly increased with increasing farm size, maximum silo size and nut storage bed depth.



	0 to 10	10 to 20	20 to 30	30 to 50	50 to 100	100 plus
Insect	1.26	0.71	0.76	0.77	0.65	0.62
Mould	0.37	0.33	0.32	0.38	0.43	0.55
Discoloured	0.31	0.31	0.36	0.33	0.44	0.35
Brown centres	0.32	0.38	0.52	0.55	0.85	1.18
Immature	0.71	0.65	0.55	0.50	0.66	0.70
Germinated	0.09	0.10	0.08	0.08	0.11	0.06

Figure 3.7-2: Comparison of average consignment reject analysis for farms of different sizes for the 2009 to 2014 seasons.

There were major differences in the quality parameter results between 2014 and the averages over the six seasons from 2009 to 2014. Some of the most important include:

- All the farm size categories had a greater average SKR and PKR in 2014 than the averages from 2009 to 2014.
- Farms less than 100 hectares had a greater average CKR in 2014.
- Farms less than 10 hectares and between 20 and 30 hectares had a greater average RKR and the farms between 10 and 20 hectares and between 30 and 100 hectares had a smaller average RKR in 2014.
- Farms less than 100 hectares had less rejects due to insect damage in 2014.
- All the farm size categories had more rejects due to mould and less rejects due to discolouration in 2014.
- Farms larger than 10 hectares had less rejects due to brown centres in 2014.
- Farms between 30 and 100 hectares had less rejects due to immaturity in 2014.

There were also significant differences in the quality parameter results between the farm size categories over the six seasons from 2009 to 2014:

- Farms between 10 and 20 hectares had a significantly higher average SKR than farms between 20 and 30 hectares and larger than 50 hectares.
- Farms between 10 and 20 hectares had a significantly higher average PKR than farms larger than 100 hectares.
- Larger farms had a significantly lower average CKR and significantly higher average RKR than smaller farms.
- Smaller farms had a significantly higher average level of rejects due to insect damage than larger farms.
- Larger farms had a significantly higher average level of rejects due to mould and brown centres than smaller farms.
- Farms between 30 and 50 hectares had a significantly lower average level of rejects due to immaturity than farms less than 20 hectares.
- Larger farms had a significantly lower average NIS MC than smaller farms.

3.8 Planting density

Planting density is measured as the average number of trees per planted hectare. This is weighted by the number of trees for each different tree spacing.

Figure 3.8-1 shows the average annual yield per tree for all bearing farms in the benchmarking sample over the six seasons from 2009 to 2014. Farms are sorted by their average planting density with the least dense plantings at the left and the densest plantings at the right. The red line represents the smoothed moving average of the 20 previous points on the chart.

Average yield per tree decreased from just over three kilograms of saleable kernel at the lowest tree planting densities to less than two kilograms per tree at the highest planting densities. The chart also shows however that there is substantial production variability across the range of planting densities so this variation is likely to be the result of other factors such as individual farm management.

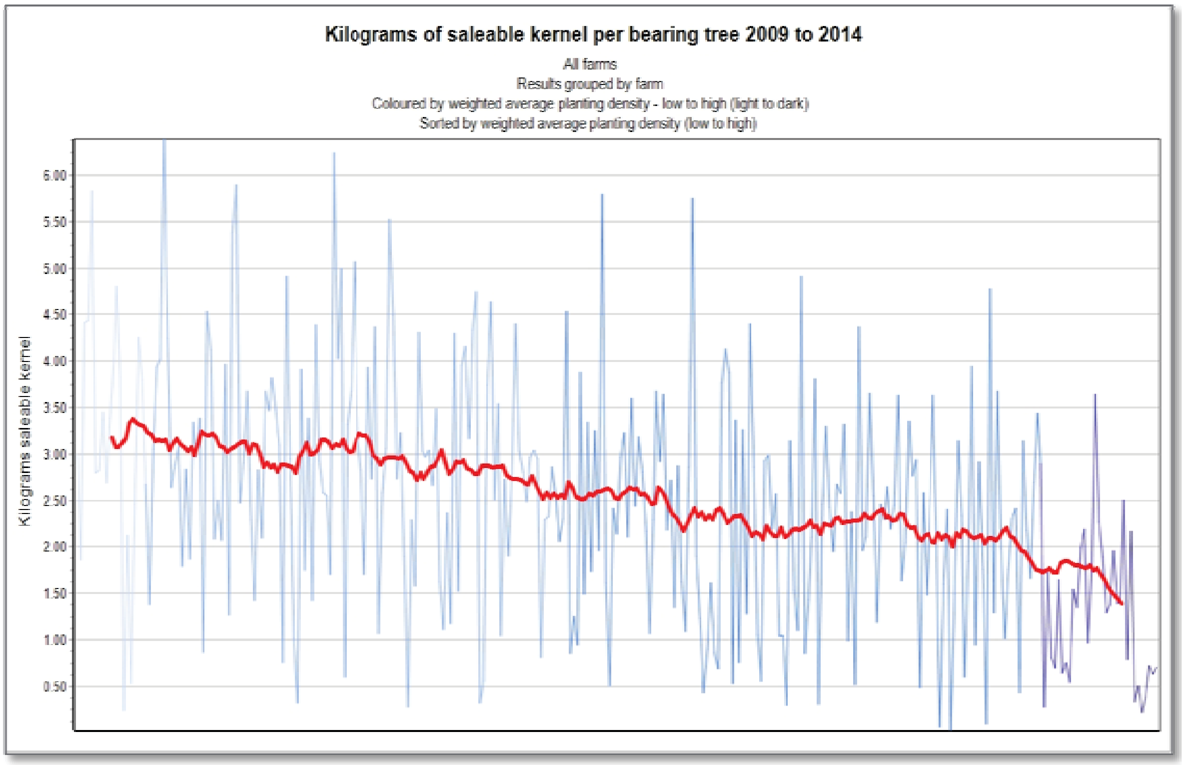


Figure 3.8-1: Saleable kernel per bearing tree by weighted average planting density for 2009 to 2014

Figure 3.8-2 shows that the average annual yield per hectare for the farms at the lowest and highest planting densities was similar at approximately 0.6 tonnes of saleable kernel per bearing hectare. The average yields per hectare at many of the medium planting densities were higher at approximately 0.8 tonnes per bearing hectare. As with the previous chart, there is substantial variability across the range of planting densities.

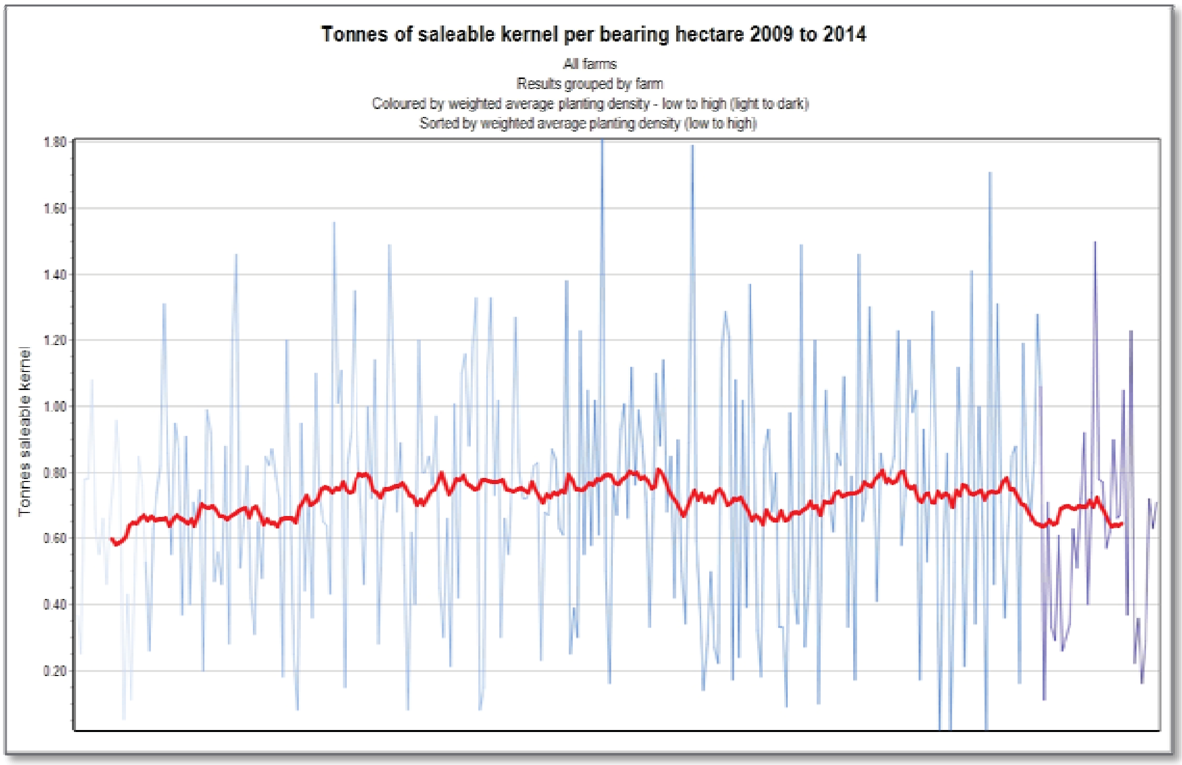


Figure 3.8-2: Saleable kernel per bearing hectare by weighted average planting density for 2009 to 2014

The average annual yield per tree for farms with an average tree age from 20 to 24 years showed a similar relationship with planting density as with all the bearing trees in the benchmarking sample. The average yield decreased from an average of just over 3.5 kilograms of saleable kernel at the lowest planting densities to an average of approximately 2.5 kilograms at the highest planting densities. The average annual yields for these farms increased from approximately 0.7 tonnes of saleable kernel per hectare to about 0.9 tonnes per hectare as the planting density increased and then plateaued at this level.

3.9 Irrigation status

Irrigated farms in the benchmarking sample were on average more than three times larger than non-irrigated farms over the six years of the benchmarking study. There was also a higher proportion of irrigated farms amongst non-owner managed farms than owner managed farms. Most of the irrigated farms in the benchmarking sample are in the Bundaberg district and other parts of the Central Queensland region and also in the drier production areas of South East Queensland.

Irrigated farms had lower average yields of NIS, saleable kernel and total kernel per bearing hectare in 2014 compared to the average for the six years from 2009 to 2014. By comparison, non-irrigated farms had higher average yields of NIS, saleable kernel and total kernel per bearing hectare in 2014 when compared with the same period.

Non-irrigated farms had significantly higher average yields of NIS, saleable kernel and total kernel per bearing hectare than the irrigated farms for the six years from 2009 to 2014.

Figure 3.9-1 ranks the tonnes of saleable kernel per bearing hectare for irrigated and non-irrigated farms for 2009 to 2014. The irrigated farms were more concentrated in the middle 50% and the non-irrigated farms more concentrated amongst the top 25% and bottom 25% of farm years for yield per hectare.

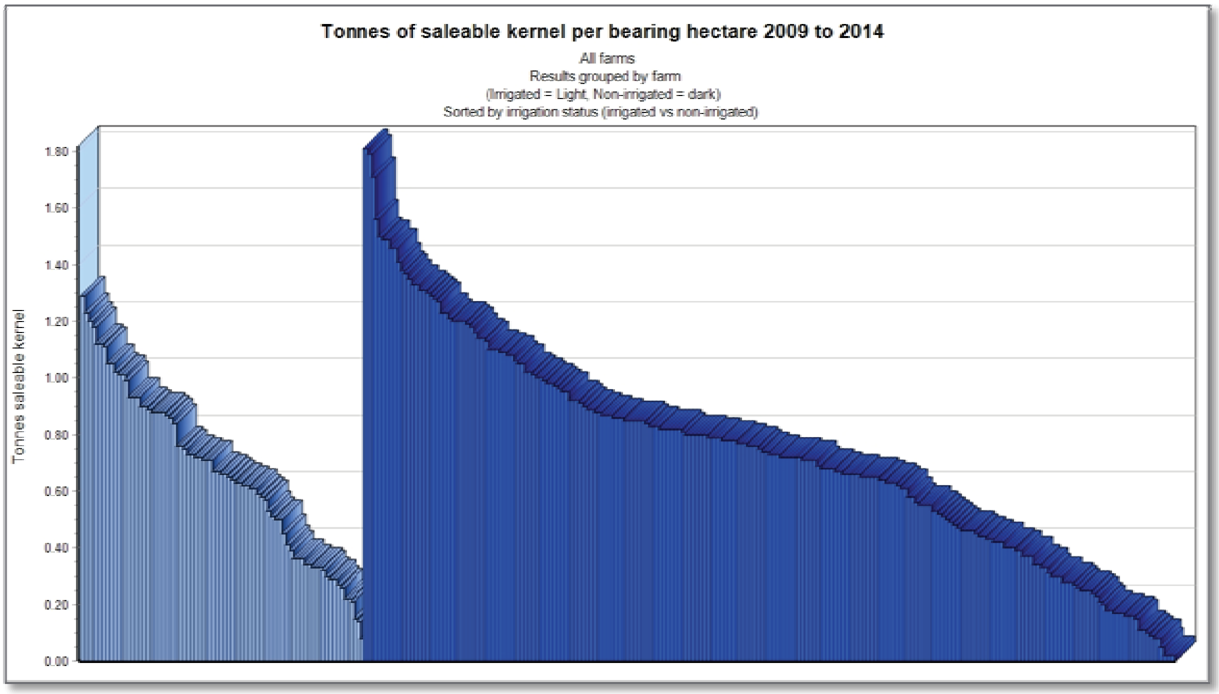


Figure 3.9-1: Saleable kernel per bearing hectare yield trends for irrigated and non-irrigated farms for 2009 to 2014

Both irrigated and non-irrigated farms had a higher average SKR, PKR and CKR and a lower average NIS MC in 2014 compared to the average from 2009 to 2014. Irrigated farms had an equivalent RKR in 2014 and non-irrigated farms had a lower average RKR in 2014 than the average from 2009 to 2014. Irrigated farms had a lower average and non-irrigated farms had a higher average percentage of whole kernels in 2014.

Irrigated farms had a higher average level of rejects due to insect damage, mould, immaturity and germination and a lower average level of rejects due to discolouration and brown centres in 2014 compared to the average from 2009 to 2014. Non-irrigated farms had a higher average level of rejects due to mould and immaturity and a lower average level of rejects due to insect damage, discolouration, brown centres and germination in 2014.

Non-irrigated farms had a significantly higher average CKR, NIS MC and percentage whole kernels and a significantly lower average PKR than irrigated farms over the six seasons from 2009 to 2014. There were no significant differences between the irrigated and non-irrigated farms for average SKR and RKR. Irrigated farms had a significantly higher average level of rejects due to discolouration and brown centres and non-irrigated farms had a significantly higher average level of rejects due to insect damage, immaturity and germination from 2009 to 2014.

3.10 Management structure

Non-owner managed farms in the survey sample were on average approximately three times larger than owner managed farms over the six years of the benchmarking study. Most of the irrigated farms and many of the non-owner managed farms in the benchmarking sample are in the Central Queensland region.

Both owner managed and non-owner managed farms had higher average yields of NIS, saleable kernel and total kernel per bearing hectare in 2014 compared to the average over the six seasons from 2009 to 2014. There was no significant difference in the average yields of NIS, saleable kernel or total kernel per bearing hectare from 2009 to 2014 between the owner managed and the non-owner managed farms.

Figure 3.10-1 ranks average tonnes of saleable kernel per bearing hectare for owner managed and non-owner managed farms for 2009 to 2014. As with irrigation status, the owner managed farms were more concentrated in the top 25% and bottom 25% and the non-owner farms more concentrated in the middle 50% of farm years for yield per hectare.

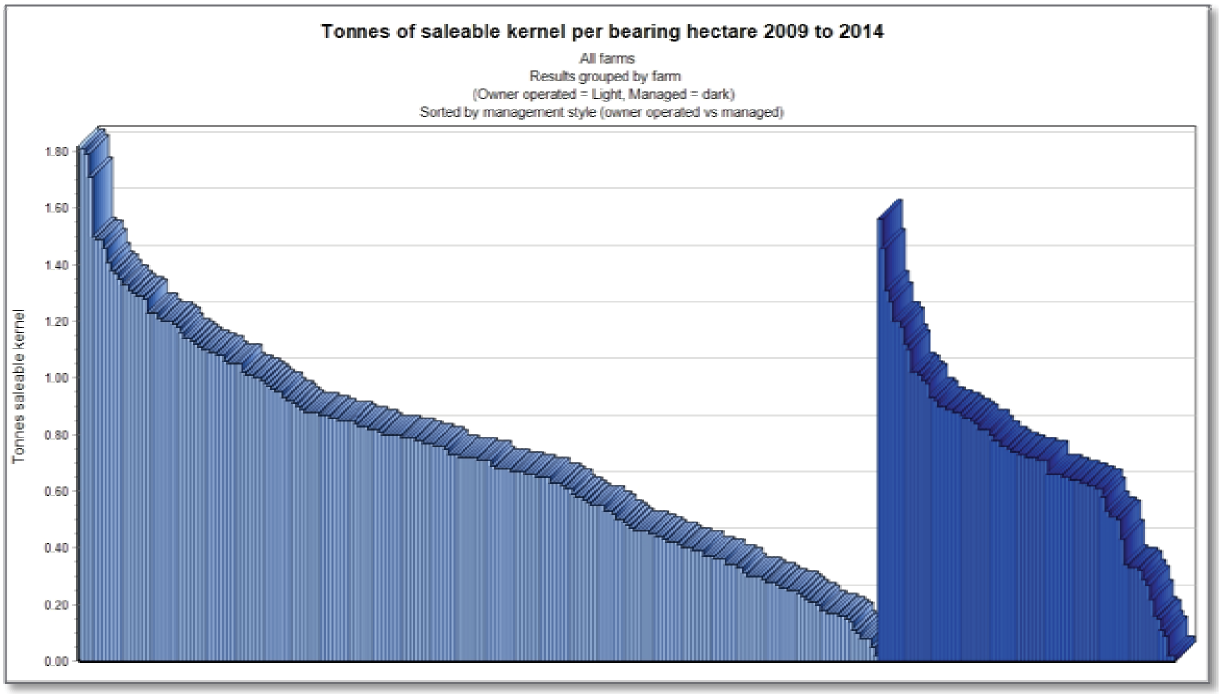


Figure 3.10-1: Saleable kernel per bearing hectare yield trends for managed vs owner- operated farms for 2009-2014

Both owner managed and non-owner managed farms had a higher average SKR, PKR, CKR and percentage of whole kernels and a lower average RKR and NIS MC in 2014 than the average from 2009 to 2014. Owner managed farms had a higher average level of rejects due to mould and immaturity and a lower average level due to insect damage, discolouration, brown centres and germination in 2014 compared to the average from 2009 to 2014. Non-owner managed farms had a higher average level of rejects due to mould, insect damage and germination and a lower average level due to discolouration, brown centres and immaturity in 2014 compared to the average from 2009 to 2014.

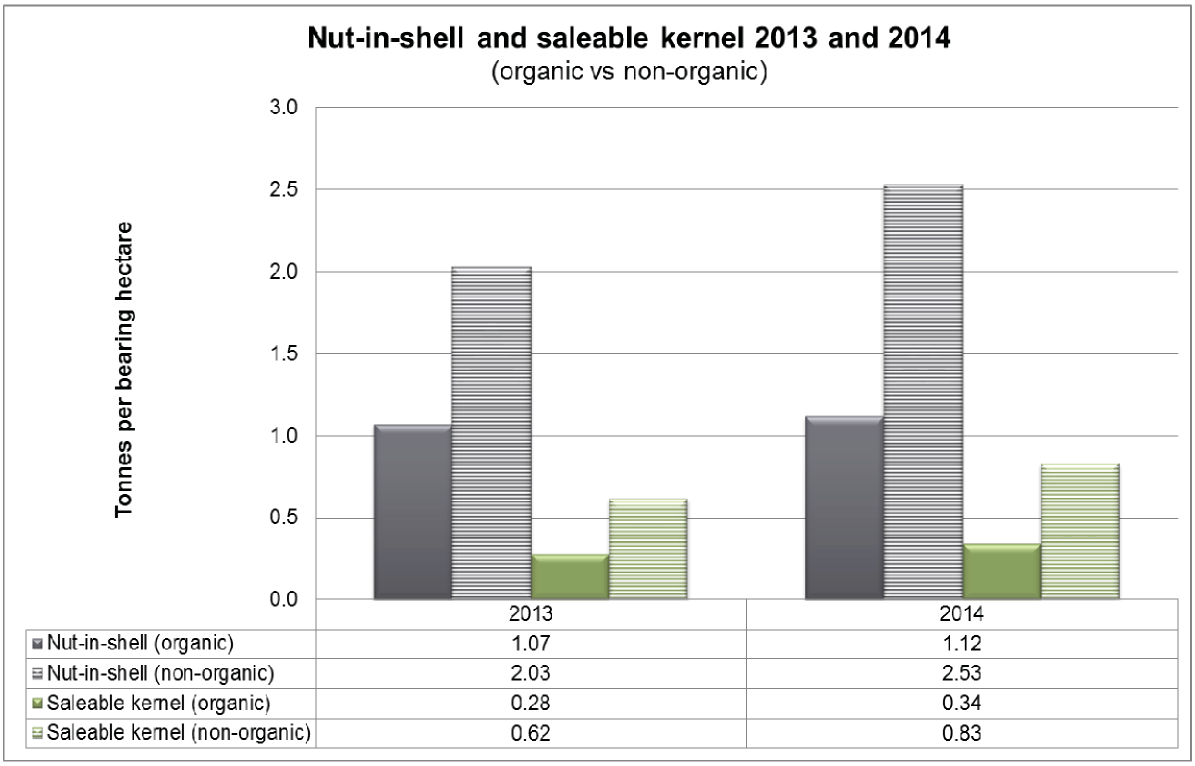
Owner managed farms had a significantly higher average PKR and NIS MC and significantly lower average CKR than non-owner managed farms over the six seasons from 2009 to 2014. There were no significant differences between owner managed and non-owner managed farms for average SKR, RKR or percentage of whole kernels. Owner managed farms had a higher average level of rejects due to insect damage, immaturity and germination and non-owner managed farms had a higher average level of rejects of rejects due to discolouration and brown centres.

3.11 Organic farms

Organic macadamia farms were identified during the benchmarking data collection following the 2013 and 2014 harvest seasons. Organic farms were defined in the benchmarking analysis as those macadamia farms that were either certified as organic or in transition to certification.

There were only six farms identified as organic in the benchmarking sample in 2013 and eight farms in 2014. These organic farms were on average much smaller than the non-organic farms. All the organic farms were located in the Northern Rivers or the Mid North Coast of New South Wales regions.

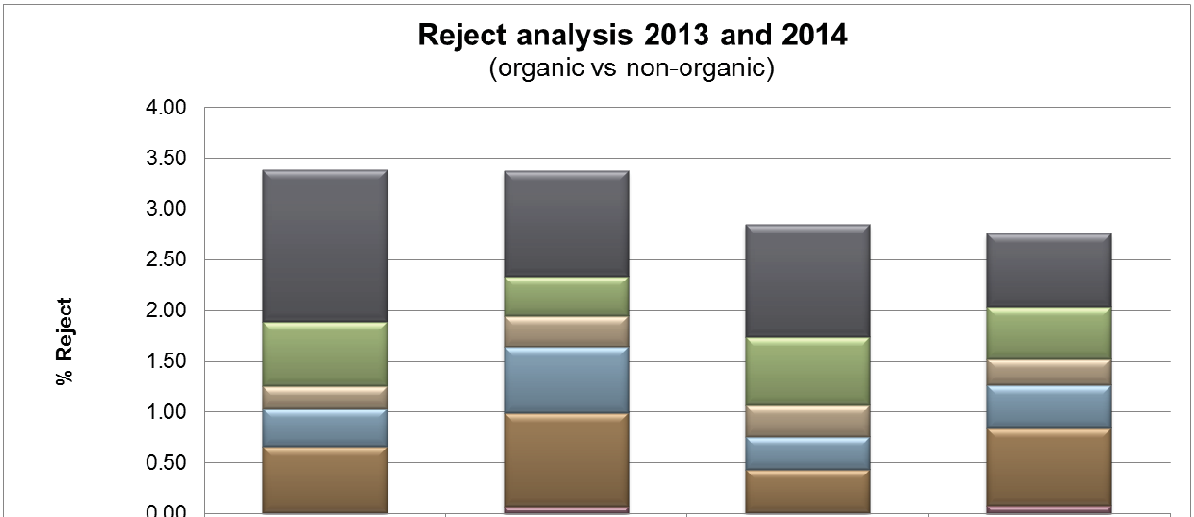
Figure 3.11-1 shows that non-organic farms had higher average yields of NIS and saleable kernel per hectare than organic farms in both 2013 and 2014. Non-organic farms also had a higher average SKR than the organic farms in both 2013 and 2014.



	2013	2014
Nut-in-shell (organic)	1.07	1.12
Nut-in-shell (non-organic)	2.03	2.53
Saleable kernel (organic)	0.28	0.34
Saleable kernel (non-organic)	0.62	0.83

Figure 3.11-1: Average production figures of organic farms vs non-organic farms (2013 and 2014 seasons)

Organic farms had an equivalent average RKR to non-organic farms in 2013 and a slightly higher average RKR than non-organic farms in 2014. Figure 3.11-2 shows that organic farms had higher average levels of rejects due to insect damage and mould and lower average levels of rejects due to brown centres, immaturity and germination in both years.



	2013 % reject (organic)	2013 % reject (non-organic)	2014 % reject (organic)	2014 % reject (non-organic)
Insect damage	1.50	1.04	1.11	0.72
Mould	0.63	0.39	0.67	0.51
Discolouration	0.22	0.31	0.31	0.26
Brown centres	0.38	0.65	0.32	0.43
Immaturity	0.65	0.92	0.43	0.76
Germination	0.01	0.07	0.01	0.08

Figure 3.11-2: Reject analysis of organic farms vs non-organic farms (2013 and 2014 seasons)

Further investigation is required to determine whether differences in yield and quality results for organic and non-organic farms are due to the farming methods used or other factors such as farm size or region.

4. Background

Benchmarking is a management tool widely used in agricultural industries. It assists individual businesses to compare their results with similar operations and with industry best practice and to analyse where and how they can improve their performance.

This benchmarking builds on the results of the macadamia productivity groups. The continuing facilitation of the network of productivity groups provides an opportunity for Australian macadamia owners and managers to compare and analyse their farm practices and results. The benchmarking enables an increased number of owners and managers to compare their results with those from farms with a similar location, size, tree age, irrigation status and management structure.

The benchmarking also builds on the results of the *"On-farm economic analysis in the Australian macadamia industry"* project (MC03023). This project provided a detailed analysis of the revenue, expenses, profit and production from a cross section of 41 farms for four years from 2003 to 2006. It also builds on the results of the *"Macadamia cash flow analysis 2003 to 2006, including estimates for 2008 and 2009"* which analysed cash flows for a cross section of Australian farms.

With guidance from the project industry steering group, the focus of the benchmarking to-date has been on analysing and reporting yield and quality results. Increasing farm productivity is also a major initiative of the Australian Macadamia Society.

The focus of the benchmarking was expanded in 2014 to cover a comparison and analysis of macadamia farming costs of production. The results of the study of costs of production are covered in a separate report.

Farm details and production data for 2014 were collected from 265 bearing farms. Most of these farms had also supplied production data during previous benchmarking rounds. These farms represented approximately 55% of the Australian macadamia industry by planted area and production. They also represented a cross section of farms in the Australian macadamia industry for location, farm size, tree age, irrigation status and management structures.

Organic farms were also identified during the data collection following the 2013 and 2014 harvest seasons. This enabled a comparison of the yield and quality results between the organic farms and those farms using conventional farming methods.

Information was collected directly from macadamia owners and managers. Production data was also collected from macadamia processors with the owner's or manager's consent. Businesses received confidential individual reports for each of the farms for which data was submitted. The reports were also provided to nominated processors only with the signed consent of the owner or manager who supplied the data. As individual data is strictly confidential, only summary results are reported in this study.

The benchmarking study has identified major differences in yield and quality results between the seasons from 2009 to 2014, the major production regions, farm size and tree age categories, farm management structures and farm irrigation status. This information is important for the Australian macadamia industry for its strategic planning.

This report includes a range of descriptive and statistical data analyses. All averages contained in this report are unweighted (i.e. arithmetic means), except where otherwise specified. An unweighted mean implies that each farm in the data sample exerts equal influence on the average. In other words, the data for 10 hectare farms will have just as much influence on regional or seasonal averages as that of 200 hectare farms.

By comparison, weighted averages are calculated by dividing the total volume by the total bearing hectares in each sample (e.g. the total volume of saleable kernel divided by the total bearing hectares for a region for a particular year). This means that larger farms will have more influence on the weighted averages than smaller farms. This is important for comparing results on a whole industry or whole region basis.

5. Materials and methods

The following section details the processes used for collection and handling of data for the production of benchmark reports. It also explains the methodologies used and assumptions associated with analysis and reporting of that data.

5.1 Data collection

A project industry steering group provides guidance and direction to the project team. The group comprises key members of the Australian macadamia industry. The steering group met with the project team at the start of the project and continues to meet annually with the project team to review and validate methodology and results.

The project industry steering group members are:

- Kim Wilson, farm manager and consultant, Clunes, NSW
- Andrew Starkey, macadamia grower, Brooklet, NSW
- Chris Searle, processor grower services officer, Bundaberg, Qld
- Lindsay Bryen, macadamia grower and farm manager, Clunes, NSW
- Jolyon Burnett, CEO of the Australian Macadamia Society, Lismore, NSW

The project industry steering group determined that kernel yield and quality were initially the major priorities to address in the on-farm benchmarking. Improving Australian macadamia farm productivity is a major initiative of the Australian Macadamia Society. It has also since been agreed with the steering group to expand the scope of the benchmarking to include a comparison of farm costs of production.

In 2013 the project team was requested by organic growers within the macadamia industry to separately benchmark yield and quality results for organic farms. For the purposes of benchmarking, organic macadamia farms are defined as those that are certified as being organic or as being in transition to certification by an organic farming regulatory organisation. Sufficient numbers of organic farms participated following the 2014 season to enable statistical analysis of the yield and quality results from these farms compared to the results from farms using conventional farming methods.

Farm details and 2014 production data were collected from 265 bearing farms. Most of these farms had also supplied production data for previous rounds of benchmarking. These farms represented approximately 55% of the Australian macadamia industry by planted area and production based on Australian Macadamia Society statistics. They also represented a cross section of farms in the Australian macadamia industry for location, farm size, tree age and management systems.

Farm information included tree planting numbers, ages, areas and also varieties where this information was available. Production information included summary consignment data for each season available, including information about the tonnage of NIS consigned, premium, commercial and reject kernel recovery, reject analysis, moisture content and percentage of whole kernel.

The information was collected directly from macadamia owners and managers by project team members. Production data was also collected from macadamia processors with the owner's or manager's consent. All major Australian macadamia processors were visited or contacted directly to gain their support. The project team is very grateful for the cooperation of all the major Australian macadamia processors with the data collection. Some of the processors very actively encouraged their grower suppliers to participate.

The collected farm, yield and quality data were entered into a database built specifically for the benchmarking study. The database was also designed to analyse agronomic and economic data to be collected in subsequent benchmarking rounds.

Owners and farm managers received confidential individual reports for each of the farms for which data was submitted. The reports were also provided to nominated processors only when signed consent to provide the reports was received by the owner or manager who supplied the data. The reports included:

- A summary table and bar charts comparing how their farm performed against a range of averages for yield and nut quality.
- Charts ranking the performance of their farm against others in the sample.
- Stacked bar charts comparing their farm's reject analysis with other farms in the survey sample.
- A chart showing production trends for their farm for multiple seasons.

5.2 Data analysis

The focus of the benchmarking to-date has been on analysing and comparing farm yield and quality results.

Yield parameters compared within the benchmarking include nut-in-shell (NIS), saleable kernel and total kernel per bearing hectare. Saleable kernel includes both premium grade kernel and commercial grade kernel. Saleable kernel is used as the key indicator of yield within the benchmarking as it is the main factor in determining the relative price of NIS received.

Quality parameters compared within the benchmarking include:

- Saleable Kernel Recovery (SKR) – This includes both premium and commercial kernel recovery.
- Premium Kernel Recovery (PKR)
- Commercial Kernel Recovery (CKR)
- Reject Kernel Recovery (RKR)
- The percentage of rejects due to insect damage, mould, discolouration, brown centres, immaturity and germination.
- Nut-in-shell moisture content (NIS MC)
- The percentage of whole kernels

Not all the processors provide data to their grower suppliers for each of these parameters. Some processors also use different terminology to describe some of these parameters. Some processors also include other reject categories that are not included in the benchmarking.

Farms within the benchmarking sample are categorised to enable comparisons of yield and quality parameters. These categories include:

- Production season
- Production region
- Tree age (weighted average)
- Farm size (based on the area of bearing trees)
- Planting density (weighted average)

- Irrigated or non-irrigated
- Owner managed or non-owner managed
- Organic or non-organic

Percentiles

A percentile is a statistical measure indicating the value below which a given percentage of observations in a sample fall. For example, the 25th percentile in a data sample is the value below which 25% of the observations may be found. The 25th percentile is also known as the first quartile. Percentiles have been included in this report to identify differences between the top 25%, middle 50% and lower 25% of farms or farm years.

For ease of understanding and to minimise skewing due to individual farm results, percentile groups used in this report are based on relatively uniform sample sizes. An iterative algorithm has been used to derive these percentile groups. The following example shows how this process works on a 100 point data sample:

1. The sample is ranked according to a dependent variable such as tonnes of saleable kernel per bearing hectare.
2. A marker is placed on the 25th data point and its value is identified.
3. Adjoining points in both directions within the sample are iteratively compared with the current marker point to determine the nearest data point whose value is different to the current marker.
4. If required, the marker is moved to reflect the closest unique data value (i.e. its value is different to at least one adjoining point). This becomes the cut point for the 75th percentile.

The above process is repeated on the 75th data point to determine a similar unique cut point for the 25th percentile. Values that fall above the cut point for the 75th percentile are grouped to form the top 25% and those that fall below the 25th percentile form the bottom 25%. The remainder of values represent the middle 50%. As a result, the number of data points in each quartile is not always the same.

Weighted and unweighted averages

Weighted averages are calculated by dividing the total amount by the bearing hectares in each sample (e.g. the total weight of saleable kernel divided by the total bearing hectares for a region for a particular year).

This means that larger farms will have more influence on a weighted average than smaller farms. This is important for comparing results and trends on a whole industry or a whole region basis.

This analysis provides a different perspective to the unweighted averages (i.e. arithmetic means) which are used in most of the descriptive and statistical analyses throughout this report. Unweighted averages imply that each farm in the data sample exerts equal influence on the average. In other words, the data for a 10 hectare farm will have just as much effect on the average as that of a 200 hectare farm.

Cross tabulations

A cross-tabulation is a categorical analysis that provides an overview of how two or more variables are interrelated using a tabular layout. The cells in the table contain the frequencies of the corresponding pairs of values of the selected variables as well as the percentage of the total. In statistical terms, it is a joint distribution between two or more discrete categorical variables such as irrigation and management style. If there are a disproportionately large or small number of cases in a particular cell then this indicates there may be an interaction between these two variables. For example, we may want to know what proportion of owner managed farms have irrigation. Alternatively we may also want to know how many non-irrigated farms are non-owner managed.

These analyses are used to present findings for a range of measures including NIS tonnes per hectare, saleable kernel tonnes per hectare, saleable kernel recovery, premium kernel recovery, commercial kernel recovery and reject kernel recovery. This is typically presented for the top 25%, middle 50% and bottom 25% of farms for all seasons with respect to categories such as irrigation status, ownership/management status, farm region and farm size. See the percentiles section above for more information about the percentile methodology used in this report.

The term farm year is used throughout this report. A farm year describes the records for an individual farm for a given year. For example, records from 200 farms over 5 years equates to 1000 farm years.

Correlations

Correlation is a measure of the interdependence of two random variables. The coefficient of correlation ranges in value from -1 indicating perfect negative correlation to +1 indicating positive correlation, with 0 representing no correlation. Correlation is a directional measure of the interdependence between two variables. The strength of the correlation is measured by the significance level as well as the value of the correlation coefficient. A significance level of less than 10% (0.10 or less) indicates that there is a significant correlation between two variables. A positive or negative correlation coefficient then indicates the direction of that relationship.

Analysis of variance

The statistical technique known as Least Significant Difference (LSD), a post hoc analysis of variance (ANOVA) test, is used in the benchmarking analysis. This technique is used to analyse whether two samples (e.g. two seasons) for a particular variable (e.g. NIS tonnes per hectare) are significantly different.

When examining the significance level of the comparisons, any value less than 0.10 ($p<0.1$) indicates a significant difference at the 10 percent level. The mean difference tells us the directional nature of the relationship between any two variables. If the mean difference for sample 1 minus sample 2 is negative for a particular variable and the difference is significant, then the variable from sample 1 is significantly less than the variable from sample 2. For example in table 6.3-1, we can see that for 2009 minus 2013 for NIS tonnes per hectare, there is a mean difference of 0.74, which is significant at 0.00 (less than 0.01). This means that farms in the survey sample in 2009 yielded significantly greater average tonnes of NIS per hectare than farms in 2013.

6. Analysis results

This section includes major findings from analysis of industry on-farm data spanning six production seasons (2009-2014). Results are categorised by season, region, tree age, farm size, planting density, irrigation status, management structure and farming method. A separate analysis of the top 20 farms is also presented.

6.1 Results for all farms

This section provides results as they apply to the whole benchmark sample in the latest season compared to the results for all six seasons from 2009 to 2014.

Sample description

Planting details and 2014 production data were collected from 265 bearing farms. Most of these farms also provided data during previous rounds of benchmarking. The following is a summary of the benchmarking participation to date:

Seasons

Table 6.1-1 shows the number of bearing farms, the average planted and bearing hectares and the cumulative farm year total for each year of the benchmarking. A farm year describes the records for an individual farm for a given year. For example, records from 200 farms over 6 years equates to 1200 farm years.

- The number of participating farms has increased in each round of benchmarking, from 178 in 2009 to 265 in 2014. Farms on which planted trees were less than five years of age were not regarded as bearing within the benchmarking study. Although some farms do harvest nuts from 4 year old trees these are usually small amounts and not considered commercial quantities.
- There was a total of 1324 farm years involved in the benchmarking over the six years from 2009 to 2014.
- The 265 bearing farms that participated in 2014 represented approximately 55% of the Australian macadamia industry by both planted area and production in that year.
- The average tree area of participating farms in 2014 was 38.04 planted hectares and 37.08 bearing hectares. Average planted and bearing hectares varied slightly in each of the six years of the benchmarking study depending on the composition of the participating farms.

Year	Bearing farms	Average planted hectares	Average bearing hectares	Cumulative farm year total
2009	178	38.54	32.56	178
2010	184	38.54	34.72	362
2011	192	40.32	36.16	554
2012	243	36.53	34.73	797
2013	262	37.32	36.15	1059
2014	265	38.04	37.08	1324

Table 6.1-1: Annual summary of bearing farms for the 2009 to 2014 seasons

Regions

Participating farms were categorised into four major production regions as shown in table 6.1-2. The table also lists the major production districts that are included in those regions.

Region	Major production districts
Central Queensland (CQ)	Bundaberg, Childers, Mackay, Emerald and Rockhampton
South East Queensland (SEQ)	Glasshouse Mountains, Sunshine Coast, Gympie, and Maryborough
Northern Rivers of New South Wales (NRNSW)	Alstonville, Lismore, Dunoon and Bangalow
Mid North Coast of New South Wales (MNNSW)	Nambucca and Yarrahapinni

Table 6.1-2: Production regions and localities

Table 6.1-3 shows the number of farms and the average planted and bearing area per participating farm in each of the regions in 2014. Average farm size was much larger for Central Queensland farms than in the other three regions. The largest area of trees yet to begin to bear was also in the Central Queensland region. The Mid North Coast of New South Wales region averaged the smallest farm size in the benchmarking study.

Region	Bearing farms	Average planted hectares	Average bearing hectares
CQ	52	95.83	92.52
SEQ	47	31.40	30.97
NRNSW	142	22.73	22.30
MNNSW	24	16.42	16.35
All farms in the sample	265	38.04	37.08

Table 6.1-3: Regional summary for the 2014 season

Figures 6.1-1 and 6.1-2 show the total planted and bearing trees and hectares in the different regions in the benchmarking sample in 2014.

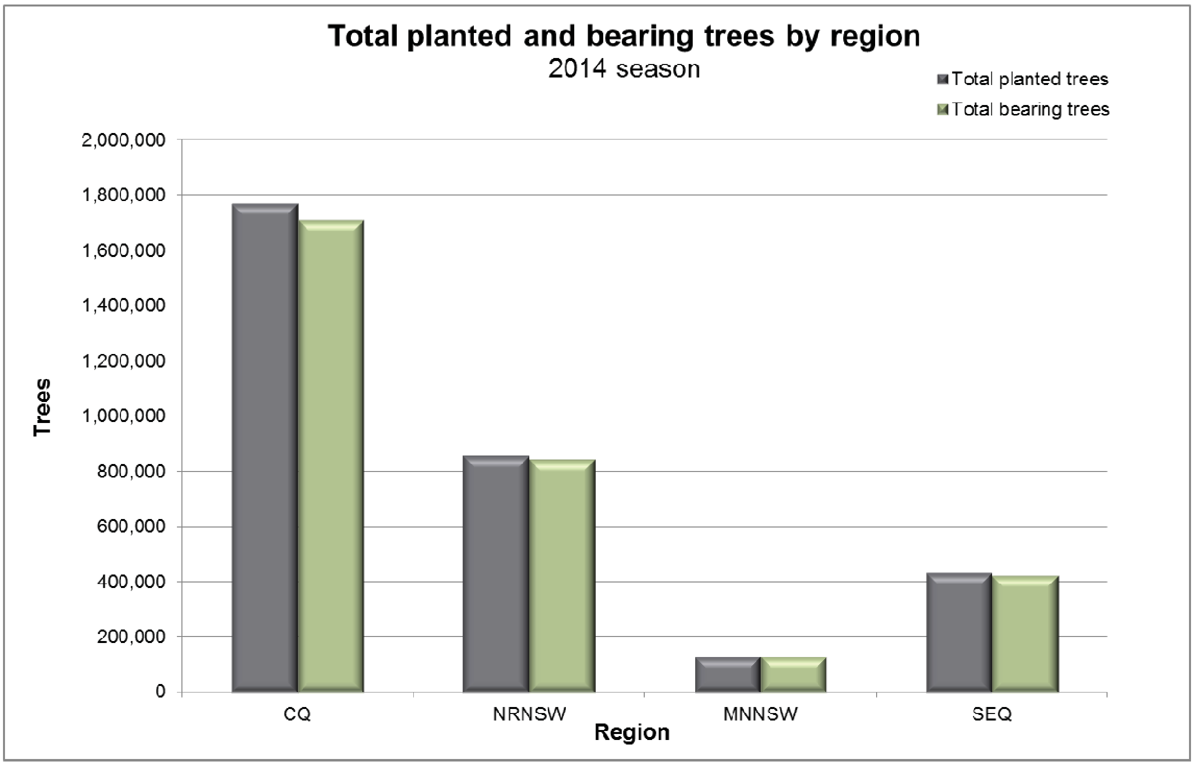


Figure 6.1-1: Total number of planted and bearing trees for the benchmarking sample in the different regions for the 2014 season

The largest number and area of planted and bearing trees was in the Central Queensland region. The 52 participating farms in this region totalled 1,770,645 planted trees (5033 hectares) and 1,712,864 bearing trees (4811 hectares).

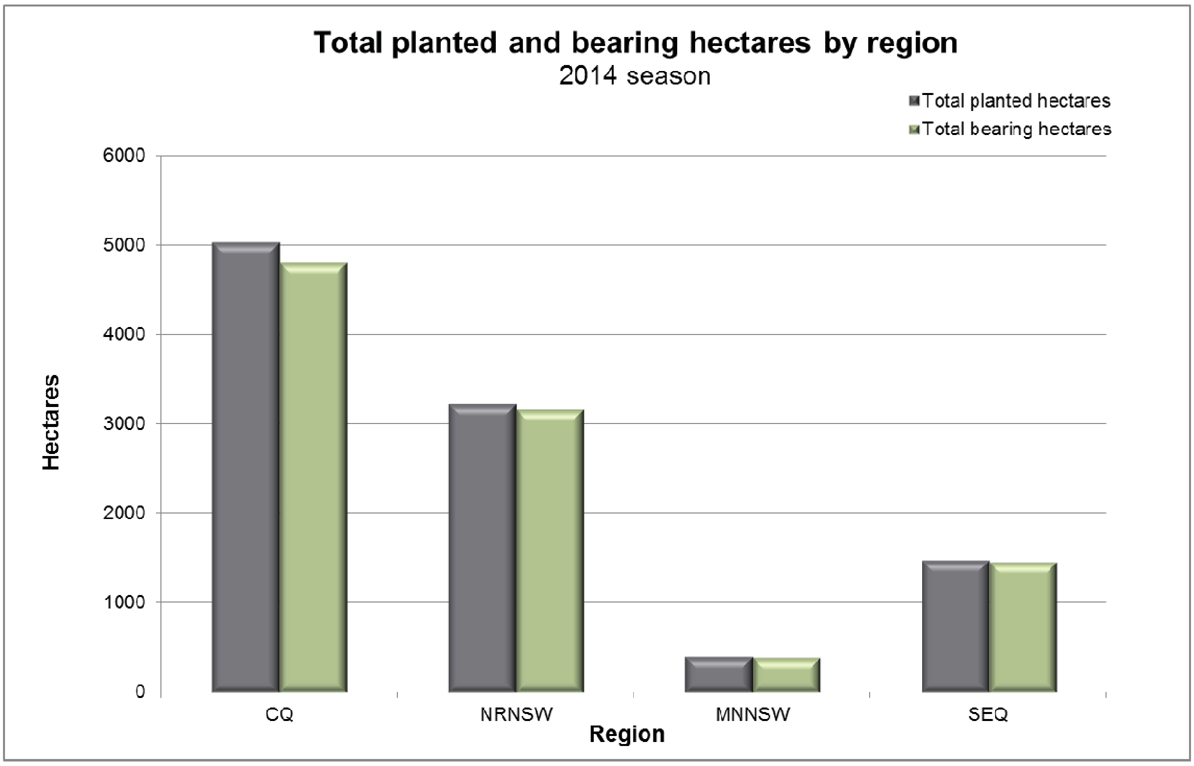


Figure 6.1-2: Total planted and bearing hectares for the benchmarking sample in the different regions for the 2014 season

Figures 6.1-3 and 6.1-4 show the average planted and bearing trees and hectares per farm in the different regions in the benchmarking sample in 2014.

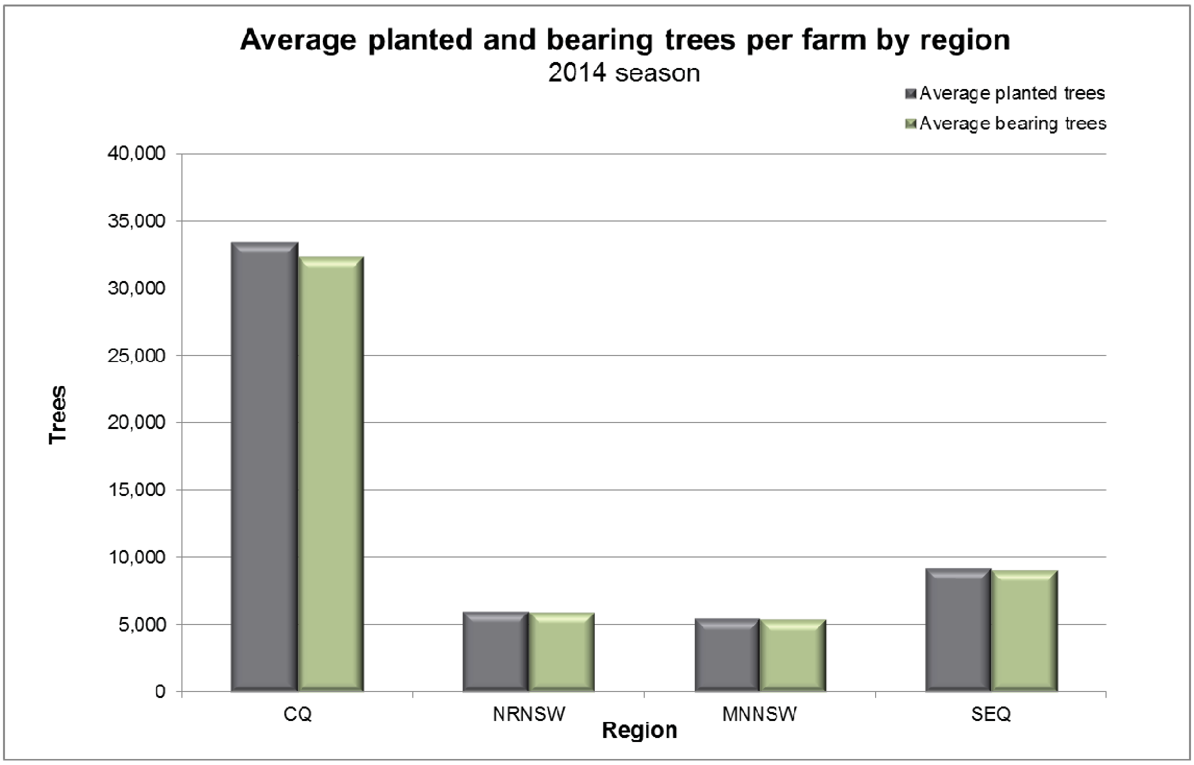


Figure 6.1-3: Average number of planted and bearing trees per farm in the different regions for the 2014 season

The average number and area of planted (33,408 trees and 95.83 hectares) and bearing (32,318 trees and 92.52 hectares) trees per farm was much larger amongst Central Queensland farms than farms from the other three regions. The average number and area of planted (9239 trees and 31.4 hectares) and bearing (9090 trees and 30.97 hectares) trees per farm in South East Queensland was also much larger than in both the Mid North Coast and Northern Rivers of New South Wales regions.

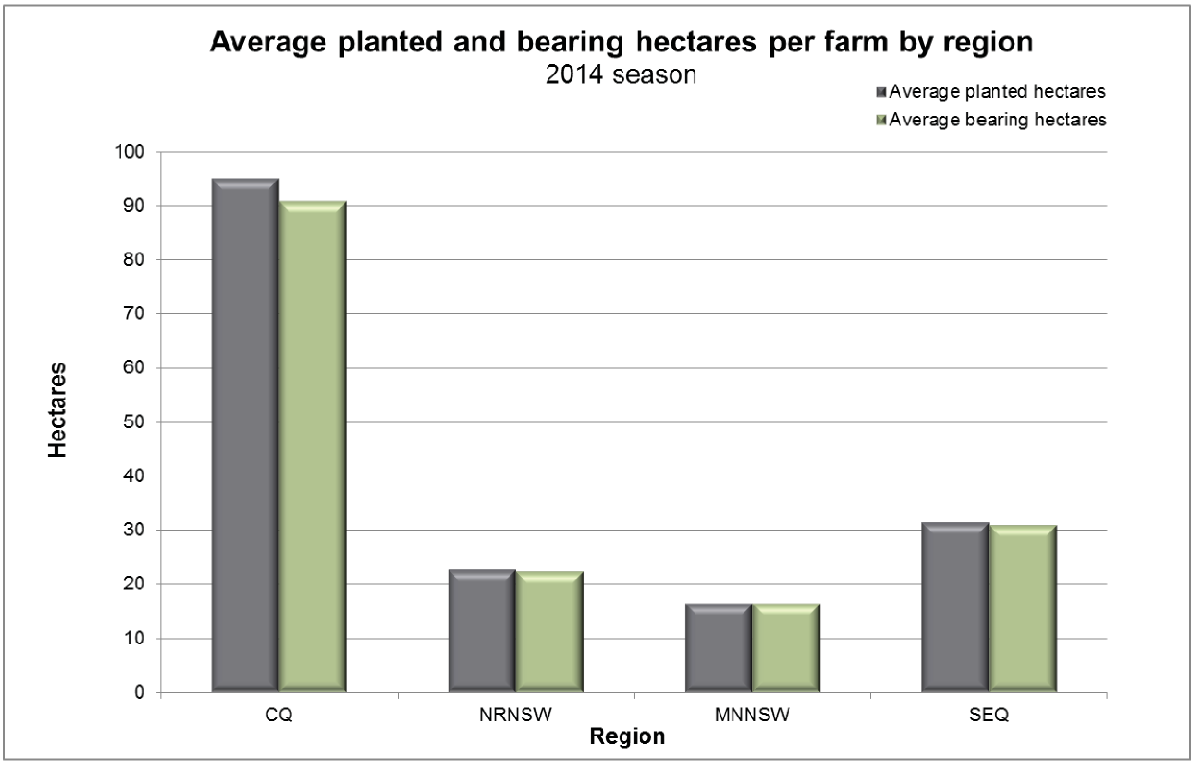


Figure 6.1-4: Average area of planted and bearing hectares per farm in the different regions for the 2014 season

Figure 6.1-5 shows the average bearing tree age in the different regions in the benchmarking sample in 2014. Central Queensland trees were on average younger than trees from the other three regions (11.3 years). This compares with an average age for bearing trees of 15.0 years for the Mid North Coast, 21.6 years for South East Queensland and 23.3 years for Northern Rivers.

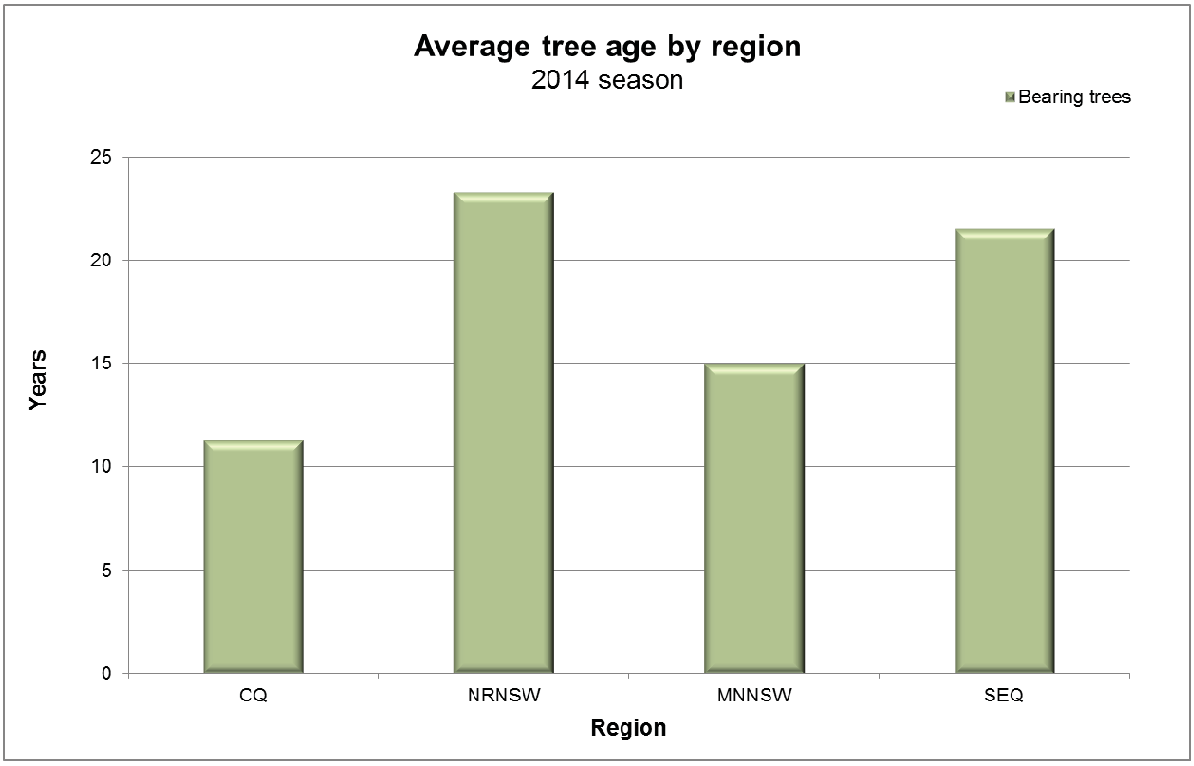


Figure 6.1-5: Average age of bearing trees in the different regions for the 2014 season

Tree age

Figure 6.1-6 provides a breakdown of the average tree age for all farms involved in the benchmarking in 2014. The oldest farms in the benchmarking had an average tree age of 39 years. The farm with an average tree age less than 5 years was in the Central Queensland region. It is important to note that many farms have plantings of different ages. The tree ages in figure 6.1-6 represent the average age of all plantings, weighted according to the number of trees of each age planted.

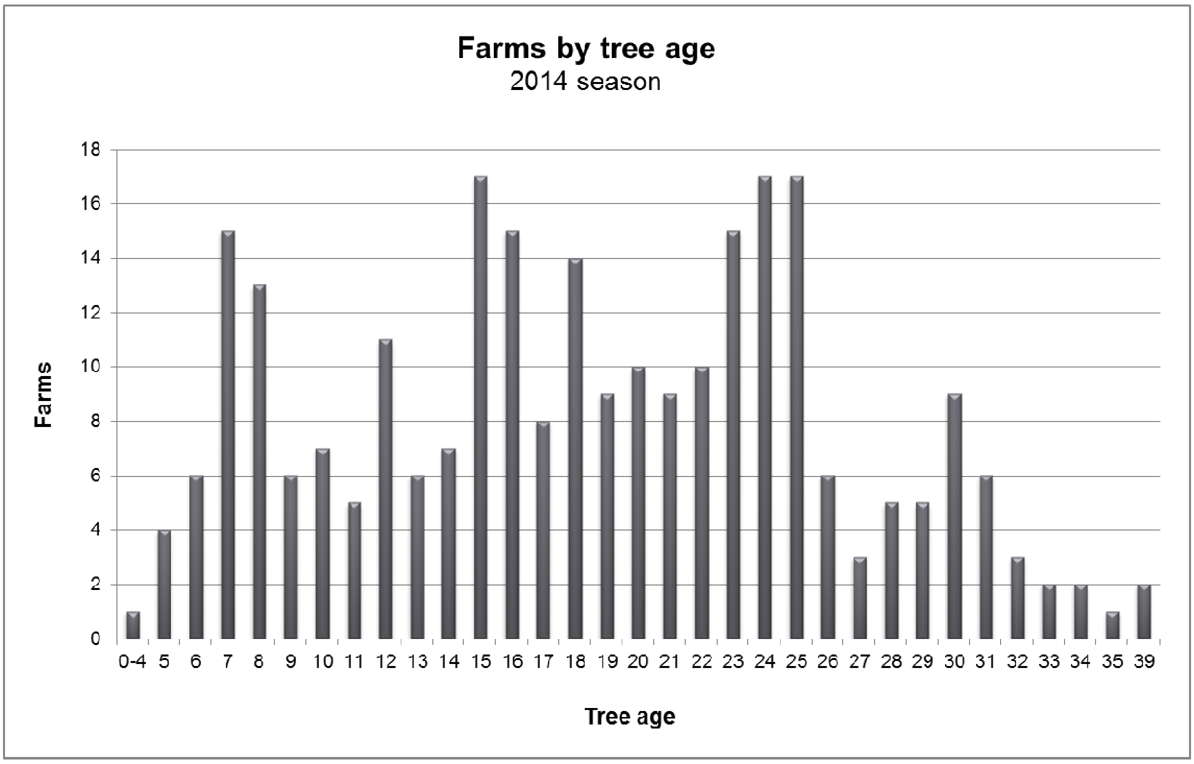


Figure 6.1-6: Number of farms of different average tree ages in the benchmarking sample in 2014

Farms were divided into categories of approximately equal numbers based on their average age of bearing trees. Trees that were less than 5 years of age were not considered to be bearing. Some farms, particularly in the Central Queensland region, harvest nuts from 4 year old trees but these are usually small amounts. The bearing tree age categories are:

- 5 to 7 years,
- 8 to 9 years,
- 10 to 14 years,
- 15 to 19 years,
- 20 to 24 years,
- 25 years and older.

Many farms have bearing trees of different ages. Most farms do not keep separate harvest yield or consignment data from the different age trees. Where farms include trees of different ages, a single average tree age has been calculated. This average is weighted according to the number of trees of each age on the farm.

Figure 6.1-7 provides a breakdown of the average tree age categories used for statistical analysis in the benchmarking for 2014. There are similar numbers of farms in the tree age categories from 15 to 19 years (65 farms), 20 to 24 years (60 farms) and 25 years or older (64 farms). The 20 to 24 year old category in 2014 corresponded to trees planted on average from 1990 to 1994. There are fewer farms in the younger tree age categories. These categories are separated as very different yield results between the tree age categories are expected in the early bearing years of trees.

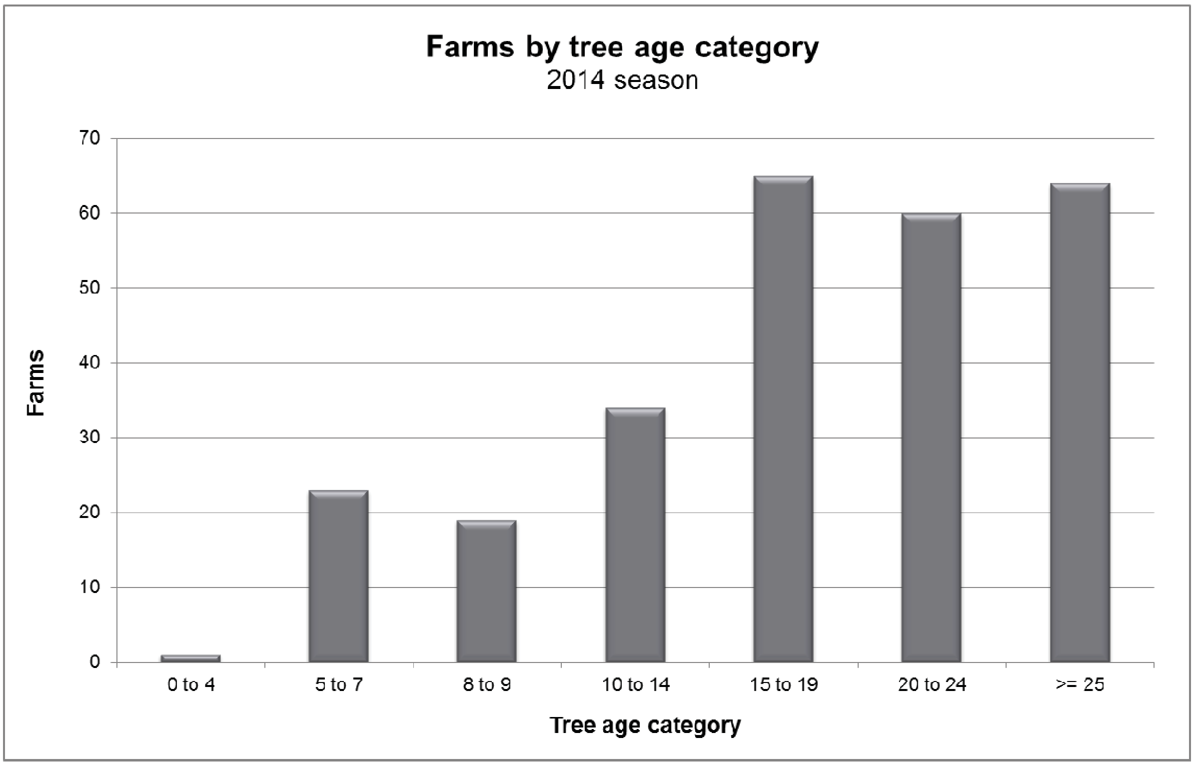


Figure 6.1-7: Number of farms within average weighted tree age categories in the benchmarking sample in 2014

Figures 6.1-8, 6.1-9, 6.1-10 and 6.1-11 show the total and average planted and bearing trees and hectares for the different tree age categories in the benchmark sample in 2014.

The difference between the numbers and areas of planted and bearing trees is due to many farms having plantings of different ages, including plantings that had yet to begin to bear. The largest difference is in farms where the average tree age is 5 to 7 years. Many of these farms had large plantings less than 5 years of age. The difference between the total and average planted and bearing hectares within the age categories reduces as the average tree age increases (i.e. the older farms had less plantings that had yet to begin to bear).

The average number of bearing trees and hectares per farm in the benchmark sample is largest in the 5 to 7 year tree age group. These farms had an average of 24,962 bearing trees and 67.72 bearing hectares per farm. By comparison, farms whose tree age groups were older than 15 years averaged less than 9000 bearing trees and 32 bearing hectares per farm.

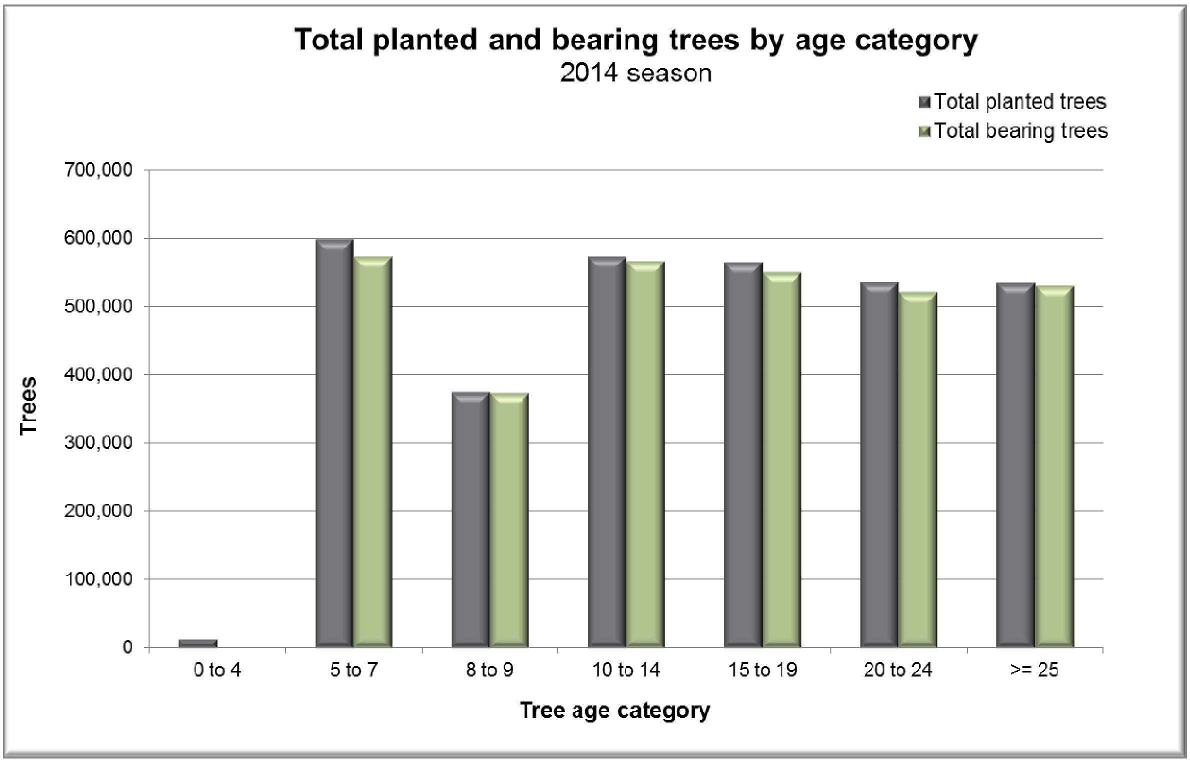


Figure 6.1-8: Total planted and bearing trees within the benchmarking sample for different tree age groups for the 2014 season

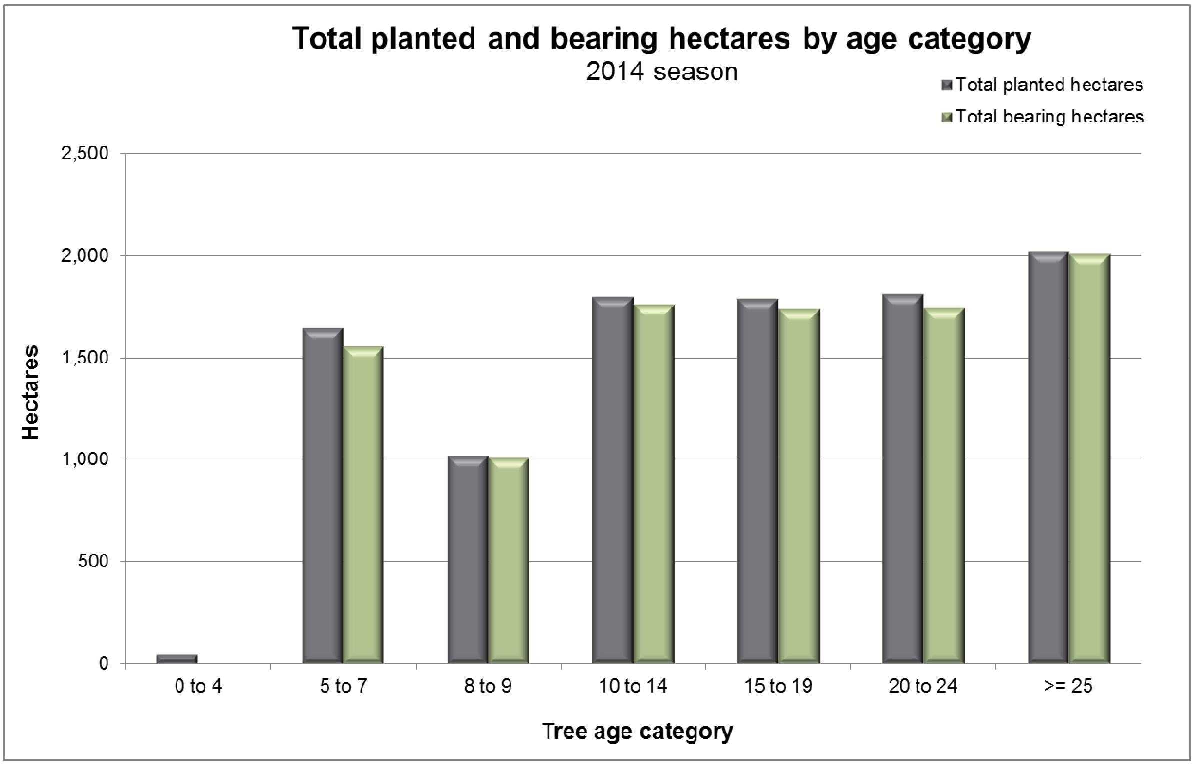


Figure 6.1-9: Total planted and bearing hectares within the benchmarking sample for different tree age categories for the 2014 season

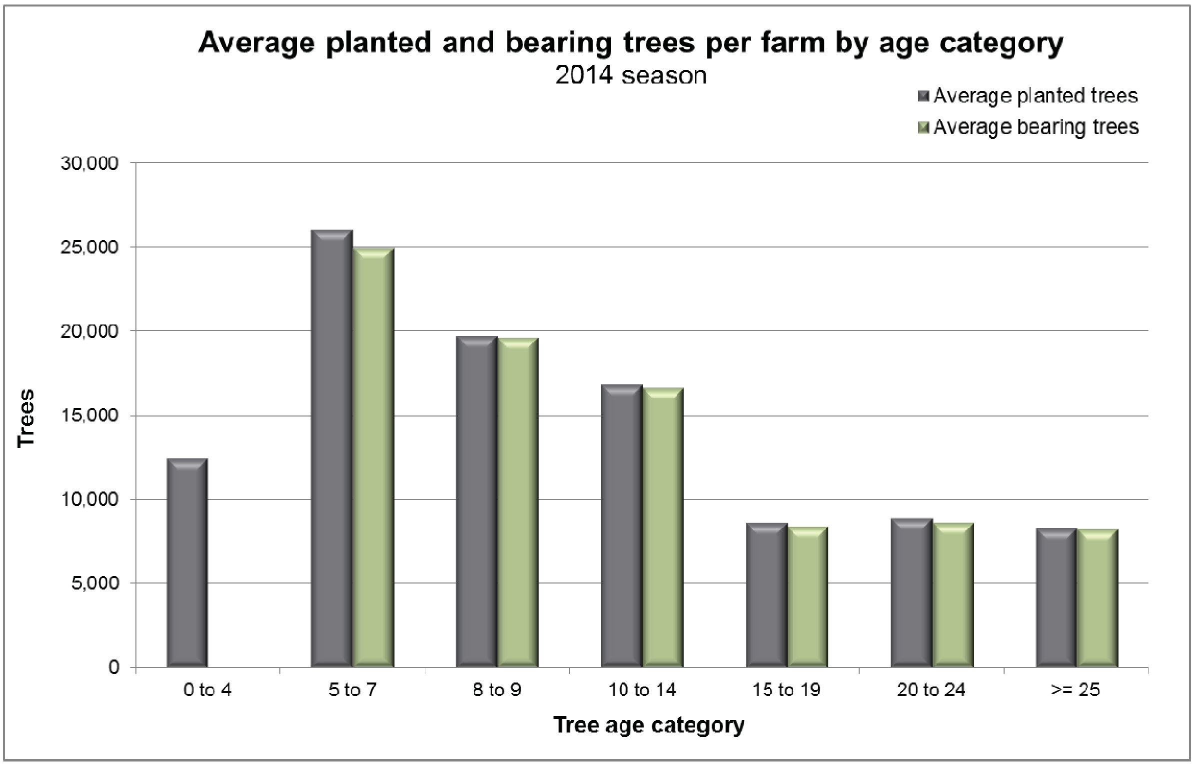


Figure 6.1-10: Average planted and bearing trees per farm within the different tree age categories or the 2014 season

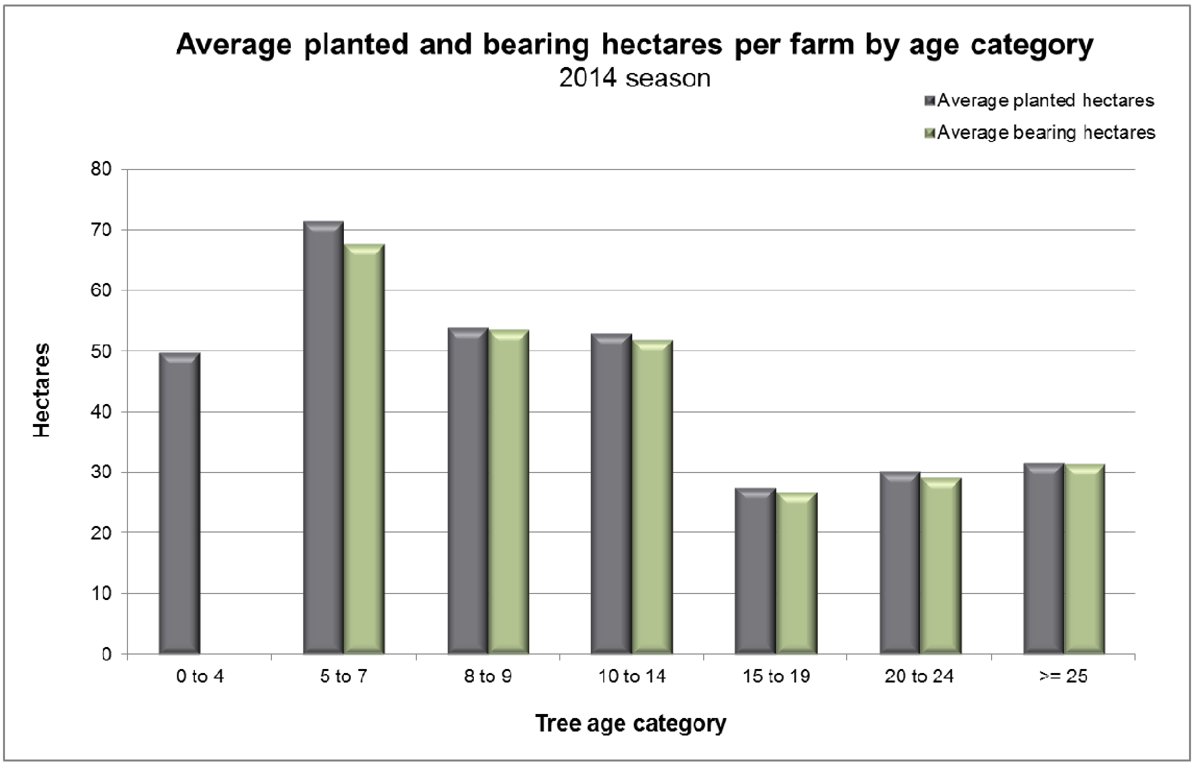


Figure 6.1-11: Average planted and bearing hectares per farm within the different tree age categories for the 2014 season

Farm size

Figure 6.1-12 provides a breakdown of the number of bearing farms in 2014 within the farm size categories used for statistical analysis in the benchmarking. The greatest concentration of farms is in the group with less than 10 bearing hectares (79 farms). Most of these smaller farms are in New South Wales. The smallest number of farms is in the group with more than 100 bearing hectares (24 farms). Most of these larger farms are in the Central Queensland region.

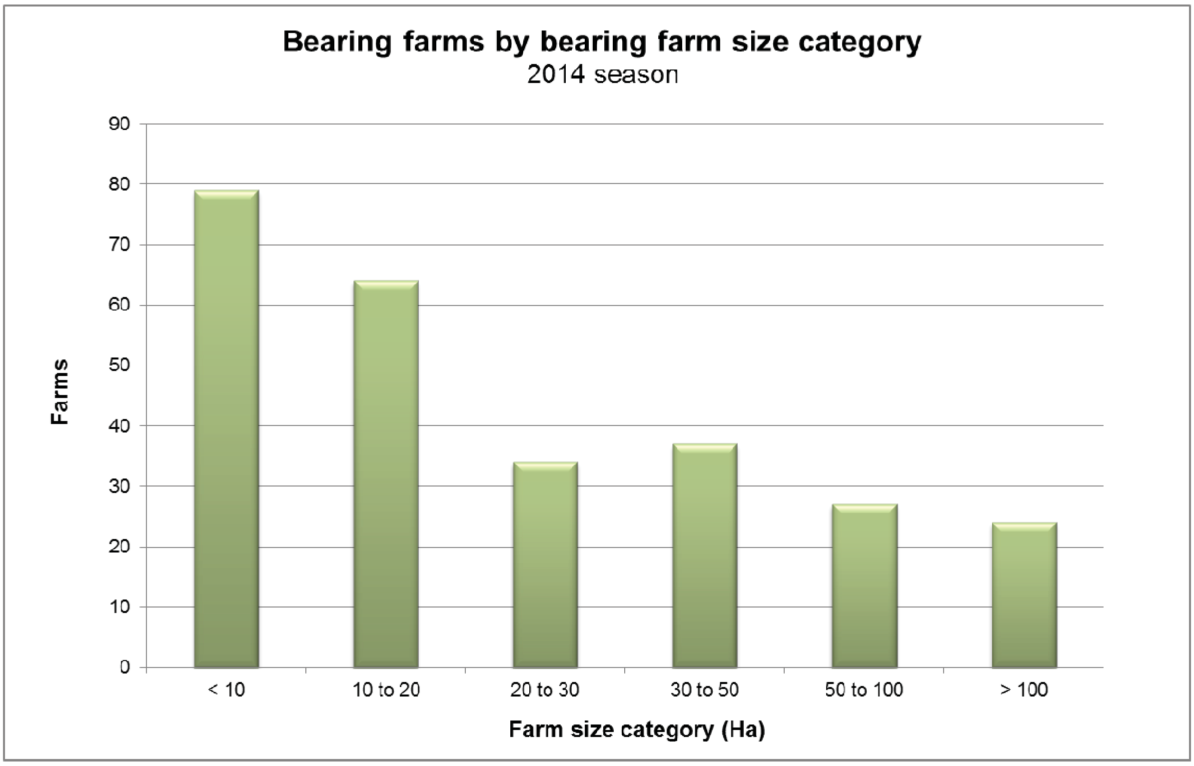


Figure 6.1-12:Number of bearing farms in each farm size category for the 2014 season

Irrigation status

Table 6.1-4 provides a comparison of farm sizes between irrigated and non-irrigated farms for 2014 and for all years from 2009 to 2014. The term farm year is used in this analysis. A farm year describes the records for an individual farm for a given year. For example, records from 200 farms for six years give 1200 farm years.

The majority of farms and farm years in the benchmarking sample are non-irrigated. This is a similar profile across the broader Australian macadamia industry.

The irrigated farms are on average larger than the non-irrigated farms. Most of the irrigated farms in the benchmarking survey are in the Bundaberg district, other parts of the Central Queensland region and also in the drier production areas of South East Queensland.

Irrigation status		2014	2009-2014
Irrigated	Hectares	75.07	70.95
	Farm years	72	353
Non-irrigated	Hectares	22.90	22.47
	Farm years	193	971

Table 6.1-4: Comparison of farm sizes (in hectares) by irrigation status for 2014 and for all years from 2009 to 2014

Management structure

Table 6.1-5 provides a comparison of farm sizes between owner managed vs. non-owner managed farms and farm years for 2014 and for all years from 2009 to 2014.

The majority of farms and farm years in the benchmarking sample are owner managed. This is a similar profile to the broader Australian macadamia industry.

The non-owner managed farms were on average larger (70.56 hectares in 2014) than the owner managed farms (23.86 hectares in 2014). Many of the non-owner managed farms in the benchmarking survey are in the Bundaberg district and other parts of the Central Queensland region.

Management structure		2014	2009-2014
Owner managed	Hectares	23.86	21.80
	Farm years	190	933
Non-owner managed	Hectares	70.56	67.84
	Farm years	75	391

Table 6.1-5: Comparison of farm sizes (in hectares) by management structure for 2014 and for all years from 2009 to 2014

Organic farms

Table 6.1-6 provides a comparison of farm size between organic farms and non-organic farms for 2014 and for all years from 2009 to 2014.

There were only 8 farms identified as organic compared with 257 non-organic farms amongst the 265 participating bearing farms in 2014. Similarly, there were only 14 organic farm years compared to 1310 non-organic farm years in the 1324 farm years from 2009 to 2014. All the organic farm years were from 2013 and 2014.

The organic farms were on average much smaller (11.23 hectares in 2014) than the non-organic farms (37.88 hectares in 2014). All of the organic farms in the benchmarking survey were from the Mid North Coast and Northern Rivers regions of New South Wales.

Organic status		2014	2009-2014
Organic	Hectares	11.23	11.56
	Farm years	8	14
Non-organic	Hectares	37.88	35.65
	Farm years	257	1310

Table 6.1-6: Comparison of farm sizes (in hectares) by organic status for 2014 and for all years from 2009 to 2014

Combined yield and quality results

Yield and kernel recovery results have been charted together for each participating farm in the benchmarking sample with an average tree age of ten years or older. The age of ten years or older was chosen to exclude young farms where yield per hectare is expected to be less than that of mature farms. The results show the average for each farm over all the years that farm participated in the benchmarking.

Figure 6.1-13 shows the saleable kernel yield per hectare rankings (bars) and the corresponding average SKR (line) for each farm. The straight trend line represents the linear line of best fit for SKR.

There were 254 farms with an average tree age of ten years or older that participated in the benchmarking between 2009 and 2014. These farms participated for an average of 4.31 farm years during that time.

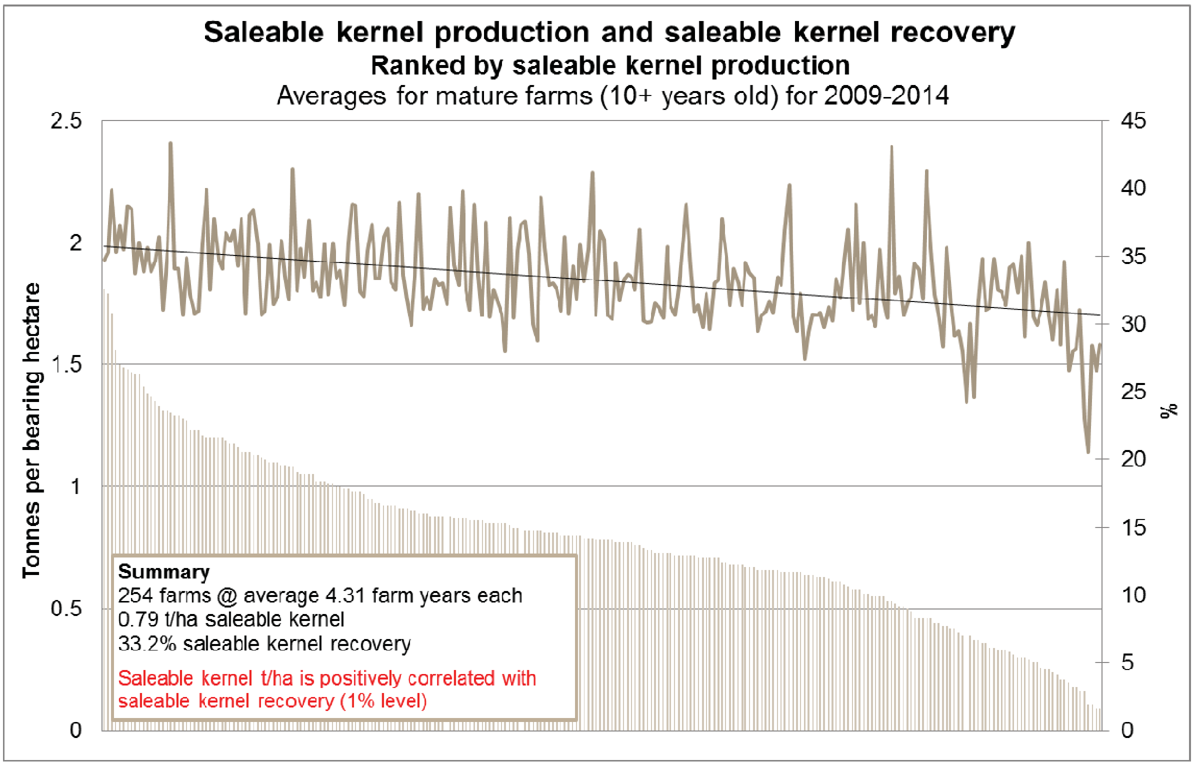


Figure 6.1-13: Average saleable kernel yield rankings and corresponding saleable kernel recoveries for farms older than 10 years (2009-2014)

The average farm yield for the 2009 to 2014 seasons was 0.79 tonnes of saleable kernel per bearing hectare and the average SKR was 33.2%.

There is considerable variation between the farms for SKR. Despite this variation, the line of best fit through the kernel recovery results shows that the SKR tends to increase as the saleable kernel yield per bearing hectare increases. Statistical analysis also shows that yield of saleable kernel per bearing hectare and SKR are positively correlated. This means that more productive farms also tend to achieve better kernel quality results and a subsequent higher price per kilogram of NIS.

Figure 6.1-14 compares rankings for productivity and quality for farms in 2014 with the averages from 2009 to 2014 for all farms involved in the benchmarking. It is important to note that quality is ranked independently of productivity in this chart, whereas productivity and quality results are ranked together in figure 6.1-13. This leads to the more uniform SKR lines compared with the highly variable line in figure 6.1-13.

The rankings have been overlaid to show the differences between the 2014 season and the averages from 2009 to 2014. Tonnes of saleable kernel per hectare and SKR results were higher in 2014 compared to the averages from 2009 to 2014 across the chart. This is reflected in the better average yield and quality benchmarking results for the 2014 season.

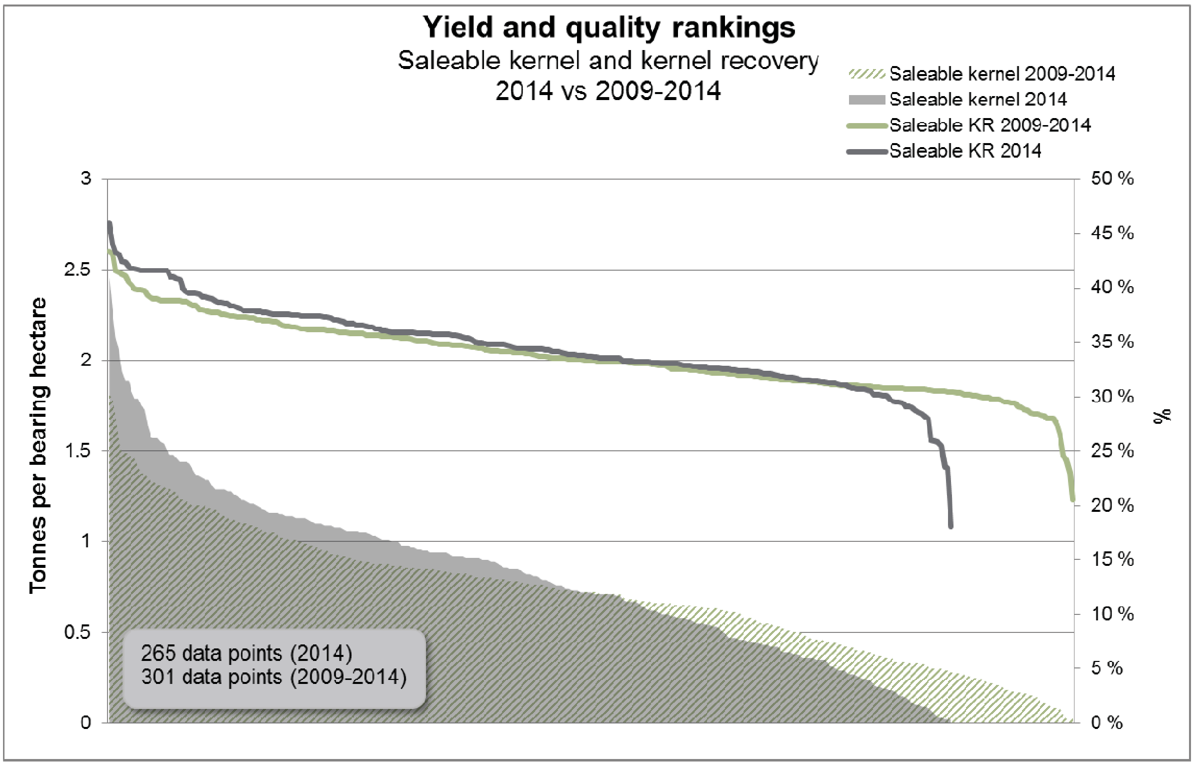


Figure 6.1-14: Saleable kernel production and saleable kernel recovery rankings for 2014 and 2009-2014 (independently ranked).

The rankings have also been overlaid in figure 6.1-15 to show the differences between the 2013 and 2014 seasons. Tonnes of saleable kernel per bearing hectare and SKR results were consistently higher in 2014 compared to 2013. The yield and quality results for the 2013 season were well below the averages from 2009 to 2014.

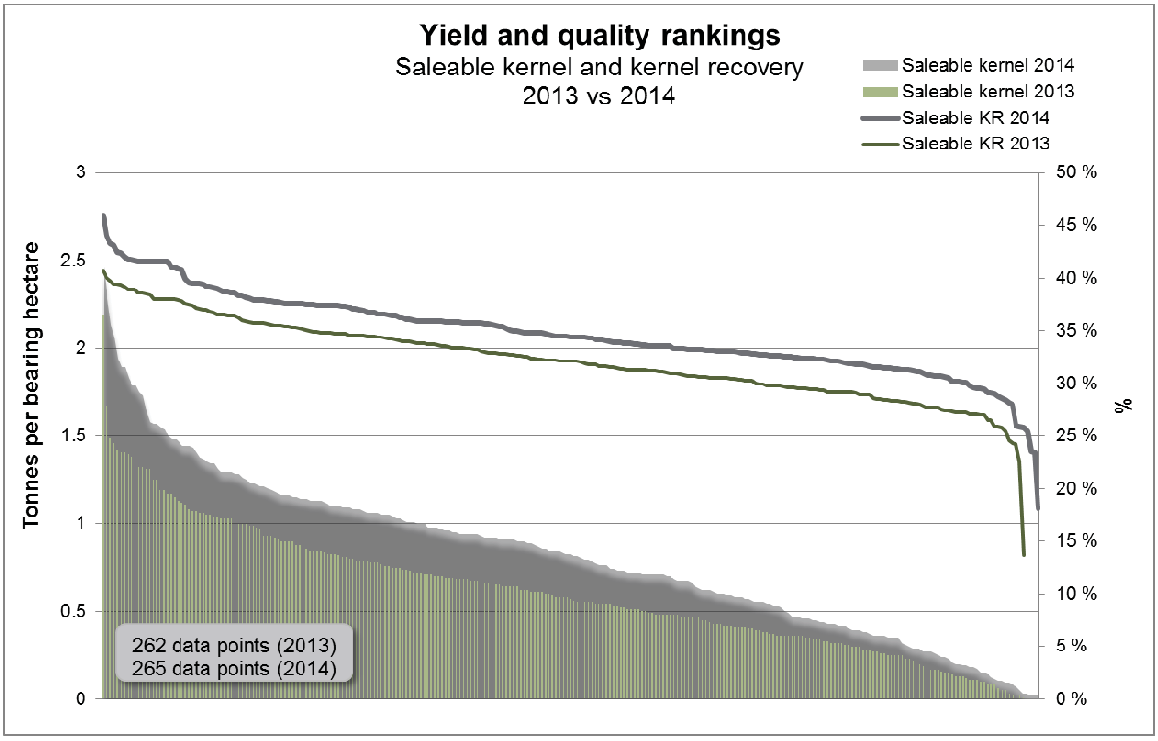


Figure 6.1-15: Saleable kernel production and saleable kernel recovery rankings for 2013 vs 2014 (independently ranked).

Yield and quality correlations

In the correlation matrix in table 6.1-7, nut-in-shell (NIS) tonnes per hectare and saleable kernel tonnes per hectare have a positive correlation coefficient of 0.98 and the significance level is less than 1% (0.00). This means that they are significantly positively correlated indicating that in the benchmarking sample, as NIS tonnes per hectare increases, saleable kernel tonnes per bearing hectare also tends to increase.

Conversely, NIS tonnes per hectare is significantly negatively correlated at the 1% level (-0.27, 0.00) with reject kernel recovery (RKR). This indicates that as NIS tonnes per hectare increases, RKR tends to decrease.

NIS and saleable kernel tonnes per hectare are positively correlated with SKR, PKR and NIS MC. This means that as yield increases, SKR, PKR and NIS MC also tend to increase. Similarly, RKR is negatively correlated with NIS and saleable kernel tonnes per hectare, SKR and PKR. This means that as yield, SKR and PKR tend to increase, RKR tends to decrease. This indicates that the more productive farms also tend to achieve less consigned rejects and better quality results and a subsequent higher relative price per kilogram of NIS.

CKR is negatively correlated with NIS tonnes per hectare and PKR. CKR is positively correlated with SKR, RKR and also NIS MC. This means that farms that produce more NIS per hectare, farms with a higher average PKR and lower average RKR, and farms with lower average NIS MC tend to have a lower average CKR.

In table 6.1-8, the number of bearing hectares is positively correlated with the RKR and the level of rejects due to mould and brown centres and negatively correlated with the SKR and the level of rejects due to insect damage, and NIS MC. This means that larger farms tend to have a higher average RKR and a lower average SKR, a higher average level of rejects due to mould and brown centres, a lower average level of rejects due to insect damage and a lower average NIS MC. Many of the larger farms are based in the Central Queensland region where the climate tends to be drier during the harvest season, contributing to the lower average NIS MC.

Some of the other important kernel quality correlations include:

- SKR is positively correlated with PKR and CKR (SKR is equivalent to the sum of PKR and CKR).
- RKR is positively correlated with all of the reject analysis categories. This means that as each of the reject analysis categories tends to increase, the RKR tends to increase.
- PKR is negatively correlated with all of the reject analysis categories and with RKR. This means that as the RKR and each of the reject analysis categories tends to increase, PKR tends to decrease. SKR is also negatively correlated with all of the reject analysis categories except for germination.
- CKR is positively correlated with RKR and with insect damage and germination but not with any of the other reject analysis categories. This means that farms with a higher average CKR also tend to have a higher average RKR and a higher average level of rejects due to insect damage and germination.
- NIS MC is positively correlated with insect damage and immaturity and negatively correlated with mould, discolouration and brown centres. This means that farms with a higher average NIS MC tend to have a higher average level of rejects due to insect damage and immaturity but a lower average level of rejects due to mould, discolouration and brown centres.
- The level of rejects due to insect damage is positively correlated with the level of rejects due to mould, discolouration and germination and negatively correlated with the level of rejects due to brown centres. This means that farms with a higher average level of rejects due to insect damage also tend to have a higher average level of rejects due to mould, discolouration and germination and lower average levels of rejects due to brown centres.
- The level of rejects due to brown centres was positively correlated with the level of rejects due to mould and discolouration and negatively correlated with the level of rejects due to insect damage.

		NIS tonnes/ha	Saleable kernel tonnes/ha	Saleable KR %	Premium KR %	Reject KR %	Commercial KR %
Saleable kernel tonnes/ha	Pearson Correlation	0.98					
	Sig. (2-tailed)	0.00 ***					
	N	1324					
Saleable KR %	Pearson Correlation	0.18	0.35				
	Sig. (2-tailed)	0.00 ***	0.00 ***				
	N	1316	1316				
Premium KR %	Pearson Correlation	0.98	0.99	0.33			
	Sig. (2-tailed)	0.00 ***	0.00 ***	0.00 ***			
	N	1316	1316	1316			
Reject KR %	Pearson Correlation	-0.27	-0.31	-0.42	-0.32		
	Sig. (2-tailed)	0.00 ***	0.00 ***	0.00 ***	0.00 ***		
	N	1316	1316	1316	1316		
Commercial KR %	Pearson Correlation	-0.08	-0.02	0.22	-0.13	0.09	
	Sig. (2-tailed)	0.00 ***	0.40	0.00 ***	0.00 ***	0.00 ***	
	N	1316	1316	1316	1316	1316	
Moisture content %	Pearson Correlation	0.14	0.13	-0.03	-0.10	0.01	0.30
	Sig. (2-tailed)	0.00 ***	0.00 ***	0.28	0.00 ***	0.79	0.00 ***
	N	1038	1038	1038	1038	1038	1038

Table 6.1-7: Correlation of farm yields and kernel recoveries

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

		Bearing Hectares	Saleable KR %	Premium KR %	Commercial KR %	Reject KR %	Insect %	Mould %	Discoloured %	Brown Centre %	Immature %	Germinated %
Saleable KR %	Pearson Correlation	-0.07										
	Sig. (2-tailed)	0.02**										
	N	1316										
Premium KR %	Pearson Correlation	-0.04	0.86									
	Sig. (2-tailed)	0.11	0.00***									
	N	1316	1316									
Commercial KR %	Pearson Correlation	-0.04	0.22	-0.32								
	Sig. (2-tailed)	0.17	0.00***	0.00***								
	N	1316	1316	1316								
Reject KR %	Pearson Correlation	0.09	-0.42	-0.46	0.09							
	Sig. (2-tailed)	0.00***	0.00***	0.00***	0.00***							
	N	1316	1316	1316	1316							
Insect %	Pearson Correlation	-0.12	-0.16	-0.22	0.12	0.68						
	Sig. (2-tailed)	0.00***	0.00***	0.00***	0.00***	0.00***						
	N	1298	1298	1298	1298	1298						
Mould %	Pearson Correlation	0.12	-0.21	-0.20	0.00	0.50	0.26					
	Sig. (2-tailed)	0.00***	0.00***	0.00***	0.99	0.00***	0.00***					
	N	1299	1299	1299	1299	1299	1299					
Discoloured %	Pearson Correlation	0.03	-0.06	-0.06	0.00	0.36	0.06	0.13				

		Bearing Hectares	Saleable KR %	Premium KR %	Commercial KR %	Reject KR %	Insect %	Mould %	Discoloured %	Brown Centre %	Immature %	Germinated %
	Sig. (2-tailed)	0.22	0.02**	0.03**	0.97	0.00***	0.03**	0.00***				
	N	1296	1296	1296	1296	1296	1296	1296				
Brown Centre %	Pearson Correlation	0.42	-0.22	-0.23	0.04	0.34	-0.07	0.18	0.22			
	Sig. (2-tailed)	0.00***	0.00***	0.00***	0.17	0.00***	0.01**	0.00***	0.00***			
	N	1294	1294	1294	1294	1294	1294	1294	1294			
Immature %	Pearson Correlation	0.01	-0.39	-0.36	-0.02	0.47	-0.01	0.02	-0.01	-0.02		
	Sig. (2-tailed)	0.84	0.00***	0.00***	0.50	0.00***	0.77	0.42	0.78	0.44		
	N	1297	1297	1297	1297	1297	1297	1297	1295	1294		
Germinated %	Pearson Correlation	-0.03	-0.02	-0.06	0.07	0.29	0.14	0.14	0.20	0.00	-0.01	
	Sig. (2-tailed)	0.24	0.41	0.04**	0.02**	0.00***	0.00***	0.00***	0.00***	0.92	0.79	
	N	1294	1294	1294	1294	1294	1294	1294	1293	1293	1294	
Moisture Content %	Pearson Correlation	-0.22	-0.03	-0.18	0.26	0.01	0.09	-0.13	-0.13	-0.09	0.06	-0.05
	Sig. (2-tailed)	0.00***	0.28	0.00***	0.00***	0.79	0.00***	0.00***	0.00***	0.00***	0.05**	0.12
	N	1038	1038	1038	1038	1038	1030	1038	1028	1027	1038	1027

Table 6.1-8: Correlation of kernel recoveries and reject analysis categories

* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

Yield and quality trends

Figure 6.1-16 shows the average NIS and saleable kernel yield per bearing hectare and also reject category trends for 2009 to 2014. There was an average of 221 farms participating per year with increasing numbers of farms each year of the benchmarking.

Both the average NIS and saleable kernel yield per hectare increased from 2013 to 2014 and were the highest averages in the benchmarking since the 2010 season.

There was a decrease in the average level of rejects due to insect damage, immaturity, brown centres and discolouration from 2013 to 2014. There was an increase in the average level of rejects due to mould. The average level of rejects due to germination consistently remained the lowest level of all the reject categories.

Insect damage remains a serious cause of losses despite a significant decrease in the level of rejects in 2014. There was a concerted campaign to improve insect spray timing and coverage amongst New South Wales macadamia farms leading up to the 2014 harvest.

Immaturity was a major cause of reject losses, particularly in the South East Queensland region in 2013 and 2014. These high levels of immaturity have largely been attributed to very dry conditions leading to moisture stress during nut growth and development and oil accumulation in the latter parts of 2012 and 2013 following very wet conditions earlier in 2012.

Although the prevalence of brown centres is lower than some other reject categories, it has been a major cause of reject on larger farms in previous years. The *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008) found that the average level of brown centres increased with increasing farm size, maximum silo size and nut storage bed depth.

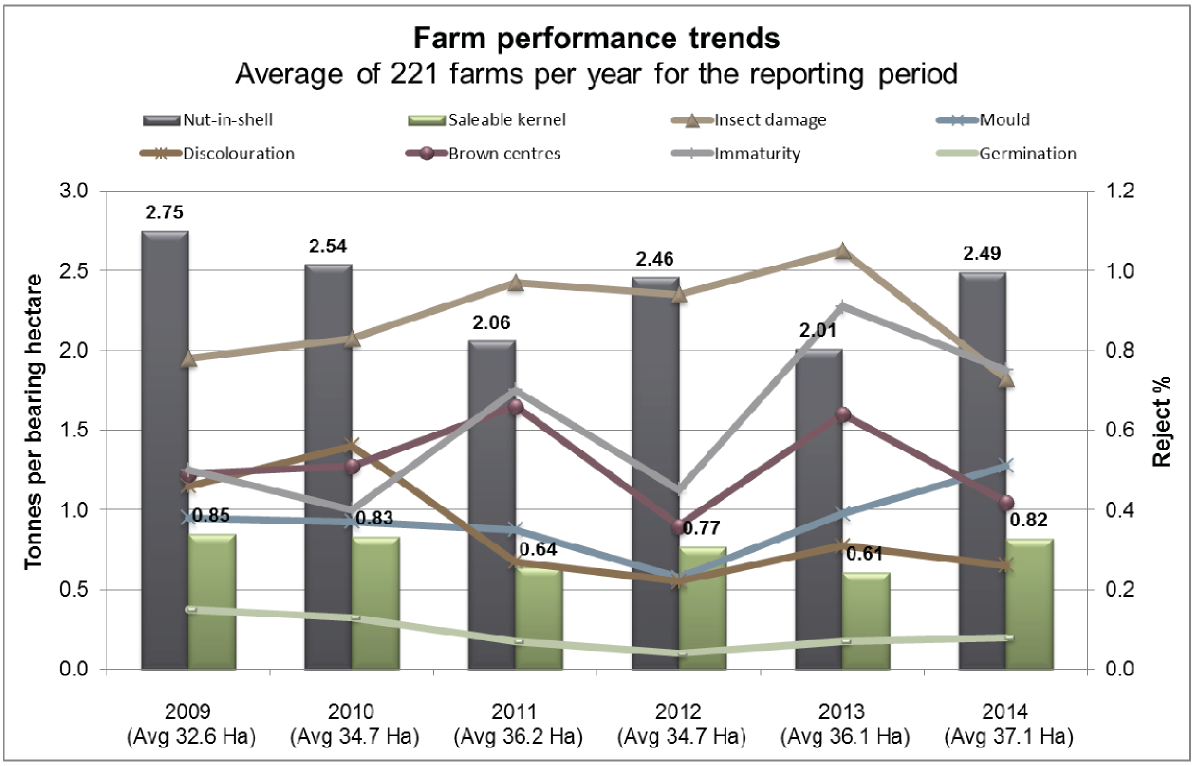


Figure 6.1-16: Seasonal comparison of yield and quality farm performance trends

6.2 *Results for top 20 farms*

Sample description

The top 20 farms were ranked according to their average yield of saleable kernel per bearing hectare over the six years from 2009 to 2014. The performance of these top 20 farms is compared with the performance of all the farms in the benchmarking sample over this period.

Farms must have provided data for at least 5 years in order to be considered for inclusion within the top 20 farms. It is important to note that these top 20 farms are based on their average performance over multiple seasons. Some of these farms may not have been in the top 20 of the most productive farms in all years.

Figures 6.2-1, 6.2-2, 6.2-3, 6.2-4 and 6.2-5 provide a breakdown of the farms represented in the top 20 farms for yield of saleable kernel per bearing hectare by average tree age, farm size, irrigation status, management structure and region.

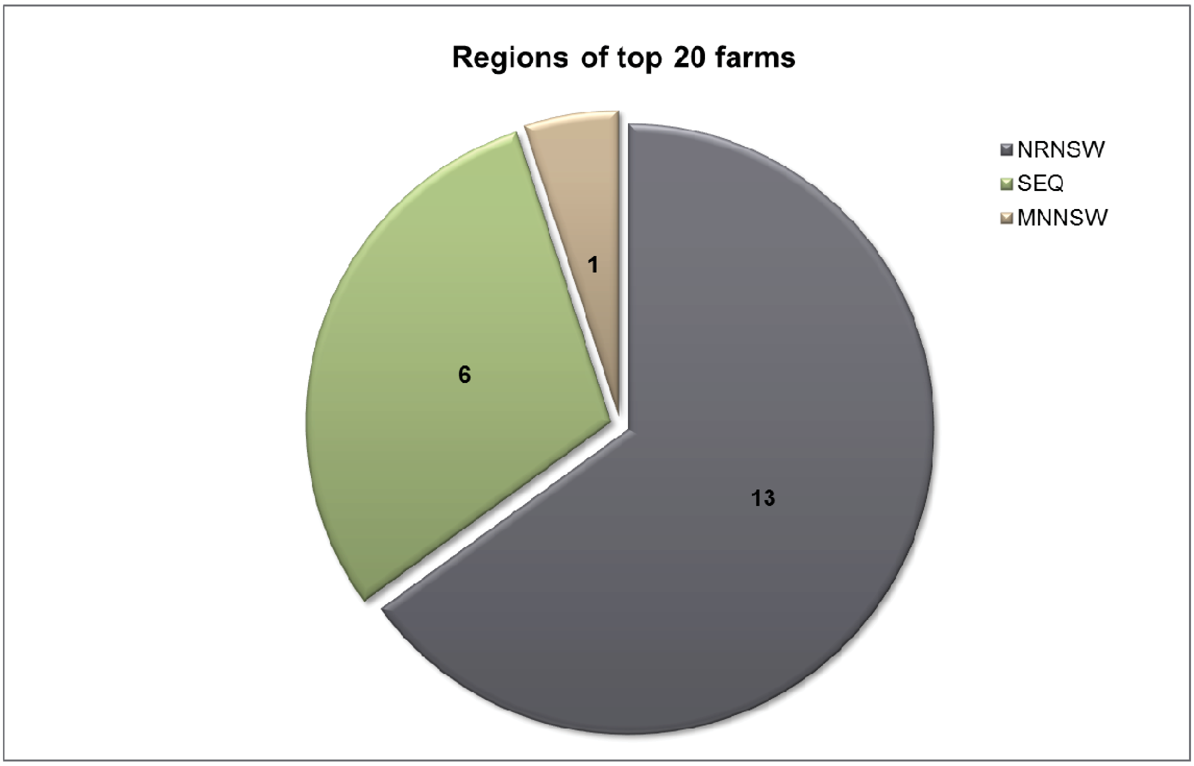


Figure 6.2-1: Locations of the top 20 farms in the benchmarking sample

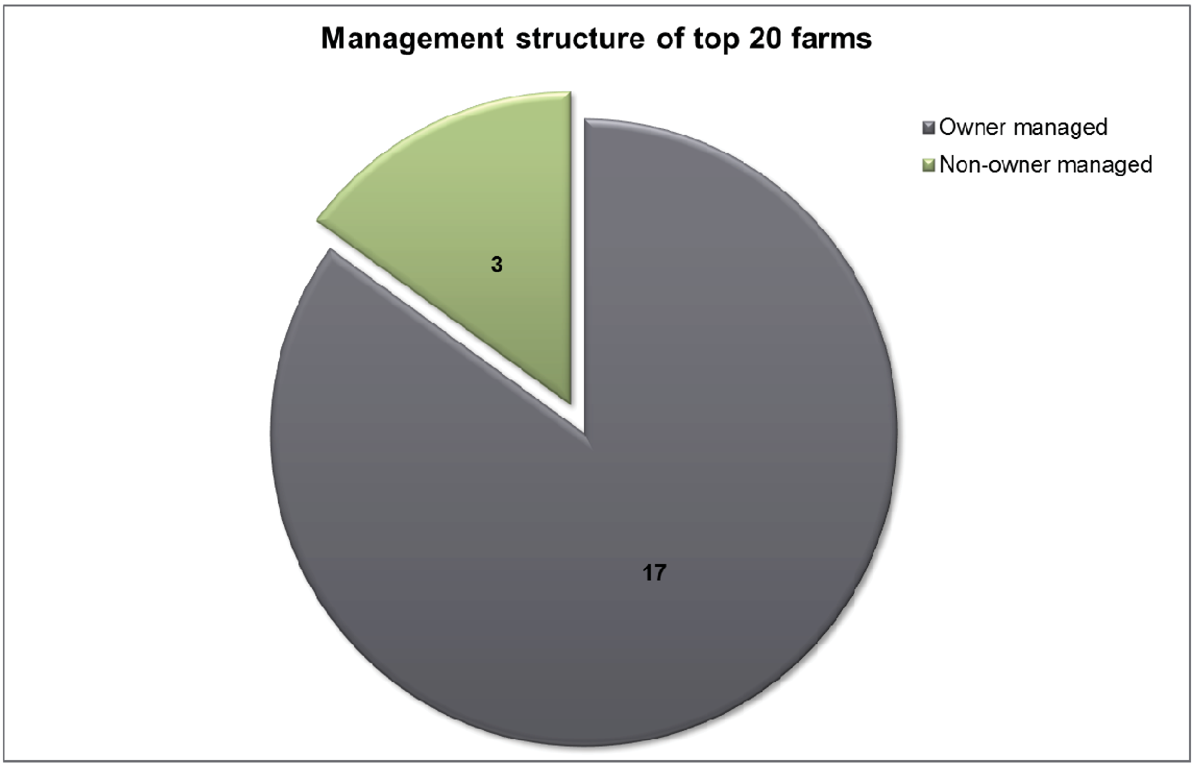


Figure 6.2-2: Management structure of the top 20 farms in the benchmarking sample

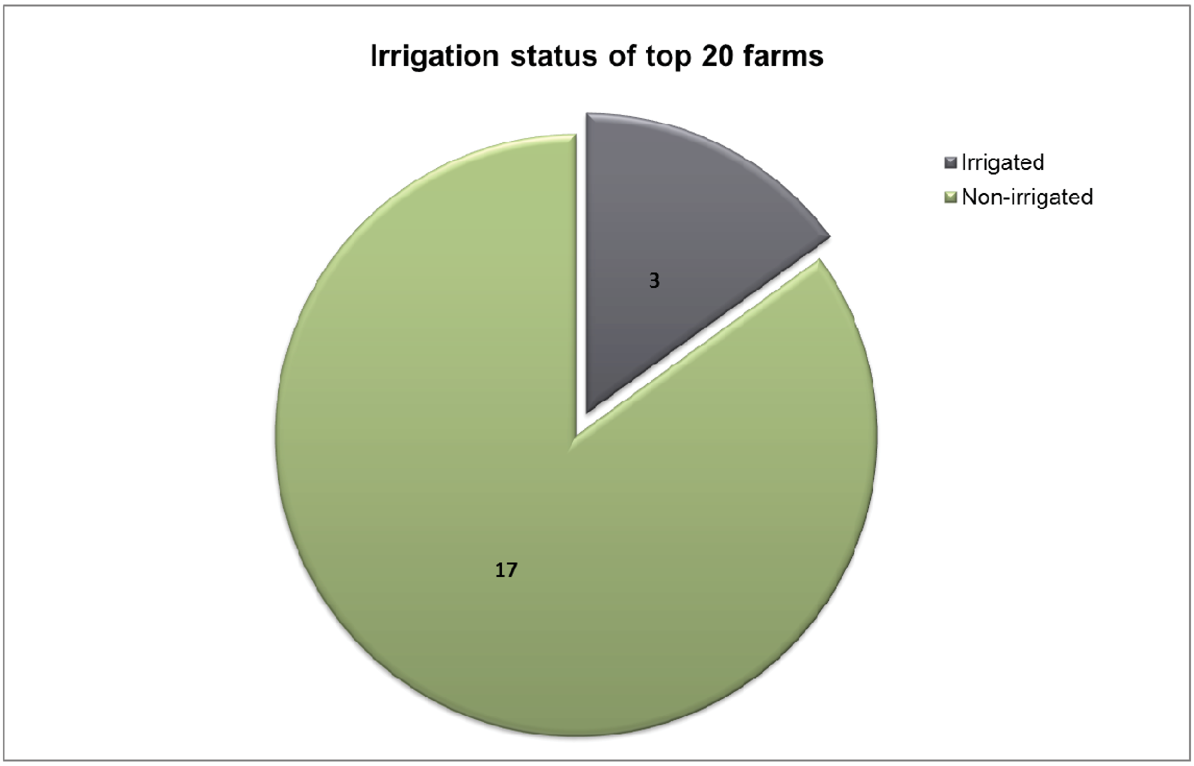


Figure 6.2-3: Irrigation status of the top 20 farms in the benchmarking sample

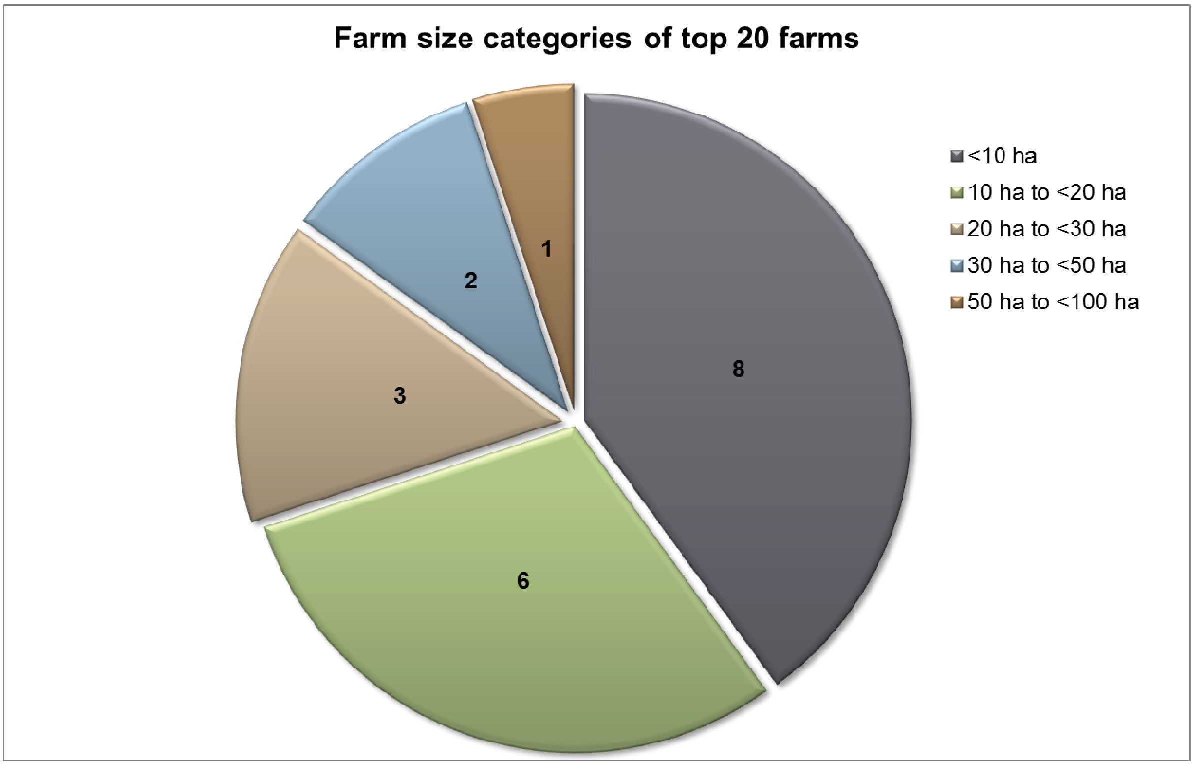


Figure 6.2-4: Farm size categories of the top 20 farms in the benchmarking sample

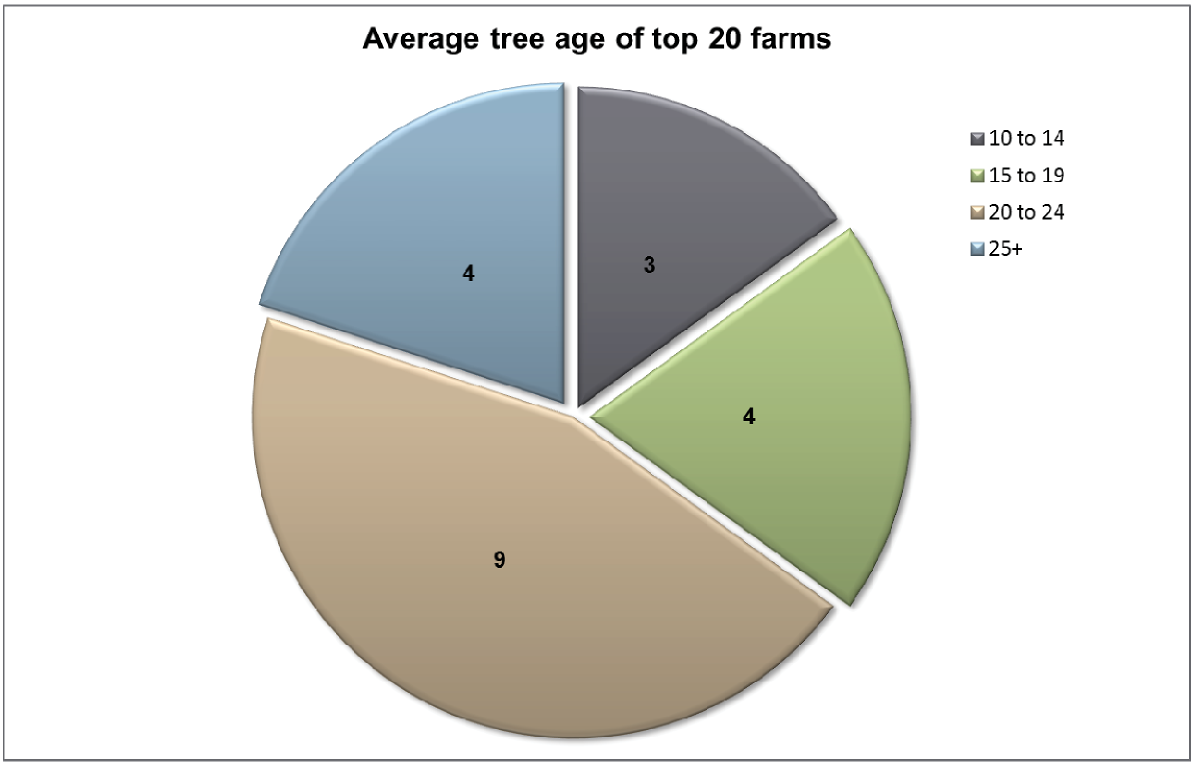


Figure 6.2-5: Average tree age of the top 20 farms in the benchmarking sample

Combined yield and quality results

Figure 6.2-6 shows the average yield of saleable kernel per hectare from the top 20 farms from 2009 to 2014 compared with all farms in the benchmarking sample. Averages for the top 25% and bottom 25% of all farms in the benchmarking sample are also shown.

The top 20 farms averaged 1.53 tonnes in 2014 compared to 1.08 tonnes in 2013 and 1.34 tonnes of saleable kernel per bearing hectare over the six years from 2009 to 2014. This represents an increase of 0.45 tonnes per hectare from 2013 to 2014

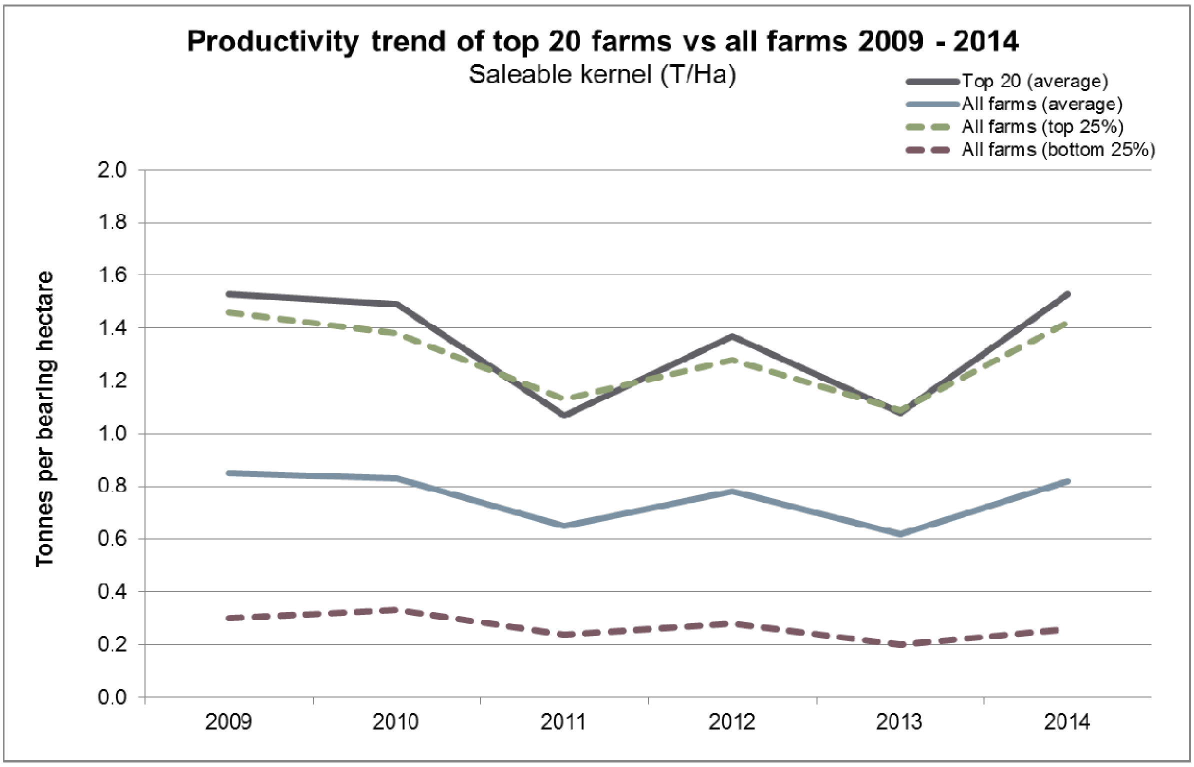


Figure 6.2-6: Average saleable kernel per bearing hectare for top 20 farms vs all farms in the benchmarking sample for 2009-2014.

By comparison to the top 20 farms, the average yield for all farms was 0.82 tonnes in 2014, 0.62 tonnes in 2013 and 0.75 tonnes of saleable kernel per bearing hectare from 2009 to 2014. This represents a difference of 0.71 tonnes per hectare in 2014 between the average yield per bearing hectare for the top 20 farms and all the farms in the benchmarking sample.

The productivity trend of the top 20 farms is similar to that of the top 25% of all farms in the benchmarking sample.

Figure 6.2-7 shows the average SKR for the top 20 farms. It is important to note that these top 20 farms are ranked according to their average yield of saleable kernel per bearing hectare over a minimum of five seasons, rather than according to their SKR result.

The top 20 farms averaged 36.23% SKR in 2014, 33.68% in 2013 and 35.1% from 2009 to 2014. This represents an increase of 2.55% in the average SKR amongst the top 20 farms from 2013 to 2014.

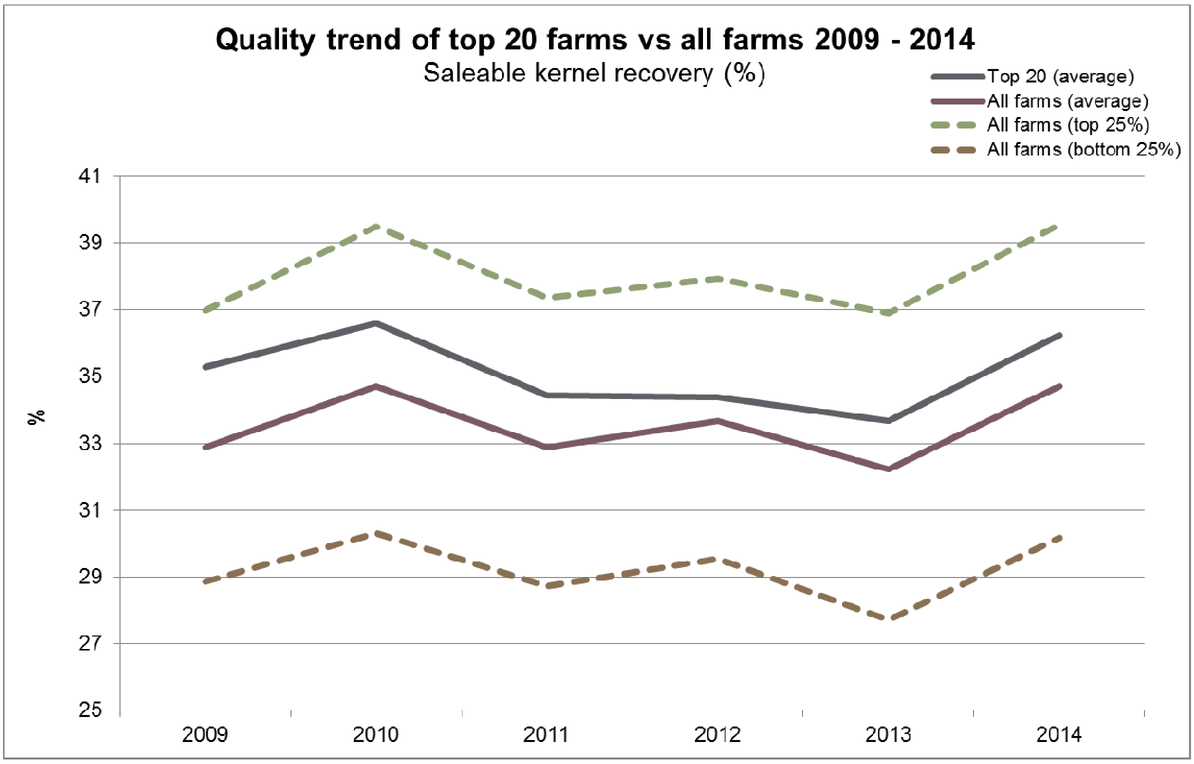


Figure 6.2-7: Average saleable kernel recovery (%) for the top 20 farms (by productivity) vs all farms in the benchmarking sample for 2009-2014

By comparison to the top 20 farms, the average SKR of all farms in the benchmarking sample was 34.7% in 2014 (1.57% less than the top 20 farms), 32.22% in 2013 and 33.52% from 2009 to 2014.

This shows that the 20 most productive farms also achieve, on average, a higher SKR than the average of all farms within the benchmarking sample.

6.3 Results by season

Yield by season

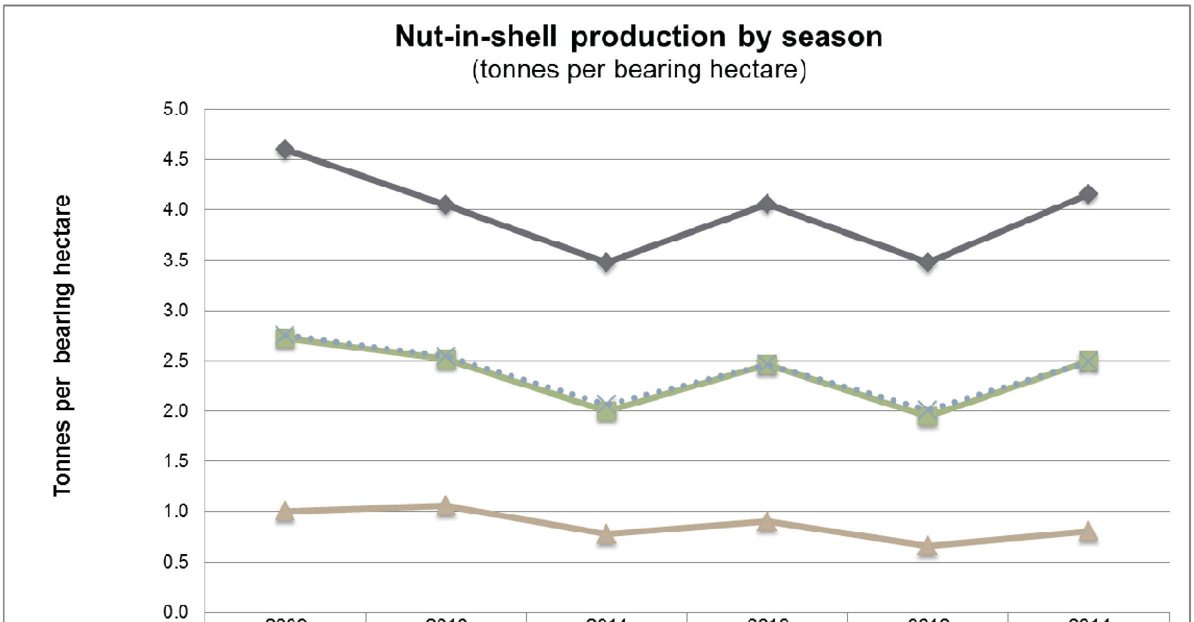
There were significant differences in the NIS and kernel yield per hectare results between the six seasons from 2009 to 2014 for the farms in the benchmarking sample. There were also major differences in the yield results between the top 25%, middle 50% and bottom 25% of farms within the benchmarking sample over this period.

Variation in yield per hectare has a major bearing on farm profitability as the *"On-farm economic analysis in the Australian macadamia industry"* project (MC03023) found a very strong correlation between farm productivity and profitability.

Nut-in-shell (NIS) tonnes per hectare by season

Figure 6.3-1 shows a comparison of the average tonnes of NIS per bearing hectare for the top 25%, middle 50% and bottom 25% of farms and all farms in the benchmarking survey for each year from 2009 to 2014. There was an increase in average yield of NIS per bearing hectare for each percentile group from 2013 to 2014.

For each of these percentile groups, average yield of NIS per bearing hectare in 2014 was higher than in 2013 and 2011 and lower than in 2009. Average yield per hectare in 2014 was also higher for the top 25% of farms, similar for the middle 50% and lower for the bottom 25% than the comparative yields in 2010 and 2012. This meant that the top 25% of farms achieved better and bottom 25% achieved lower average yields of NIS per bearing hectare in 2014 compared to 2010 and 2012.



	2009	2010	2011	2012	2013	2014
Top 25%	4.60	4.05	3.48	4.06	3.48	4.16
Middle 50%	2.73	2.52	2.00	2.46	1.95	2.50
Bottom 25%	1.00	1.06	0.78	0.90	0.66	0.80
All farms	2.75	2.54	2.06	2.46	2.01	2.49

Figure 6.3-1: Comparison of average farm yields of tonnes of nut-in-shell (NIS) per bearing hectare (2009 to 2014)

Table 6.3-1 shows the statistical differences between the NIS tonnes per bearing hectare in the six seasons from 2009 to 2014. The Least Significant Difference (LSD) statistical technique used here is described in detail in the materials and methods section earlier in the report.

The major differences in average NIS tonnes per bearing hectare are:

- The average NIS yield per hectare in 2014 was significantly more than in 2011 and 2013, significantly less than in 2009 but not significantly different from 2010 and 2012.
- The average NIS yield per hectare in 2009 was significantly more than in each of the other seasons.
- The average NIS yields per hectare in 2011 and 2013 were significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	**Year (I)**	**Year (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
NIS tonnes per hectare	2009	2010	0.21	0.10*	2.75
		2011	0.69	0.00***	
		2012	0.29	0.02**	
		2013	0.74	0.00***	
		2014	0.26	0.03**	
	2010	2009	-0.21	0.10*	2.54
		2011	0.48	0.00***	
		2012	0.08	0.52	
		2013	0.53	0.00***	
		2014	0.05	0.67	
	2011	2009	-0.69	0.00***	2.06
		2010	-0.48	0.00***	
		2012	-0.40	0.00***	
		2013	0.05	0.67	
		2014	-0.43	0.00***	
	2012	2009	-0.29	0.02**	2.46
		2010	-0.08	0.52	
		2011	0.40	0.00***	
		2013	0.45	0.00***	
		2014	-0.03	0.80	
	2013	2009	-0.74	0.00***	2.01
		2010	-0.53	0.00***	
		2011	-0.05	0.67	
		2012	-0.45	0.00***	
		2014	-0.48	0.00***	
	2014	2009	-0.26	0.03**	2.49
		2010	-0.05	0.67	
		2011	0.43	0.00***	
		2012	0.03	0.80	
		2013	0.48	0.00***	

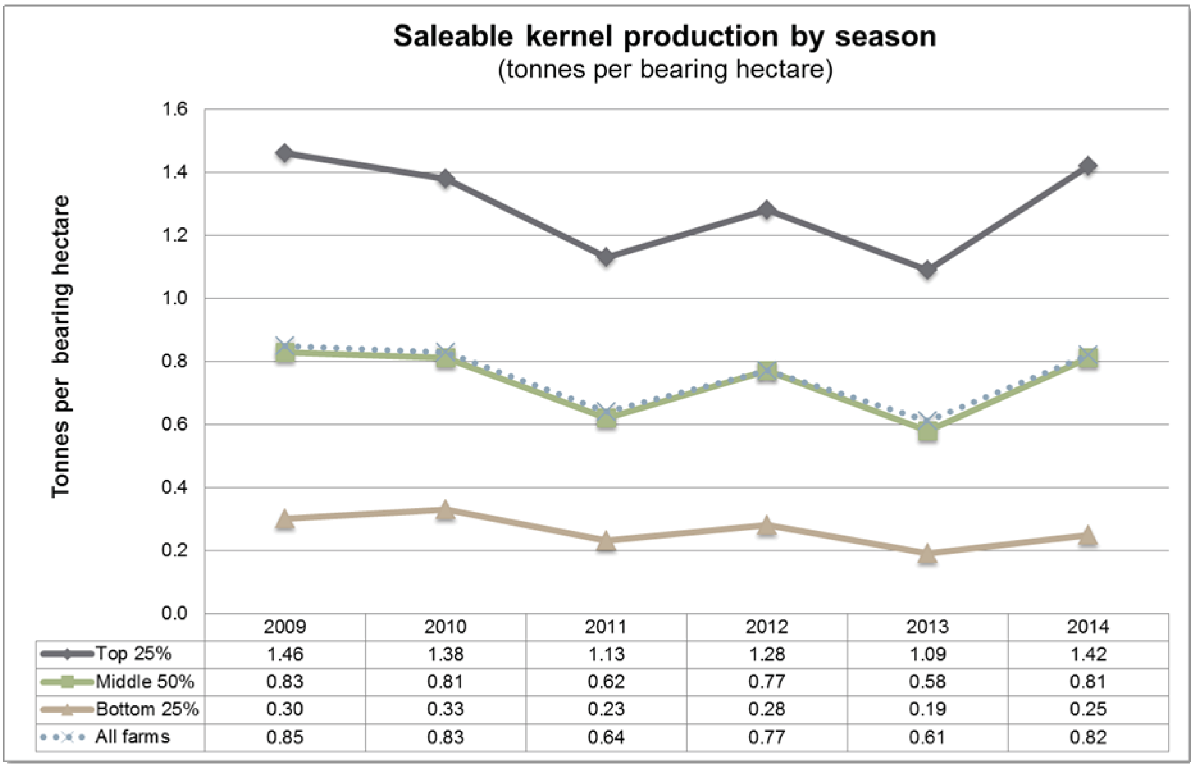
Table 6.3-1: Comparison of nut-in-shell tonnes per hectare averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Saleable kernel tonnes per hectare by season

Figure 6.3-2 shows a comparison of the average tonnes of saleable kernel per bearing hectare for the top 25%, middle 50% and bottom 25% and for all farms in the benchmarking sample from 2009 to 2014. There was an increase in average yield of saleable kernel per bearing hectare for each percentile group from 2013 to 2014.

Average yield of saleable kernel per bearing hectare for the top 25% of farms in 2014 was higher than in each year from 2010 to 2013 but lower than in 2009. Average yield per hectare for the middle 50% was higher than in each year from 2011 to 2013 and similar to 2009 and 2010. Average yield per hectare for the bottom 25% was higher than in 2011 and 2013 but lower than in 2009, 2010 and 2012. As with NIS, this meant that the top 25% achieved better and bottom 25% achieved lower average yields of saleable kernel per bearing hectare in 2014 compared to 2010 and 2012.



	2009	2010	2011	2012	2013	2014
Top 25%	1.46	1.38	1.13	1.28	1.09	1.42
Middle 50%	0.83	0.81	0.62	0.77	0.58	0.81
Bottom 25%	0.30	0.33	0.23	0.28	0.19	0.25
All farms	0.85	0.83	0.64	0.77	0.61	0.82

Figure 6.3-2: Comparison of average farm yields of tonnes of saleable kernel per bearing hectare (2009 to 2014)

Table 6.3-2 shows the statistical differences between the average saleable kernel tonnes per bearing hectare in the six seasons from 2009 to 2014. The major differences are:

- The average saleable kernel yield per hectare in 2014 was significantly more than in 2011 and 2013 but not significantly different from 2009, 2010 and 2012.
- The average saleable kernel yield per hectare in 2009 was significantly more than in 2011, 2012 and 2013.
- The average saleable yields per hectare in 2011 and 2013 were significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	Year (I)	Year (J)	Mean difference (I-J)	Sig	Mean
Saleable kernel tonnes per hectare	2009	2010	0.02	0.66	0.85
		2011	0.21	0.00***	
		2012	0.08	0.06*	
		2013	0.24	0.00***	
		2014	0.03	0.42	
	2010	2009	-0.02	0.66	0.83
		2011	0.19	0.00***	
		2012	0.06	0.15	
		2013	0.22	0.00***	
		2014	0.01	0.73	
	2011	2009	-0.21	0.00***	0.64
		2010	-0.19	0.00***	
		2012	-0.13	0.00***	
		2013	0.03	0.45	
		2014	-0.18	0.00***	
	2012	2009	-0.08	0.06*	0.77
		2010	-0.06	0.15	
		2011	0.13	0.00***	
		2013	0.16	0.00***	
		2014	-0.04	0.22	
	2013	2009	-0.24	0.00***	0.61
		2010	-0.22	0.00***	
		2011	-0.03	0.45	
		2012	-0.16	0.00***	
		2014	-0.21	0.00***	
	2014	2009	-0.03	0.42	0.82
		2010	-0.01	0.73	
		2011	0.18	0.00***	
		2012	0.04	0.22	
		2013	0.21	0.00***	

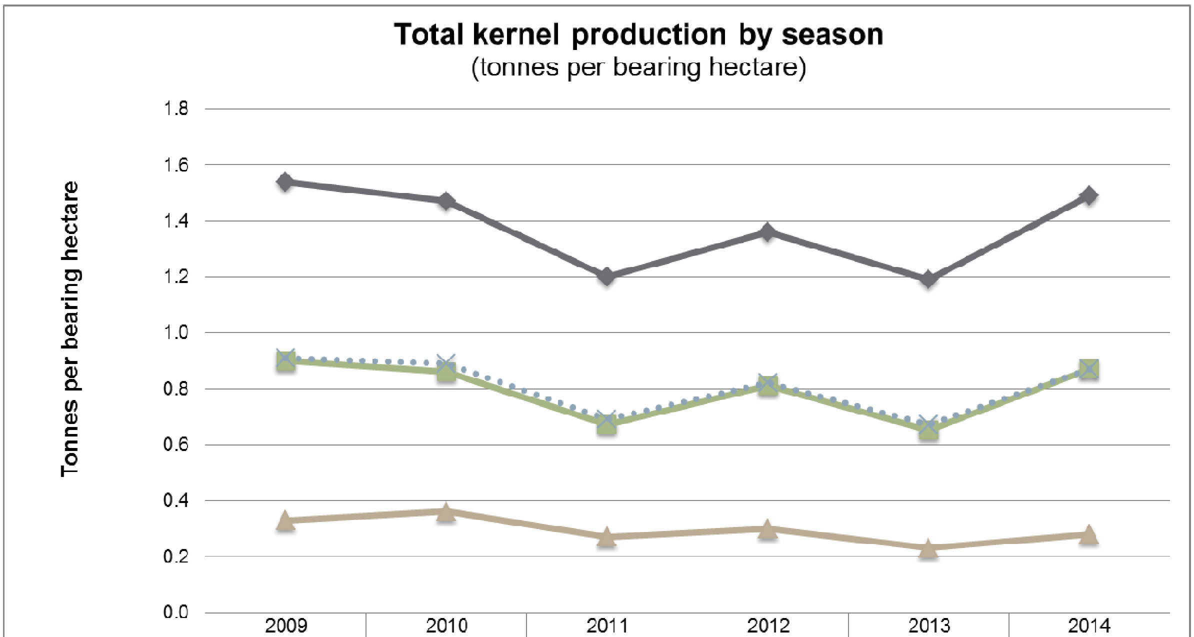
Table 6.3-2: Comparison of saleable kernel tonnes per hectare averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Total kernel tonnes per bearing hectare by season

Figure 6.3-3 shows a comparison of the average tonnes of total kernel per bearing hectare for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking survey from 2009 to 2014. There was an increase in average yield of total kernel per bearing hectare for each percentile group from 2013 to 2014.

Average yield of total kernel per bearing hectare for the top 25% of farms was higher in 2014 than in each year from 2010 to 2013 but lower than in 2009. Average yield per hectare for the middle 50% was higher than in each year from 2011 to 2013 and similar to 2009 and 2010. Average yield per hectare for the bottom 25% was higher than in 2011 and 2013 but lower than in 2009, 2010 and 2012. As with NIS and saleable kernel, this meant that the top 25% achieved better and bottom 25% achieved lower average yields of total kernel per bearing hectare in 2014 compared to 2010 and 2012.



	2009	2010	2011	2012	2013	2014
Top 25%	1.54	1.47	1.20	1.36	1.19	1.49
Middle 50%	0.90	0.86	0.67	0.81	0.65	0.87
Bottom 25%	0.33	0.36	0.27	0.30	0.23	0.28
All farms	0.91	0.89	0.69	0.82	0.67	0.87

Figure 6.3-3: Comparison of average farm yields of tonnes of total kernel per bearing hectare (2009 to 2014)

Table 6.3-3 shows the statistical differences between the average total kernel tonnes per bearing hectare in the six seasons from 2009 to 2014. The major differences are:

- The average total kernel yield per hectare in 2014 was significantly more than in 2011 and 2013 but not significantly different from 2009, 2010 and 2012.
- The average saleable kernel yield per hectare in 2009 was significantly more than in 2011, 2012 and 2013.
- The average saleable yields per hectare in 2011 and 2013 were significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	Year (I)	Year (J)	Mean difference (I-J)	Sig	Mean
Total kernel tonnes per bearing hectare	2009	2010	0.03	0.58	0.91
		2011	0.22	0.00***	
		2012	0.09	0.03**	
		2013	0.24	0.00***	
		2014	0.04	0.33	
	2010	2009	-0.03	0.58	0.89
		2011	0.19	0.00***	
		2012	0.07	0.12	
		2013	0.22	0.00***	
		2014	0.02	0.70	
	2011	2009	-0.22	0.00***	0.69
		2010	-0.19	0.00***	
		2012	-0.13	0.00***	
		2013	0.03	0.54	
		2014	-0.18	0.00***	
	2012	2009	-0.09	0.03**	0.82
		2010	-0.07	0.12	
		2011	0.13	0.00***	
		2013	0.15	0.00***	
		2014	-0.05	0.19	
	2013	2009	-0.24	0.00***	0.67
		2010	-0.22	0.00***	
		2011	-0.03	0.54	
		2012	-0.15	0.00***	
		2014	-0.20	0.00***	
	2014	2009	-0.04	0.33	0.87
		2010	-0.02	0.70	
		2011	0.18	0.00***	
		2012	0.05	0.19	
		2013	0.20	0.00***	

Table 6.3-3: Comparison of total kernel tonnes per hectare averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

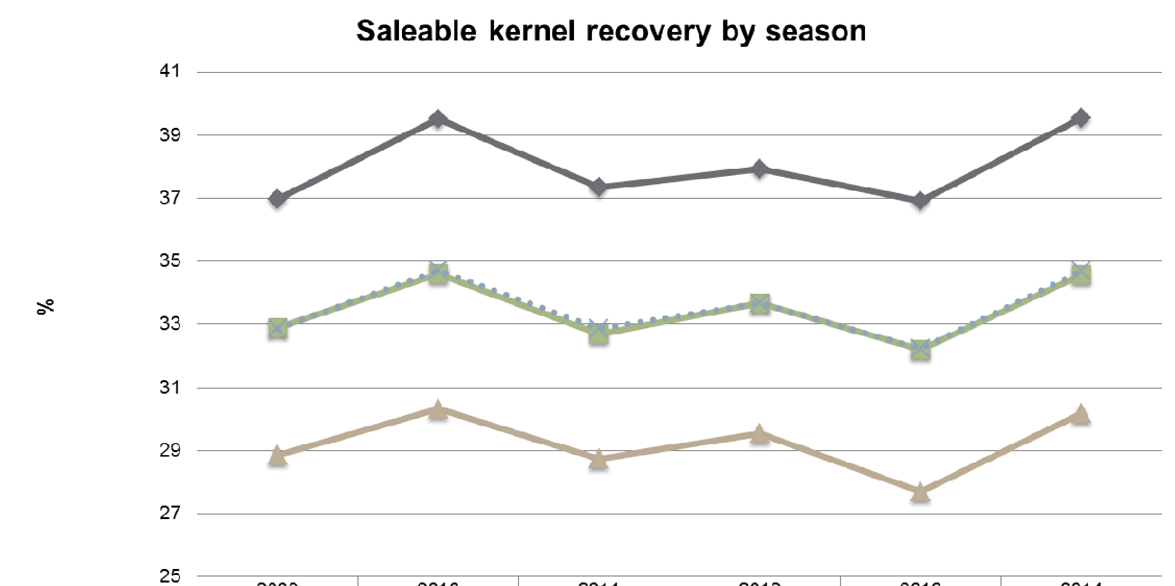
Quality by season

There were significant differences in the quality results between the six seasons from 2009 to 2014 for the farms in the benchmarking sample. There were also major differences in the quality results between the top 25%, middle 50% and bottom 25% of farms within the benchmarking sample over this period.

Saleable kernel recovery (SKR) by season

Figure 6.3-4 shows a comparison of the average SKR for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was an increase in SKR for each percentile group from 2013 to 2014.

Average SKR in 2014 was higher for each of the percentile groups than the average SKR in 2009, 2011, 2012 and 2013. Average SKR in 2014 was similar for each of the percentile groups to the average SKR in 2010.



	2009	2010	2011	2012	2013	2014
Top 25%	36.98	39.50	37.35	37.93	36.90	39.54
Middle 50%	32.90	34.60	32.71	33.68	32.21	34.57
Bottom 25%	28.85	30.32	28.73	29.54	27.70	30.18
All farms	32.88	34.71	32.88	33.67	32.22	34.70

Figure 6.3-4: Comparison of average farm saleable kernel recovery (2009 to 2014)

Table 6.3-4 shows the statistical differences between the average SKR in the six seasons from 2009 to 2014. The major differences are:

- The average SKR's in 2010 and 2014 were significantly more than in each of the other seasons.
- The SKR in 2012 was significantly more than in 2009, 2011 and 2013.
- The average SKR in 2013 was significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	**Year (I)**	**Year (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Saleable kernel recovery %	2009	2010	-1.83	0.00***	32.88
		2011	0.01	0.99	
		2012	-0.79	0.02**	
		2013	0.66	0.06*	
		2014	-1.82	0.00***	
	2010	2009	1.83	0.00***	34.71
		2011	1.83	0.00***	
		2012	1.03	0.00***	
		2013	2.49	0.00***	
		2014	0.01	0.98	
	2011	2009	-0.01	0.99	32.88
		2010	-1.83	0.00***	
		2012	-0.80	0.02**	
		2013	0.65	0.05*	
		2014	-1.82	0.00***	
	2012	2009	0.79	0.02**	33.67
		2010	-1.03	0.00***	
		2011	0.80	0.02**	
		2013	1.45	0.00***	
		2014	-1.03	0.00***	
	2013	2009	-0.66	0.06**	32.22
		2010	-2.49	0.00***	
		2011	-0.65	0.05*	
		2012	-1.45	0.00***	
		2014	-2.48	0.00***	
	2014	2009	1.82	0.00***	34.70
		2010	-0.01	0.98	
		2011	1.82	0.00***	
		2012	1.03	0.00***	
		2013	2.48	0.00***	

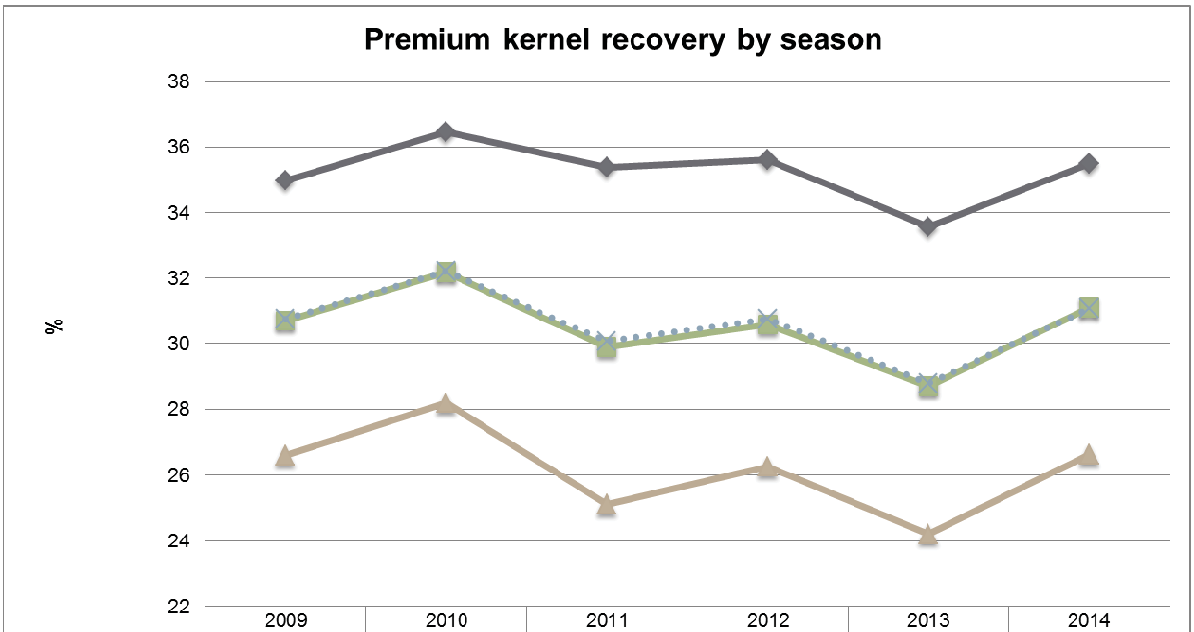
Table 6.3-4: Comparison of saleable kernel recovery (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Premium kernel recovery (PKR) by season

Figure 6.3-5 shows a comparison of the average PKR for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was an increase in average PKR for each percentile group from 2013 to 2014.

The average PKR in 2014 for the top 25% was higher than in 2009 and 2013, similar to 2011 and 2012 and lower than in 2010. The average PKR in 2014 for the middle 50% was higher than in 2009, 2011, 2012 and 2013 and lower than in 2010. The average PKR in 2014 for the bottom 25% was higher than in 2011, 2012 and 2013, similar to 2009 and lower than in 2010.



	2009	2010	2011	2012	2013	2014
Top 25%	34.98	36.46	35.38	35.63	33.57	35.50
Middle 50%	30.72	32.19	29.91	30.58	28.72	31.11
Bottom 25%	26.61	28.20	25.11	26.25	24.20	26.64
All farms	30.76	32.20	30.08	30.76	28.80	31.09

Figure 6.3-5: Comparison of average farm premium kernel recovery (2009 to 2014)

Table 6.3-5 shows the statistical differences between average PKR in the six seasons from 2009 to 2014. The major differences are:

- The average PKR in 2014 was significantly higher than in 2011 and 2013, significantly lower than in 2010, but not significantly different from 2009 and 2012.
- The average PKR in 2010 was significantly higher than in each of the other seasons.
- The average PKR in 2013 was significantly lower than in each of the other seasons.
- The average PKR in 2011 was significantly higher than in 2013 and significantly lower than in 2009, 2010, 2012 and 2014.

Bearing farms	Least significant difference				
Dependent variable	**Year (I)**	**Year (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Premium kernel recovery %	2009	2010	-1.44	0.00***	30.76
		2011	0.68	0.07*	
		2012	0.00	0.99	
		2013	1.95	0.00***	
		2014	-0.33	0.35	
	2010	2009	1.44	0.00***	32.20
		2011	2.12	0.00***	
		2012	1.44	0.00***	
		2013	3.39	0.00***	
		2014	1.11	0.00***	
	2011	2009	-0.68	0.07*	30.08
		2010	-2.12	0.00***	
		2012	-0.68	0.05**	
		2013	1.27	0.00***	
		2014	-1.01	0.00***	
	2012	2009	0.00	0.99	30.76
		2010	-1.44	0.00***	
		2011	0.68	0.05**	
		2013	1.96	0.00***	
		2014	-0.33	0.31	
	2013	2009	-1.95	0.00***	28.80
		2010	-3.39	0.00***	
		2011	-1.27	0.00***	
		2012	-1.96	0.00***	
		2014	-2.28	0.00***	
	2014	2009	0.33	0.35	31.09
		2010	-1.11	0.00***	
		2011	1.01	0.00***	
		2012	0.33	0.31	
		2013	2.28	0.00***	

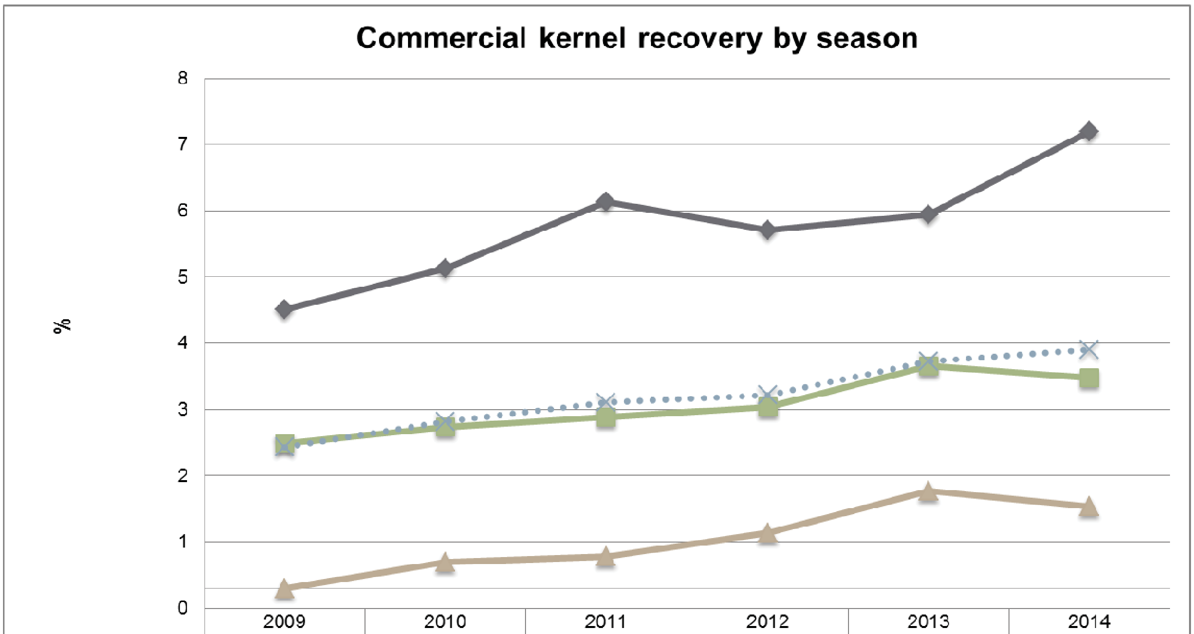
Table 6.3-5: Comparison of premium kernel recovery (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Commercial kernel recovery (CKR) by season

Figure 6.3-6 shows a comparison of the average CKR for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking from 2009 to 2014. There was an increase in the average CKR for the top 25% and a slight decrease in the average CKR for the middle 50% and bottom 25% from 2013 to 2014.

The average CKR for all farms shows an increase in each year from 2009 to 2014. The average CKR for the top 25% was higher in 2014 than in each year from 2009 to 2013. The average CKR for the middle 50% and bottom 25% was higher in 2014 than in each year from 2009 to 2012.



	2009	2010	2011	2012	2013	2014
Top 25%	4.21	4.83	5.84	5.41	5.64	6.89
Middle 50%	2.19	2.44	2.59	2.74	3.36	3.18
Bottom 25%	0.00	0.40	0.48	0.84	1.47	1.24
All farms	2.13	2.51	2.80	2.91	3.42	3.61

Figure 6.3-6: Comparison of average farm commercial kernel recovery (2009 to 2014)

Table 6.3-6 shows the statistical differences between average CKR in the six seasons from 2009 to 2014. The major differences are:

- Average CKR in 2013 and 2014 was significantly more than in each of the other seasons.
- CKR in 2012 was significantly more than in 2009 and 2010.
- Average CKR in 2009 was significantly lower than each of the other seasons. It is important to note that one major processor did not report CKR in 2009 and began to report CKR in 2010.

Bearing farms	Least significant difference				
Dependent variable	**Year (I)**	**Year (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Commercial kernel recovery %	2009	2010	-0.39	0.06*	2.13
		2011	-0.67	0.00***	
		2012	-0.79	0.00***	
		2013	-1.29	0.00***	
		2014	-1.49	0.00***	
	2010	2010	0.39	0.06*	2.51
		2011	-0.29	0.15	
		2012	-0.40	0.03**	
		2013	-0.91	0.00***	
		2014	-1.10	0.00***	
	2011	2010	0.67	0.00***	2.80
		2011	0.29	0.15	
		2012	-0.11	0.54	
		2013	-0.62	0.00***	
		2014	-0.81	0.00***	
	2012	2010	0.79	0.00***	2.91
		2011	0.40	0.03**	
		2012	0.11	0.54	
		2013	-0.50	0.00***	
		2014	-0.70	0.00***	
	2013	2010	1.29	0.00***	3.42
		2011	0.91	0.00***	
		2012	0.62	0.00***	
		2013	0.50	0.00***	
		2014	-0.19	0.26***	
	2014	2010	1.49	0.00***	3.61
		2011	1.10	0.00***	
		2012	0.81	0.00***	
		2013	0.70	0.00***	
		2014	0.19	0.26	

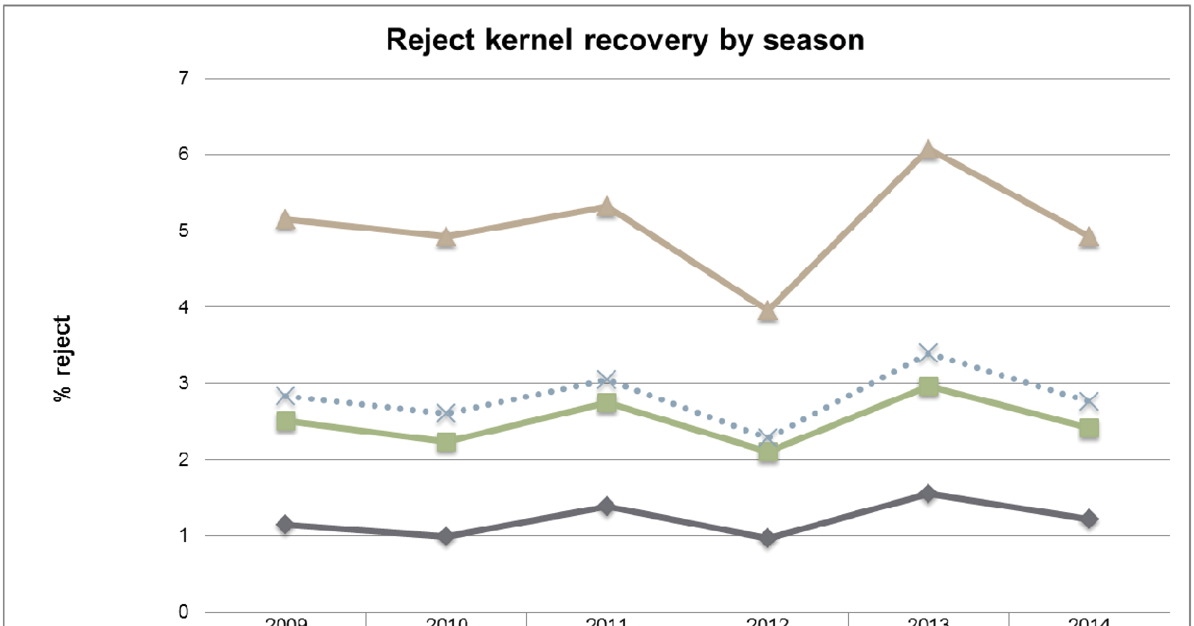
Table 6.3-6: Comparison of commercial kernel recovery (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Reject kernel recovery (RKR) by season

Figure 6.3-7 shows a comparison of average RKR for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was a decrease in RKR for each percentile group from 2013 to 2014. The percentiles are inverted (i.e. the lower levels are in the top 25%) as a low RKR represents better quality.

The average RKR for the top 25% in 2014 was lower than in 2011 and 2013 and higher than in 2009, 2010 and 2012. The average RKR for the middle 50% and bottom 25% in 2014 were lower than in 2009, 2011 and 2013 but higher than in 2010 and 2012.



	2009	2010	2011	2012	2013	2014
Top 25%	1.15	0.99	1.39	0.97	1.55	1.22
Middle 50%	2.51	2.23	2.75	2.10	2.96	2.41
Bottom 25%	5.15	4.93	5.32	3.95	6.07	4.93
All farms	2.83	2.60	3.05	2.28	3.39	2.76

Figure 6.3-7: Comparison of average reject kernel recovery (2009 to 2014)

Table 6.3-7 shows the statistical differences between average RKR in the six seasons from 2009 to 2014. The major differences are:

- Average RKR in 2014 was significantly less than in 2011 and 2013 and significantly more than in 2012 but not significantly different from 2009 and 2010.
- Average RKR in 2012 was significantly less than in each of the other seasons.
- The average RKR in 2013 was significantly more than in each of the other seasons.
- Average RKR in 2011 was significantly less than in 2013 and significantly more than in 2010, 2012 and 2014.

Bearing farms	Least significant difference				
Dependent variable	Year (I)	Year(J)	Mean difference (I-J)	Sig	Mean
Reject kernel recovery %	2009	2010	0.22	0.22	2.83
		2011	-0.22	0.23	
		2012	0.55	0.00***	
		2013	-0.56	0.00***	
		2014	0.07	0.68	
	2010	2009	-0.22	0.22	2.60
		2011	-0.44	0.01***	
		2012	0.32	0.06*	
		2013	-0.79	0.00***	
		2014	-0.15	0.36	
	2011	2009	0.22	0.23	3.05
		2010	0.44	0.01***	
		2012	0.77	0.00***	
		2013	-0.34	0.04**	
		2014	0.29	0.08*	
	2012	2009	-0.55	0.00***	2.28
		2010	-0.32	0.06*	
		2011	-0.77	0.00***	
		2013	-1.11	0.00***	
		2014	-0.48	0.00***	
	2013	2009	0.56	0.00***	3.39
		2010	0.79	0.00***	
		2011	0.34	0.04**	
		2012	1.11	0.00***	
		2014	0.63	0.00***	
	2014	2009	-0.07	0.68	2.76
		2010	0.15	0.36	
		2011	-0.29	0.08*	
		2012	0.48	0.00***	
		2013	-0.63	0.00***	

Table 6.3-7: Comparison of reject kernel recovery (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Reject analysis by season

Figure 6.3-8 shows the percentage break-up of the RKR for each reject analysis category for all participating farms in the benchmarking study from 2009 to 2014. There was a decrease in the average level of insect damage, immaturity, brown centres and discolouration and an increase in the level of mould from 2013 to 2014. The average level of rejects due to germination was similar in 2013 and 2014 and has been consistently the lowest level of the reject categories between 2009 and 2014.

Insect damage represented the highest average percentage of rejects from 2009 to 2013. The level of rejects due to insect damage in 2014 was less than each of the previous five years.

Immaturity represented the highest average percentage of rejects in 2014. The increase in the average level of immaturity in 2013 and 2014 was largely due to very high average levels of immaturity amongst South East Queensland farms.

The average percentage of rejects due to insect damage was greater in 2013 (1.05%) than in each of the other years. There was a significant increase in the percentage of rejects due to immaturity from 2012 to 2013, particularly amongst South East Queensland and Central Queensland farms. There was also a major increase in the percentage of rejects due to brown centres (internal discolouration) from 2012 to 2013 amongst Central Queensland farms.

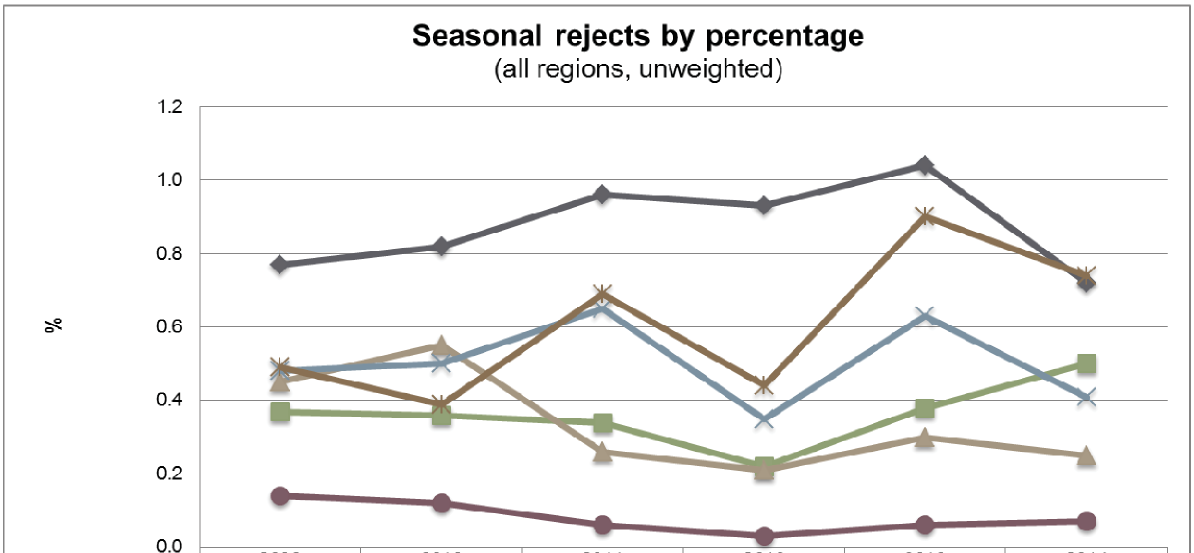
It is important to note that these percentages are unweighted averages. This means that each farm in the data sample exerts equal influence on the average. In other words, the data for 10 hectare farms will have just as much effect on regional or seasonal averages as that of 200 hectare farms.

Table 6.6-16 and Figure 6.6-2 show that the average level of rejects due to insect damage was less with increasing average farm size. By comparison, the average level of rejects due to brown centres increased with increasing farm size.

The increasing levels of brown centres are consistent with the findings of the grower surveys from the *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008). These surveys found that the average level of brown centres significantly increased with increasing farm size, maximum silo size and nut storage bed depth.

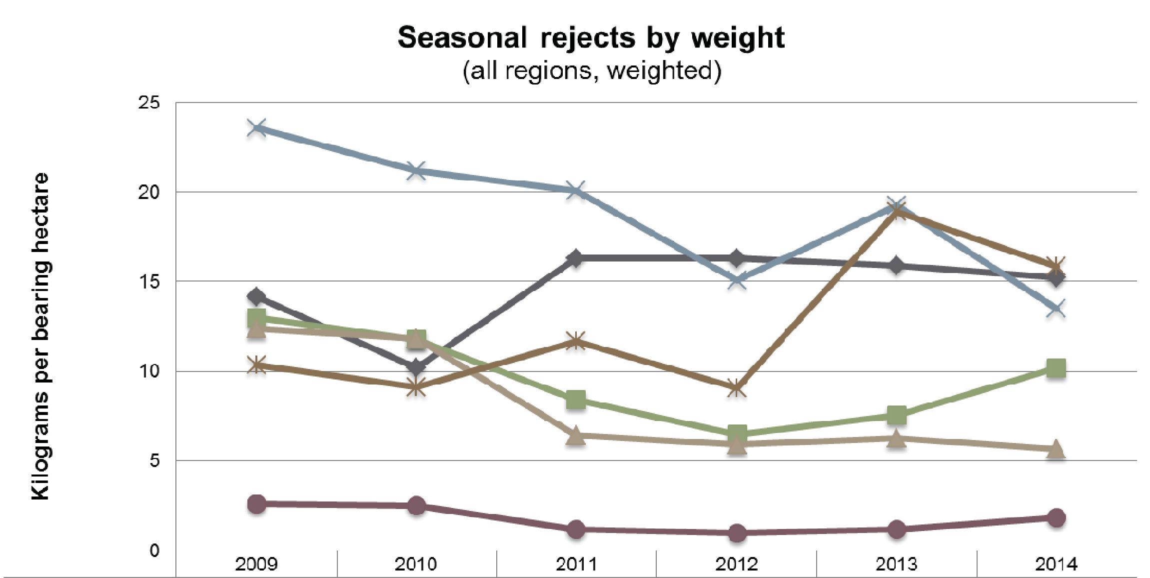
Figure 6.3-9 shows the average kilograms of kernel per bearing hectare rejected for each reject analysis category for the six seasons from 2009 to 2014 for the farms in the benchmarking survey. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of rejects by the total bearing hectares in the benchmarking sample. Both production and reject levels impact on the average calculation, therefore farms with larger yields and reject levels will exert more influence (weight) on the average than farms with smaller yields and reject levels.

When viewed as a weighted average, immaturity, insect damage and brown centres were the categories responsible for the highest average levels of reject kernel per bearing hectare in the benchmarking sample in 2014 with 15.83 kg, 15.25 kg and 13.51 kg respectively. Brown centres was also the category responsible for the highest average level of rejects per bearing hectare in 2009 (23.56 kg), 2010 (21.17 kg), 2011 (20.05 kg) and 2013 (19.24 kg). The lower percentage of rejects due to brown centres in 2012 meant that insect damage was the reason for the highest amount of rejects per bearing hectare (16.32 kg) that year.



	2009	2010	2011	2012	2013	2014
Insect	0.78	0.83	0.97	0.94	1.05	0.73
Mould	0.38	0.37	0.35	0.23	0.39	0.51
Discoloured	0.46	0.56	0.27	0.22	0.31	0.26
Brown centres	0.49	0.51	0.66	0.36	0.64	0.42
Immature	0.50	0.40	0.70	0.45	0.91	0.75
Germinated	0.15	0.13	0.07	0.04	0.07	0.08

Figure 6.3-8: Seasonal comparison of reject categories based on average consignment percentage (2009 to 2014).



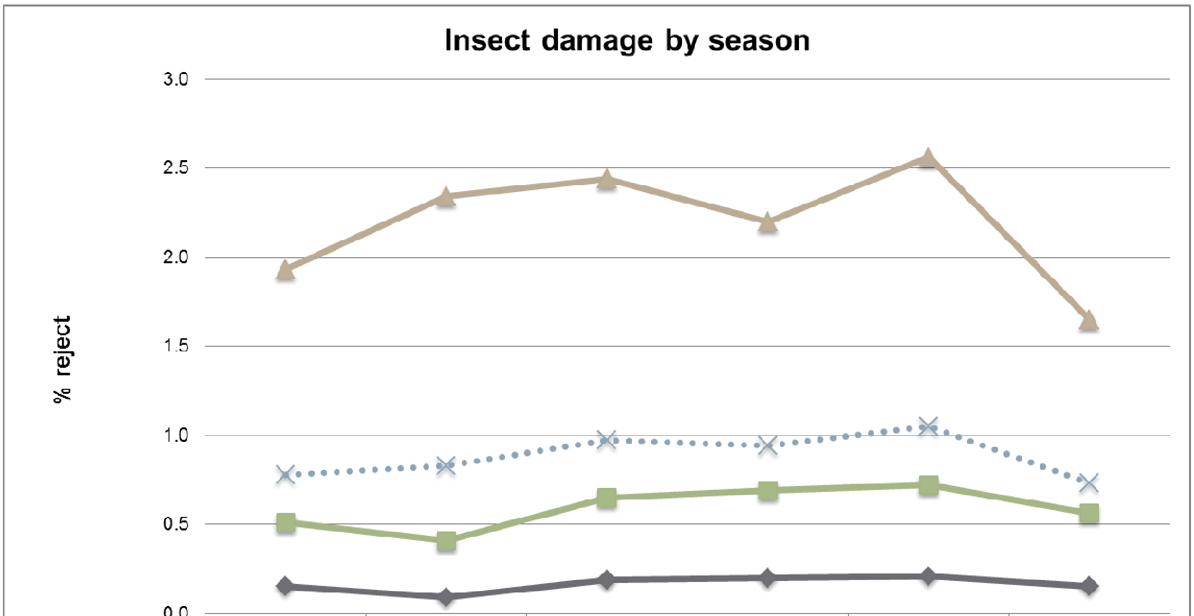
	2009	2010	2011	2012	2013	2014
Insect	14.16	10.19	16.28	16.32	15.90	15.25
Mould	12.99	11.77	8.39	6.45	7.55	10.17
Discoloured	12.40	11.80	6.43	5.91	6.28	5.68
Brown centres	23.56	21.17	20.05	15.05	19.24	13.51
Immature	10.35	9.12	11.64	9.07	18.90	15.83
Germinated	2.60	2.49	1.20	0.96	1.18	1.86

Figure 6.3-9: Seasonal comparison of reject categories based on average weighted kilograms of kernel per bearing hectare (2009 to 2014).

Insect damage by season

Figure 6.3-10 shows a comparison of the average level of rejects due to insect damage for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was a decrease in the average level of rejects due to insect damage for each percentile group from 2013 to 2014 and particularly amongst the bottom 25% of farms. As with RKR, the percentiles are inverted (i.e. the lower levels are in the top 25%) as a low level of insect damage represents better quality.

The average level of rejects due to insect damage amongst the top 25% and middle 50% was less than in each year from 2011 to 2013, similar to 2009 and higher than in 2010. The average level of rejects amongst the bottom 25% was less than in each year from 2009 to 2013.



	2009	2010	2011	2012	2013	2014
Top 25%	0.15	0.09	0.19	0.20	0.21	0.15
Middle 50%	0.51	0.41	0.65	0.69	0.72	0.56
Bottom 25%	1.93	2.34	2.44	2.20	2.56	1.65
All farms	0.78	0.83	0.97	0.94	1.05	0.73

Figure 6.3-10: Comparison of average insect damage reject levels (2009 to 2014)

Table 6.3-8 shows the statistical differences between the average levels of rejects due to insect damage in the six seasons from 2009 to 2014. The major differences are:

- The average level of rejects due to insect damage in 2014 was significantly less than in 2011, 2012 and 2013 but not significantly different from 2009 and 2010.
- The average level of rejects due to insect damage in 2013 was significantly more than in 2009, 2010 and 2014.

Bearing farms	Least significant difference				
Dependent variable	Year (I)	Year (J)	Mean difference (I-J)	Sig	Mean
Insect damage %	2009	2010	-0.05	0.69	0.78
		2011	-0.19	0.09	
		2012	-0.16	0.13	
		2013	-0.27	0.01***	
		2014	0.05	0.63	
	2010	2009	0.05	0.69	0.83
		2011	-0.15	0.20	
		2012	-0.12	0.28	
		2013	-0.22	0.04**	
		2014	0.10	0.35	
	2011	2009	0.19	0.09*	0.97
		2010	0.15	0.20	
		2012	0.03	0.77	
		2013	-0.07	0.48	
		2014	0.24	0.02**	
	2012	2009	0.16	0.13	0.94
		2010	0.12	0.28	
		2011	-0.03	0.77	
		2013	-0.10	0.28	
		2014	0.21	0.03**	
	2013	2009	0.27	0.01***	1.05
		2010	0.22	0.04**	
		2011	0.07	0.48	
		2012	0.10	0.28	
		2014	0.32	0.00***	
	2014	2009	-0.05	0.63	0.73
		2010	-0.10	0.35	
		2011	-0.24	0.02**	
		2012	-0.21	0.03**	
		2013	-0.32	0.00***	

Table 6.3-8: Comparison of insect damage (%) averages by year

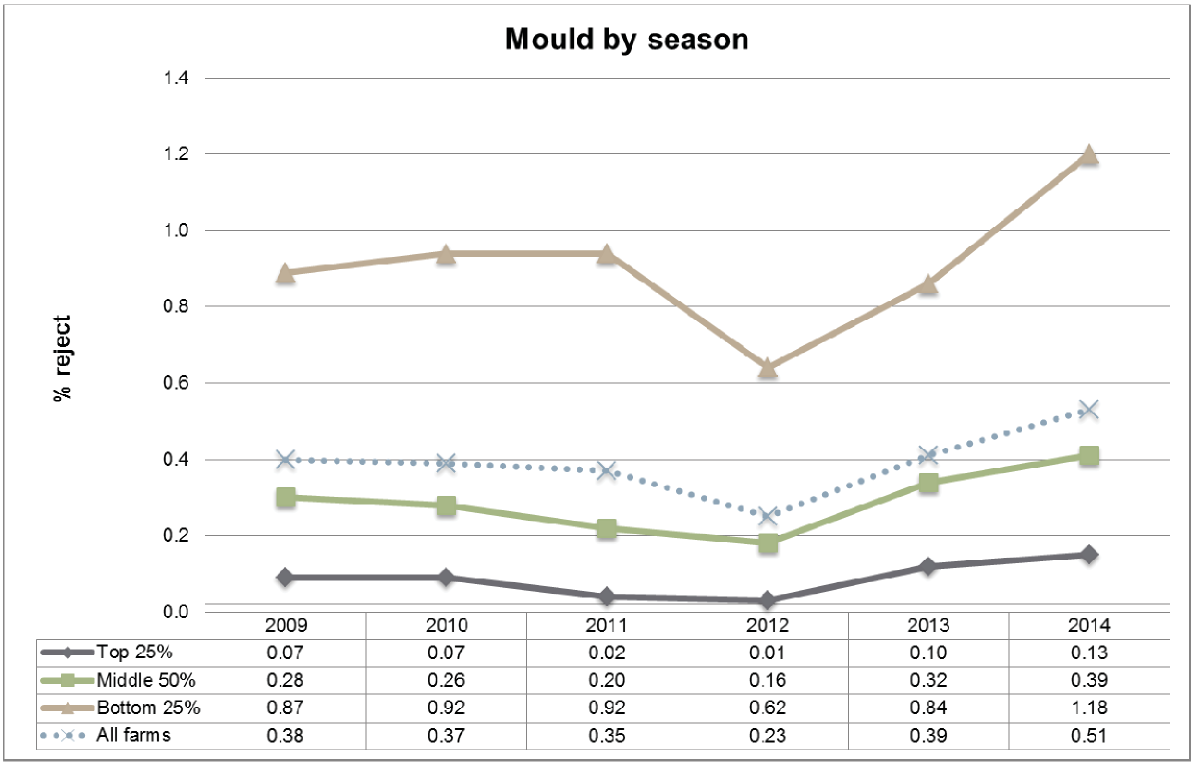
* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Mould by season

Figure 6.3-11 shows a comparison of the average level of rejects due to mould for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to

2014. There was an increase in the average level of rejects due to mould for each percentile group from 2013 to 2014 and particularly amongst the bottom 25% of farms. As with RKR, the percentiles are inverted (i.e. the lower levels are in the top 25%) as a low level of mould represents better quality.

The average level of rejects due to mould in 2014 amongst all the percentiles was higher than in each of the years 2009 to 2013. By comparison, the average level of rejects due to mould in 2012 amongst all percentiles was lower than in each of the other years.



	2009	2010	2011	2012	2013	2014
Top 25%	0.07	0.07	0.02	0.01	0.10	0.13
Middle 50%	0.28	0.26	0.20	0.16	0.32	0.39
Bottom 25%	0.87	0.92	0.92	0.62	0.84	1.18
All farms	0.38	0.37	0.35	0.23	0.39	0.51

Figure 6.3-11: Comparison of average mould reject levels (2009 to 2014)

Table 6.3-9 shows the statistical differences between the average levels of rejects due to mould in the six seasons from 2009 to 2014. The major differences are:

- The average level of rejects due to mould in 2014 was significantly more than in each of the other seasons.
- The average level of rejects due to mould in 2012 was significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean
Mould %	2009	2010	0.00	0.92	0.38
		2011	0.03	0.56	
		2012	0.15	0.00***	
		2013	-0.02	0.59	
		2014	-0.14	0.00***	
	2010	2009	0.00	0.92	0.37
		2011	0.02	0.63	
		2012	0.14	0.00***	
		2013	-0.02	0.51	
		2014	-0.14	0.00***	
	2011	2009	-0.03	0.56	0.35
		2010	-0.02	0.63	
		2012	0.12	0.00***	
		2013	-0.05	0.24	
		2014	-0.17	0.00***	
	2012	2009	-0.15	0.00***	0.23
		2010	-0.14	0.00***	
		2011	-0.12	0.00***	
		2013	-0.16	0.00***	
		2014	-0.28	0.00***	
	2013	2009	0.02	0.59	0.39
		2010	0.02	0.51	
		2011	0.05	0.24	
		2012	0.16	0.00***	
		2014	-0.12	0.00***	
	2014	2009	0.14	0.00***	0.51
		2010	0.14	0.00***	
		2011	0.17	0.00***	
		2012	0.28	0.00***	
		2013	0.12	0.00***	

Table 6.3-9: Comparison of mould (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

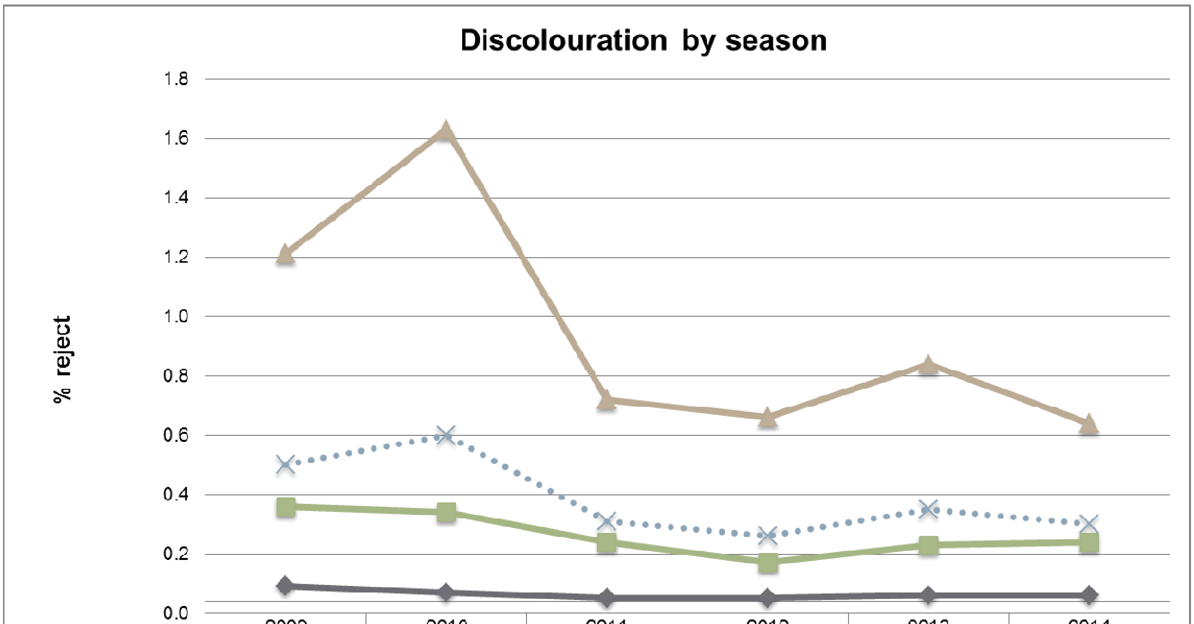
Discolouration by season

Figure 6.3-12 shows a comparison of the average level of rejects due to discolouration for the top

25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was a decrease in the average level of rejects due to discolouration for the bottom 25% in 2014 but the level stayed similar in 2013 and 2014 for the top 25% and middle 50%. As with RKR, the percentiles are inverted (i.e. the lower levels are in the top 25%) as a low level of discolouration represents better quality.

The average level of rejects due to discolouration amongst the top 25% in 2014 was similar to the level from 2010 to 2013 but lower than in 2009. The level amongst the middle 50% was higher than in 2012, similar to 2011 and 2013 and lower than in 2009 and 2010. The level amongst the bottom 25% was similar to 2012, lower than 2011 and 2013 and substantially lower than in 2009 and 2010.

Much of the discoloured kernel is classified by processors as lightly discoloured within the commercial kernel grade rather than as heavily discoloured within the reject kernel grade. One of the major Australian macadamia processors only introduced commercial grade kernel in 2010.



	2009	2010	2011	2012	2013	2014
Top 25%	0.05	0.03	0.01	0.01	0.02	0.02
Middle 50%	0.32	0.30	0.20	0.13	0.19	0.20
Bottom 25%	1.17	1.59	0.68	0.62	0.80	0.60
All farms	0.46	0.56	0.27	0.22	0.31	0.26

Figure 6.3-12: Comparison of average discolouration reject levels (2009 to 2014)

Table 6.3-10 shows the statistical differences between the average levels of rejects due to discolouration in the six seasons from 2009 to 2014. The major differences are:

- The average level of rejects due to discolouration in 2014 was significantly less than in 2009 and 2010 but not significantly different than in each of the other seasons.
- The average levels of rejects due to discolouration in 2009 and 2010 were significantly more than in each of the other seasons.
- The average level of rejects due to discolouration in 2013 was significantly more than in 2012.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean
Discolouration %	2009	2010	-0.10	0.05**	0.46
		2011	0.19	0.00***	
		2012	0.24	0.00***	
		2013	0.15	0.00***	
		2014	0.20	0.00***	
	2010	2009	0.10	0.05**	0.56
		2011	0.28	0.00***	
		2012	0.33	0.00***	
		2013	0.25	0.00***	
		2014	0.30	0.00***	
	2011	2009	-0.19	0.00***	0.27
		2010	-0.28	0.00***	
		2012	0.05	0.25	
		2013	-0.04	0.41	
		2014	0.02	0.73	
	2012	2009	-0.24	0.00***	0.22
		2010	-0.33	0.00***	
		2011	-0.05	0.25	
		2013	-0.09	0.03**	
		2014	-0.04	0.38	
	2013	2009	-0.15	0.00***	0.31
		2010	-0.25	0.00***	
		2011	0.04	0.41	
		2012	0.09	0.03**	
		2014	0.05	0.20	
	2014	2009	-0.20	0.00***	0.26
		2010	-0.30	0.00***	
		2011	-0.02	0.73	
		2012	0.04	0.38	
		2013	-0.05	0.20	

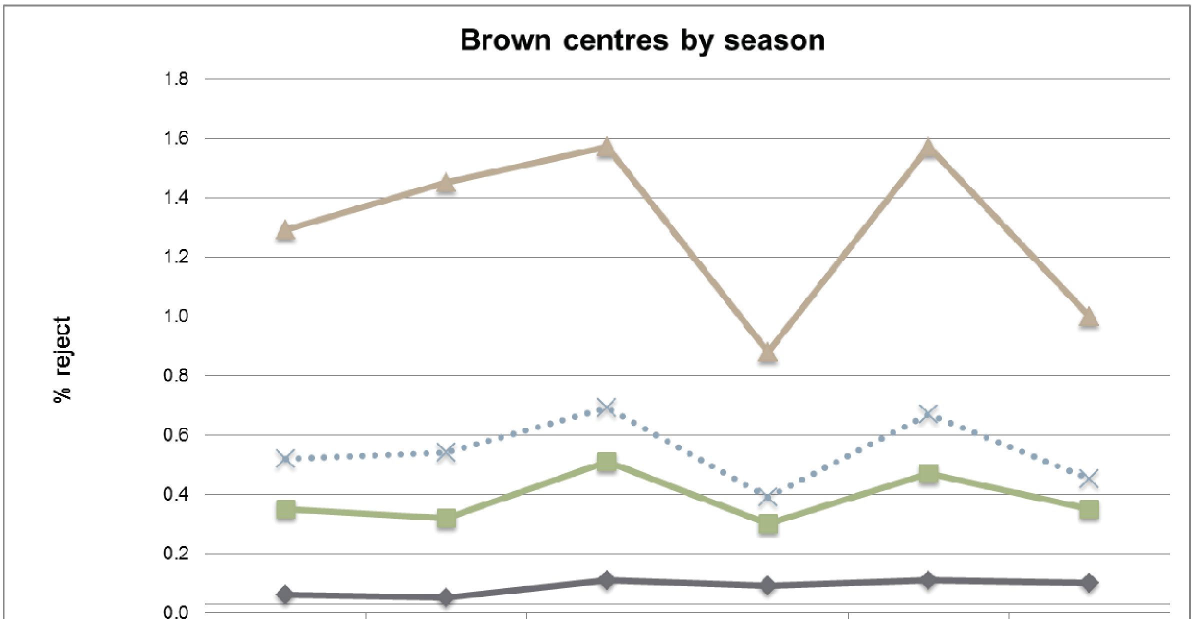
Table 6.3-10: Comparison of discolouration (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Brown centres by season

Figure 6.3-13 shows a comparison of the average level of rejects due to brown centres for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was a decrease in the average level of rejects due to brown centres from 2013 to 2014 in all the percentile groups and particularly amongst the bottom 25% of farms. As with RKR, the percentiles are inverted (i.e. the lower levels are in the top 25%) as a low level of brown centres represents better quality.

The average level of rejects due to brown centres in 2014 for the top 25% was similar to the levels from 2011 to 2013 and higher than in 2009 and 2010. The average level of rejects amongst the middle 50% was lower than in 2011 and 2013 and similar to the levels in 2009 and higher than in 2012 and 2010. The average level of rejects amongst the bottom 25% was substantially lower than in 2009, 2010, 2011 and 2013 and slightly higher than in 2012.



	2009	2010	2011	2012	2013	2014
Top 25%	0.03	0.02	0.08	0.06	0.08	0.07
Middle 50%	0.32	0.29	0.48	0.27	0.44	0.32
Bottom 25%	1.26	1.42	1.54	0.85	1.54	0.97
All farms	0.49	0.51	0.66	0.36	0.64	0.42

Figure 6.3-13: Comparison of average brown centre reject levels (2009 to 2014)

Table 6.3-11 shows the statistical differences between the average levels of rejects due to brown centres in the six seasons from 2009 to 2014. The major differences are:

- The average level of rejects due to brown centres in 2014 was significantly less than in 2010, 2011 and 2013 but not significantly different from 2009 and 2012.
- The average levels of rejects due to brown centres in 2011 and 2013 were significantly more than in each of the other seasons.
- The average level of rejects due to brown centres in 2012 was significantly less than each season apart from 2014.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean
Brown centres %	2009	2010	-0.02	0.73	0.49
		2011	-0.17	0.00***	
		2012	0.13	0.02**	
		2013	-0.15	0.00***	
		2014	0.07	0.21	
	2010	2009	0.02	0.73	0.51
		2011	-0.15	0.01***	
		2012	0.15	0.01***	
		2013	-0.13	0.01***	
		2014	0.09	0.10*	
	2011	2009	0.17	0.00***	0.66
		2010	0.15	0.01***	
		2012	0.30	0.00***	
		2013	0.02	0.68	
		2014	0.24	0.00***	
	2012	2009	-0.13	0.02**	0.36
		2010	-0.15	0.01***	
		2011	-0.30	0.00***	
		2013	-0.28	0.00***	
		2014	-0.06	0.21	
	2013	2009	0.15	0.00***	0.64
		2010	0.13	0.01***	
		2011	-0.02	0.68	
		2012	0.28	0.00***	
		2014	0.22	0.00***	
	2014	2009	-0.07	0.21	0.42
		2010	-0.09	0.10*	
		2011	-0.24	0.00***	
		2012	0.06	0.21	
		2013	-0.22	0.00***	

Table 6.3-11: Comparison of brown centre (%) averages by year

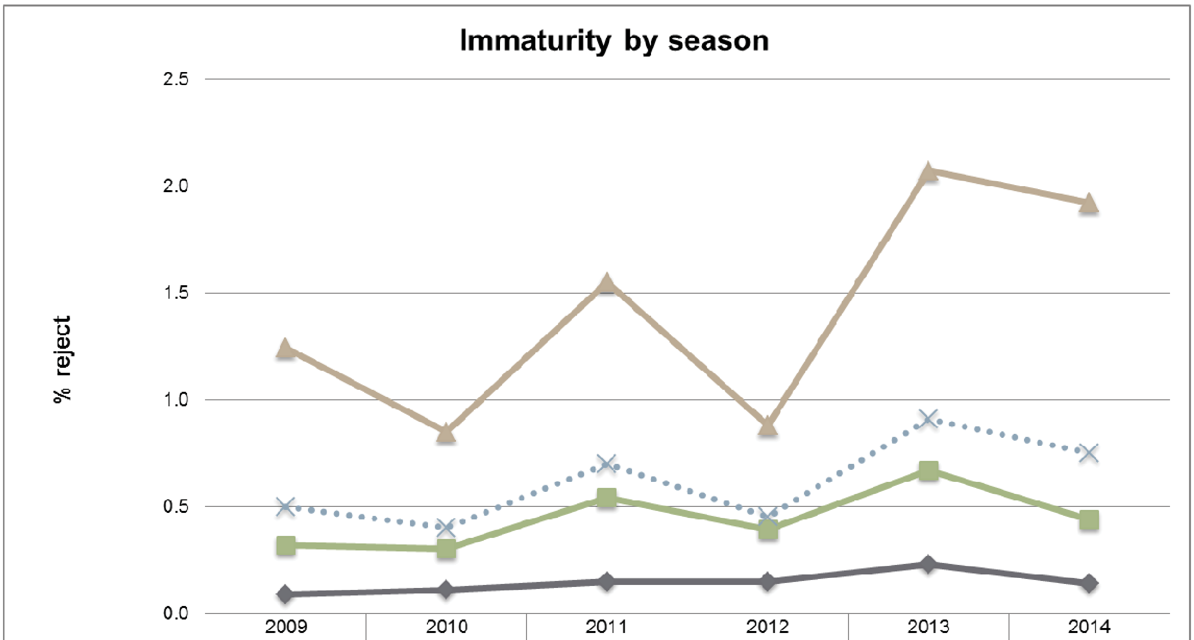
* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Immaturity by season

Figure 6.3-14 shows a comparison of the average level of rejects due to immaturity for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was a decrease in the average level of rejects due to immaturity from 2013 to 2014 for each of the percentiles. As with RKR, the percentiles are inverted (i.e. the lower levels are in the top 25%) as a low level of immaturity represents better quality.

The average level of rejects due to immaturity in 2014 amongst the top 25% was less than in 2013, similar to 2011 and 2012 and higher than in 2009 and 2010. The average level of rejects amongst the middle 50% was less than in 2011 and 2013 and higher than in 2009, 2010 and 2012. The average level of rejects amongst the bottom 25% was slightly lower than in 2013 but substantially higher than in 2009 to 2012.

There was a particularly high level of rejects due to immaturity amongst farms in South East Queensland in 2013 and 2014. Data from productivity groups shows that the high levels of immaturity in this region were largely due to very dry conditions leading to moisture stress during nut growth and development and oil accumulation in the latter parts of 2012 and 2013 following very wet conditions earlier in 2012. Immaturity levels were particularly high amongst farms without access to adequate irrigation and on soils with poor water holding capacity and amongst farms who missed opportune spring storms during key nut growth stages.



	2009	2010	2011	2012	2013	2014
Top 25%	0.09	0.11	0.15	0.15	0.23	0.14
Middle 50%	0.32	0.30	0.54	0.39	0.67	0.44
Bottom 25%	1.24	0.85	1.55	0.88	2.07	1.92
All farms	0.50	0.40	0.70	0.45	0.91	0.75

Figure 6.3-14: Comparison of average immaturity reject levels (2009 to 2014)

Table 6.3-12 shows the statistical differences between the average levels of rejects due to immaturity in the six seasons from 2009 to 2014. The major differences are:

- The average level of rejects due to immaturity in 2014 was significantly more than in 2009, 2010 and 2012, not significantly different to 2011 and significantly less than in 2013.
- The average level of rejects due to immaturity in 2013 was significantly more than in each of the other seasons.
- The average levels of rejects due to immaturity in 2009, 2010 and 2012 were significantly less than each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean
Immaturity %	2009	2010	0.10	0.24	0.50
		2011	-0.20	0.02**	
		2012	0.05	0.63	
		2013	-0.41	0.00***	
		2014	-0.25	0.00***	
	2010	2009	-0.10	0.24	0.40
		2011	-0.31	0.00***	
		2012	-0.05	0.43	
		2013	-0.52	0.00***	
		2014	-0.35	0.00***	
	2011	2009	0.20	0.02**	0.70
		2010	0.31	0.00***	
		2012	0.25	0.00***	
		2013	-0.21	0.01***	
		2014	-0.04	0.58	
	2012	2009	-0.05	0.63	0.45
		2010	0.05	0.43	
		2011	-0.25	0.00***	
		2013	-0.46	0.00***	
		2014	-0.30	0.00***	
	2013	2009	0.41	0.00***	0.91
		2010	0.52	0.00***	
		2011	0.21	0.01***	
		2012	0.46	0.00***	
		2014	0.17	0.02**	
	2014	2009	0.25	0.00***	0.75
		2010	0.35	0.00***	
		2011	0.04	0.58	
		2012	0.309	0.00***	
		2013	-0.17	0.02**	

Table 6.3-12: Comparison of immaturity (%) averages by year

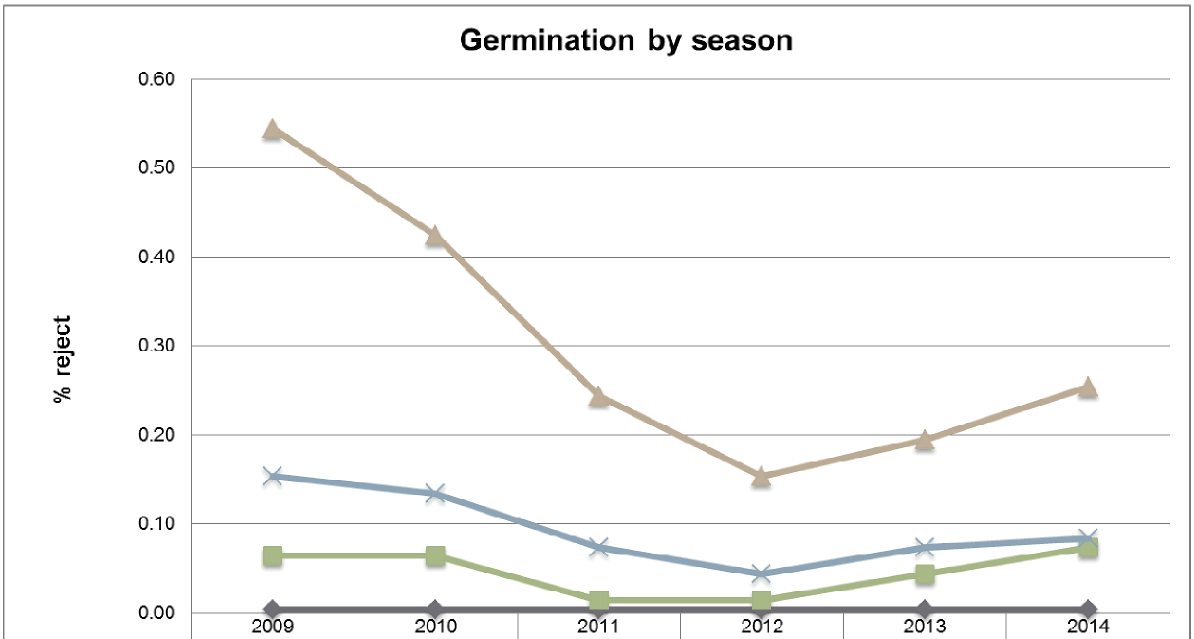
* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Germination by season

Figure 6.3-15 shows a comparison of the average level of rejects due to germination for the top 25%, middle 50% and bottom 25% and all farms in the benchmarking study in each year from 2009 to 2014. There was an increase in the average level of rejects due to germination from 2013 to 2014 amongst the middle 50% and bottom 25% of farms. As with RKR, the percentiles are inverted (i.e. the lower levels are in the top 25%) as a low level of germination represents better quality.

The average level of rejects due to germination was lower than for each of the other reject categories in each year of the benchmarking from 2009 to 2014.

The top 25% of farms averaged no germination reject each year from 2009 to 2014. The average level of rejects in 2014 amongst the middle 50% was higher than in each of the years from 2009 to 2014. The average level of rejects in 2014 amongst the bottom 25% was higher than in 2011 to 2013 but substantially lower than in 2009 and 2010.



	2009	2010	2011	2012	2013	2014
Top 25%	0.00	0.00	0.00	0.00	0.00	0.00
Middle 50%	0.06	0.06	0.01	0.01	0.04	0.07
Bottom 25%	0.54	0.42	0.24	0.15	0.19	0.25
All farms	0.15	0.13	0.07	0.04	0.07	0.08

Figure 6.3-15: Comparison of average germination reject levels (2009 to 2014)

Table 6.3-13 shows the statistical differences between the average levels of rejects due to germination in the six seasons from 2009 to 2014. The major differences are:

- The average level of rejects due to germination in 2014 was significantly less than in 2009 and 2010 and significantly more than in 2012 but not significantly different from 2011 and 2013.
- The average levels of rejects due to germination in 2009 and 2010 were significantly more than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean
Germination %	2009	2010	0.02	0.25	0.15
		2011	0.08	0.00***	
		2012	0.11	0.00***	
		2013	0.08	0.00***	
		2014	0.07	0.00***	
	2010	2009	-0.02	0.25	0.13
		2011	0.06	0.01***	
		2012	0.09	0.00***	
		2013	0.06	0.00***	
		2014	0.05	0.01***	
	2011	2009	-0.08	0.00***	0.07
		2010	-0.06	0.01***	
		2012	0.03	0.13	
		2013	0.00	0.98	
		2014	-0.01	0.62	
	2012	2009	-0.11	0.00***	0.04
		2010	-0.09	0.00***	
		2011	-0.03	0.13	
		2013	-0.03	0.09*	
		2014	-0.04	0.03**	
	2013	2009	-0.08	0.00***	0.07
		2010	-0.06	0.00***	
		2011	0.00	0.98	
		2012	0.03	0.09*	
		2014	-0.01	0.61	
	2014	2009	-0.07	0.00***	0.08
		2010	-0.05	0.01***	
		2011	0.01	0.62	
		2012	0.04	0.03**	
		2013	0.01	0.61	

Table 6.3-13: Comparison of germination (%) averages by year

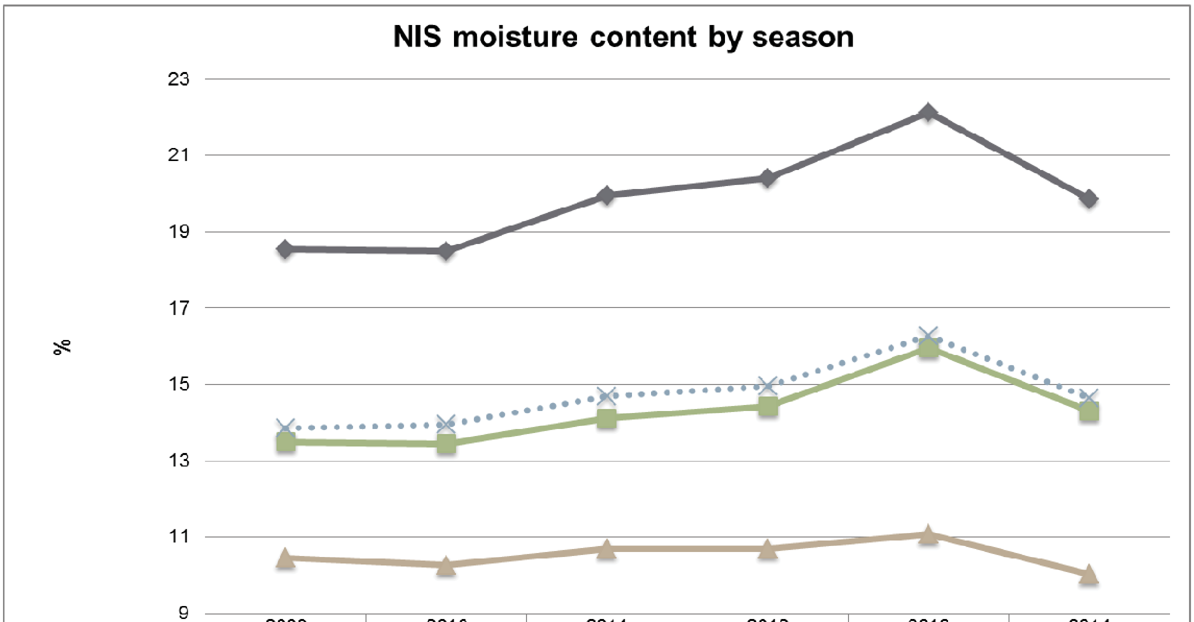
* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

NIS moisture content (NIS MC) by season

Figure 6.3-16 shows a comparison of the average NIS MC at delivery to the processor for the top 25%, middle 50% and bottom 25% and for all participating farms in the benchmarking from 2009 to 2014.

Average NIS MC for all percentile groups was lower in 2014 than in 2013. The average NIS MC for the top 25% of farms was lower in 2014 than in 2012 and 2013, similar to 2011 and higher than in 2009 and 2010. Most of these farms within the top 25% are in the Northern Rivers of New South Wales. As well as seasonal influences, this higher NIS MC in recent years reflects a trend, particularly in the Northern Rivers of New South Wales, to reduce the amount of time spent drying and storing nuts on farm prior to consignment for processing.

The average NIS MC for the middle 50% in 2014 was lower than in 2012 and 2013 but higher than from 2009 to 2011. The average NIS MC for the bottom 25% in 2014 was lower than in each year from 2009 to 2013. Most of the farms in the bottom 25% are located in the Central Queensland region which tends to be drier during the harvest season than the other three regions.



	2009	2010	2011	2012	2013	2014
Top 25%	18.53	18.49	19.94	20.40	22.13	19.85
Middle 50%	13.48	13.44	14.11	14.42	15.95	14.31
Bottom 25%	10.46	10.27	10.69	10.68	11.07	10.03
All farms	13.86	13.95	14.69	14.96	16.27	14.63

Figure 6.3-16: Comparison of average NIS moisture content (2009 to 2014)

Table 6.3-14 shows the statistical differences between the average NIS MC's in the six seasons from 2009 to 2014. The major differences are:

- The average NIS MC in 2014 was significantly less than in 2013 and significantly more than in 2009 and 2010 but not significantly different to 2011 and 2012.
- The average NIS MC in 2013 was significantly more than in each of the other seasons.
- The average NIS MC in 2009 and 2010 was significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean
Moisture content %	2009	2010	-0.09	0.85	13.86
		2011	-0.84	0.06*	
		2012	-1.10	0.01***	
		2013	-2.42	0.00***	
		2014	-0.77	0.06*	
	2010	2009	0.09	0.85	13.95
		2011	-0.75	0.09*	
		2012	-1.01	0.02**	
		2013	-2.33	0.00***	
		2014	-0.68	0.10*	
	2011	2009	0.84	0.06*	14.69
		2010	0.75	0.09*	
		2012	-0.26	0.53	
		2013	-1.58	0.00***	
		2014	0.07	0.87	
	2012	2009	1.10	0.01***	14.96
		2010	1.01	0.02**	
		2011	0.26	0.53	
		2013	-1.32	0.00***	
		2014	0.33	0.39	
	2013	2009	2.42	0.00***	16.27
		2010	2.33	0.00***	
		2011	1.58	0.00***	
		2012	1.32	0.00***	
		2014	1.65	0.00***	
	2014	2009	0.77	0.06*	14.63
		2010	0.68	0.10*	
		2011	-0.07	0.87	
		2012	-0.33	0.39	
		2013	-1.65	0.00***	

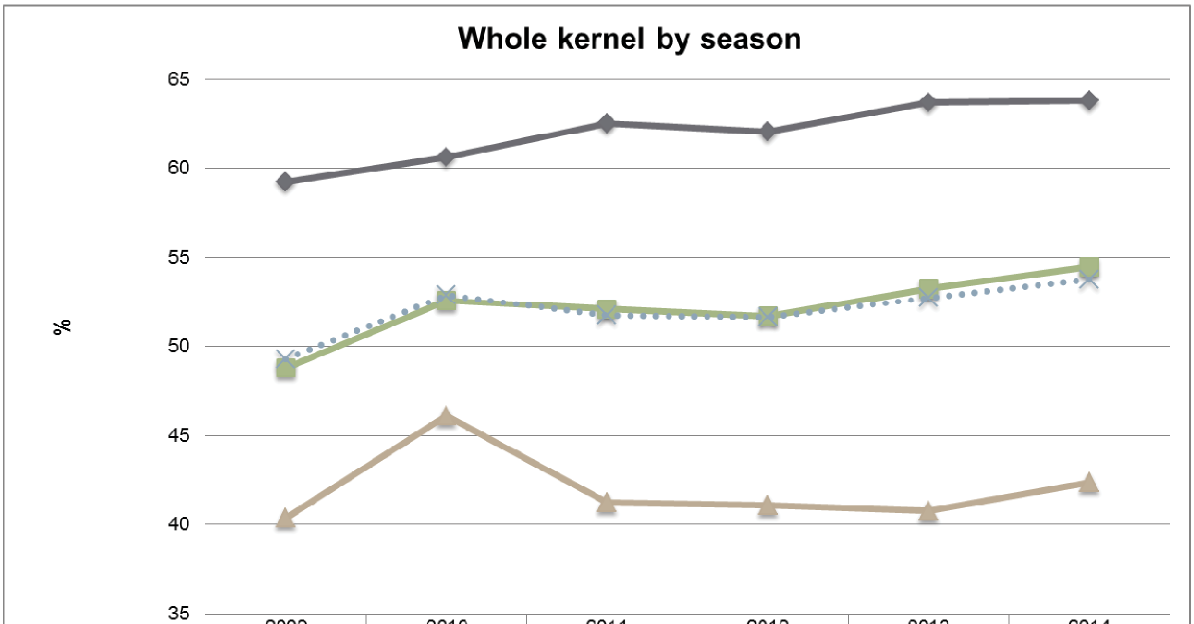
Table 6.3-14: Comparison of consigned moisture content (%) averages by year

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Whole kernel percentage by season

Figure 6.3-17 shows a comparison of the average percentage of whole kernels for the top 25%, middle 50% and bottom 25% and for all farms in the benchmarking survey from 2009 to 2014. There was an increase in the average percentage of whole kernels in each of the percentiles from 2013 to 2014.

The average percentage of whole kernels amongst the top 25% of farms in 2014 was similar to that from 2011 to 2013 and higher than in 2009 and 2010. The average percentage amongst the middle 50% was higher than in each of the previous years. The average percentage amongst the bottom 25% was lower than in 2010 but higher than in each of the other years.



	2009	2010	2011	2012	2013	2014
Top 25%	59.22	60.60	62.53	62.06	63.69	63.77
Middle 50%	48.79	52.59	52.10	51.70	53.26	54.46
Bottom 25%	40.36	46.13	41.22	41.08	40.78	42.37
All farms	49.30	52.89	51.74	51.63	52.74	53.76

Figure 6.3-17: Comparison of average percentage whole kernels (2009 to 2014)

Table 6.3-15 shows the statistical differences between the average percentages of whole kernels in the six seasons from 2009 to 2014. The major differences are:

- The average percentage of whole kernels in 2014 was significantly more than in 2009, 2011 and 2012 but not significantly different from each of the other seasons.
- The average percentage of whole kernels in 2009 was significantly less than in each of the other seasons.

Bearing farms	Least significant difference				
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Whole kernel %	2009	2010	-3.59	0.01***	49.30
		2011	-2.44	0.06*	
		2012	-2.33	0.04**	
		2013	-3.44	0.00***	
		2014	-4.46	0.00***	
	2010	2009	3.59	0.01***	52.89
		2011	1.15	0.37	
		2012	1.26	0.27	
		2013	0.15	0.90	
		2014	-0.87	0.44	
	2011	2009	2.44	0.06*	51.74
		2010	-1.15	0.37	
		2012	0.11	0.92	
		2013	-1.00	0.37	
		2014	-2.02	0.07*	
	2012	2009	2.33	0.04	51.63
		2010	-1.26	0.27	
		2011	-0.11	0.92	
		2013	-1.11	0.25	
		2014	-2.13	0.03**	
	2013	2009	3.44	0.00***	52.74
		2010	-0.15	0.90	
		2011	1.00	0.37	
		2012	1.11	0.25	
		2014	-1.02	0.28	
	2014	2009	4.46	0.00***	53.76
		2010	0.87	0.44	
		2011	2.02	0.07*	
		2012	2.13	0.03**	
		2013	1.02	0.28	

Table 6.3-15: Comparison of whole kernel (%) averages by year

** The mean difference is significant at the 10% level*
*** The mean difference is significant at the 5% level*
**** The mean difference is significant at the 1% level*

6.4 *Results by region*

Yield by region

Regional averages

Table 6.4-1 provides a summary of regional averages for yield criteria analysed in the benchmarking survey. The averages are provided for Central Queensland, South East Queensland, Northern Rivers New South Wales and Mid North Coast New South Wales farms involved in the benchmarking for 2014 and for all years from 2009 to 2014. The yield differences are discussed in detail within this section.

The Central Queensland and South East Queensland farms in the benchmarking had a lower average yield of NIS and saleable and total kernel per hectare in 2014 compared with the average over the six seasons from 2009 to 2014. The Northern Rivers and Mid North Coast of New South Wales farms had a higher average yield per hectare in 2014 than the average from 2009 to 2014.

Regional averages	2014					2009-2014				
	CQ (52)	SEQ (47)	NRNSW (142)	MNNSW (24)	All (265)	CQ (232)	SEQ (259)	NRNSW (700)	MNNSW (133)	All (1324)
NIS tonnes/ha	1.94	2.34	2.77	2.32	2.49	2.15	2.43	2.51	1.92	2.37
Saleable kernel tonnes/ha	0.63	0.72	0.91	0.85	0.82	0.68	0.75	0.79	0.65	0.75
Total kernel tonnes/ha	0.68	0.78	0.97	0.90	0.87	0.74	0.81	0.85	0.72	0.81

Table 6.4-1: Regional yield averages for 2014 and for all years from 2009 to 2014

Figure 6.4-1 shows the ranking trends for farms in each of the major production regions for tonnes of saleable kernel per bearing hectare for 2009 to 2014. Each bar in the ranking chart in figure 6.4-1 represents the average yield per hectare from an individual farm over the six years from 2009 to 2014.

These charts show that highly productive farms are not restricted to any one region. There are farms within each of the four regions that averaged more than one tonne of saleable kernel per bearing hectare between 2009 and 2014. There is also wide variation in the average yield per hectare amongst farms from each region within each season.

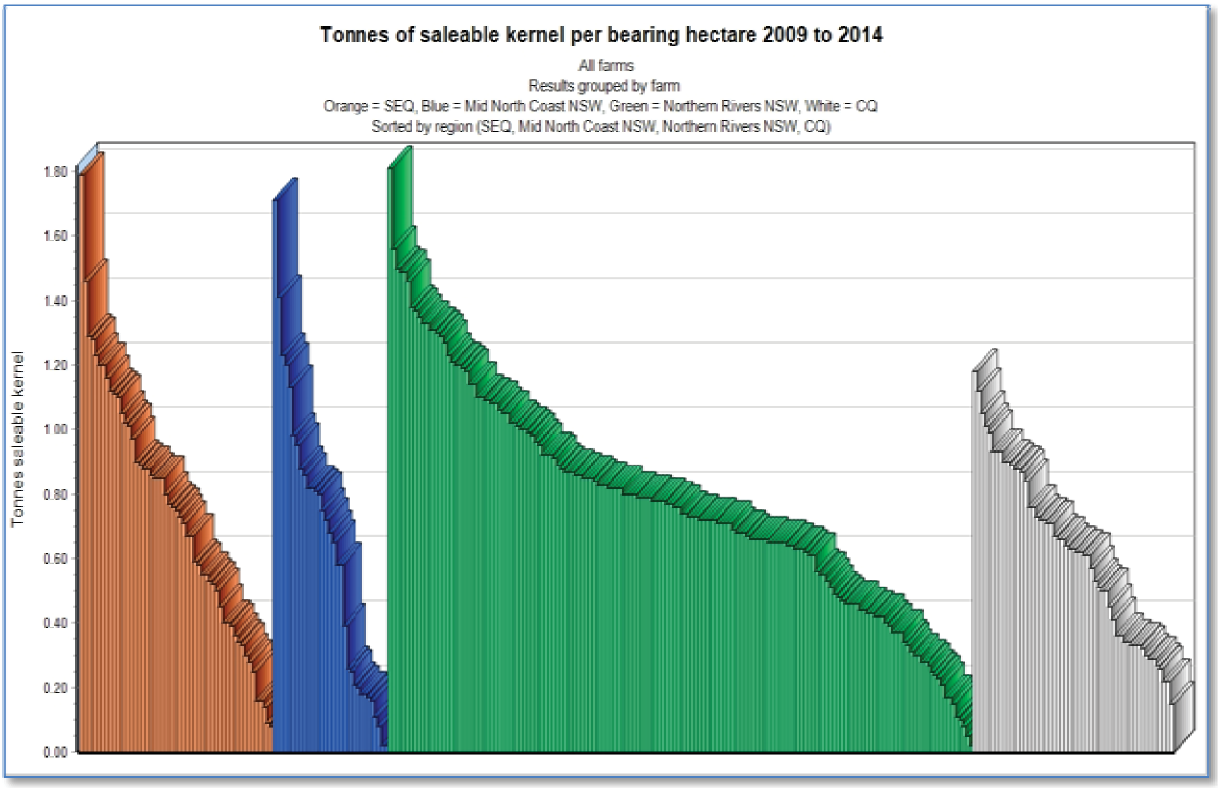


Figure 6.4-1: Saleable kernel per bearing hectare yield trends for farms in different regions for 2009-2014

The comparative analysis undertaken for this report categorises macadamia farm performance in each region for 2014 and the average of all years from 2009 to 2014 into the top 25%, middle 50% and bottom 25% of farms and the four major regions based on yield and quality parameters. The figures in the tables show the averages within each of these categories.

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Nut-in-shell (NIS) tonnes per bearing hectare by region

There were increases in yield from 2013 to 2014 in each of the four regions. The largest increases in yield occurred amongst farms in the Northern Rivers of New South Wales and the Mid North Coast of New South Wales.

Table 6.4-2 shows the average yield of NIS in tonnes per bearing hectare for the top 25%, middle 50% and bottom 25% of participating farms in Central Queensland, the Northern Rivers of New South Wales, the Mid North Coast of New South Wales and South East Queensland in 2014 and for all years from 2009 to 2014.

The average NIS yield per bearing hectare across all regions in 2014 (2.49 tonnes) was higher than the average for the six years from 2009 to 2014 (2.37 tonnes). In 2014, the top 25% of farms averaged 4.16 tonnes, the middle 50% of farms averaged 2.50 tonnes and the bottom 25% averaged only 0.80 tonnes of NIS per bearing hectare. In the six years from 2009 to 2014, the top 25% of farms averaged 4.01 tonnes of NIS, the middle 50% of farms averaged 2.32 tonnes and the bottom 25% averaged 0.83 tonnes per bearing hectare.

Average yields of NIS per bearing hectare in 2014 were also higher in the Northern Rivers and Mid North Coast regions of New South Wales compared with the average corresponding yields from 2009 to 2014. The average yields per hectare in 2014 in the Central and South East Queensland regions were lower than the average yields from 2009 to 2014.

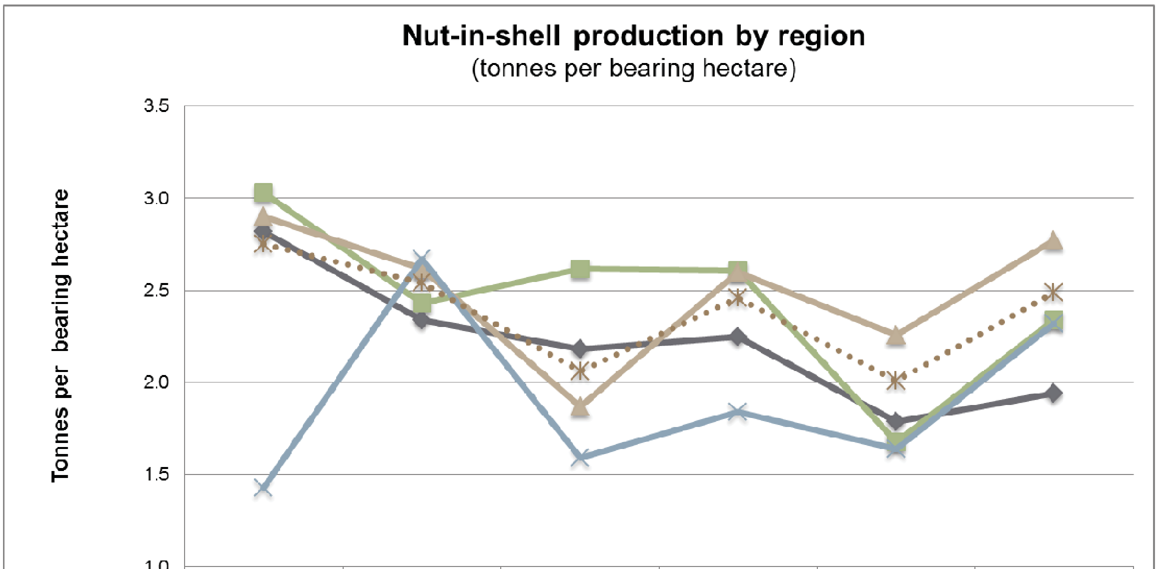
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=47)	**NRNSW** (n=142)	**MNNSW** (n=24)	**All** (n=265)	**CQ** (n=232)	**SEQ** (n=259)	**NRNSW** (n=700)	**MNNSW** (n=133)	**All** (n=1324)
Top 25%	2.93	4.01	4.3	4.99	4.16	3.36	4.18	4.13	3.96	4.01
Middle 50%	1.97	2.46	2.87	1.98	2.50	2.16	2.40	2.46	1.71	2.32
Bottom 25%	0.87	0.58	1.03	0.35	0.80	0.96	0.73	0.99	0.32	0.83
All percentiles	1.94	2.34	2.77	2.32	2.49	2.15	2.43	2.51	1.92	2.37

Table 6.4-2: Average nut-in-shell tonnes per bearing hectare for 2014 and for all years from 2009-2014

CQ=Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales; SEQ = South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-2 shows a comparison of the average yields of NIS per bearing hectare for each year for each of the four major regions. Each region had a higher average yield of NIS per bearing hectare in 2014 than in 2013. Farms in the Central Queensland region had the smallest increase in average NIS yield per hectare in 2014. Farms in the Northern Rivers of New South Wales region had their largest average NIS yield per hectare since 2009. Farms in the Mid North Coast of New South Wales region had their largest average NIS yield per hectare since 2010. Farms in Central and South East Queensland regions had lower average NIS yields per hectare in 2014 than in the years from 2009 to 2012.



	2009	2010	2011	2012	2013	2014
CQ	2.82	2.34	2.18	2.25	1.79	1.94
SEQ	3.03	2.43	2.62	2.61	1.68	2.34
NRNSW	2.90	2.62	1.87	2.60	2.26	2.77
MNNSW	1.43	2.67	1.59	1.84	1.64	2.32
All regions	2.75	2.54	2.06	2.46	2.01	2.49

Figure 6.4-2: Comparison of average regional yields of tonnes of nut-in-shell (NIS) per bearing hectare (2009 to 2014)

Table 6.4-3 shows a total of 1324 farm years from 2009 to 2014. A farm year describes the records for an individual farm for a given year. There were 232 (17.5%) of the total farm years from 2009 to 2014 in Central Queensland, 259 (19.6%) from South East Queensland, 700 (52.9%) from the Northern Rivers of New South Wales and 133 (10%) from the Mid North Coast of New South Wales.

Central Queensland farms were concentrated more in the middle 50% of farm years (21.4%) and less concentrated in the top 25% (10.2%) for NIS tonnes per hectare. South East Queensland farms were concentrated more towards the top 25% of farm years (22.3%). Mid North Coast of New South Wales farms had a higher relative proportion in the bottom 25% (18.7%). Northern Rivers of New South Wales farms had a higher relative proportion in the top 25% (60.2%) and a lower relative proportion in the bottom 25% (44.6%).

The relationship between the tonnes of NIS per hectare and region is statistically significant.

NIS tonnes per hectare	Total farm years = 1324	Top 25% (>=3.16)	Middle 50% (>=1.46 to< 3.16)	Bottom 25% (<1.46)	Total
CQ	Farm year	34	141	57	232
	% within percentile	10.2%	21.4%	17.2%	17.5%
	% of total	2.6%	10.6%	4.3%	17.5%
SEQ	Count	74	120	65	259
	% within percentile	22.3%	18.2%	19.6%	19.6%
	% of total	5.6%	9.1%	4.9%	19.6%
NRNSW	Farm year	200	352	148	700
	% within percentile	60.2%	53.3%	44.6%	52.9%
	% of total	15.1%	26.6%	11.2%	52.9%
MNNSW	Farm year	24	47	62	133
	% within percentile	7.2%	7.1%	18.7%	10.0%
	% of total	1.8%	3.5%	4.7%	10.0%
Total	Farm year	332	660	332	1324
	% of total	25.1%	49.8%	25.1%	100.0%

Table 6.4-3: Cross tabulation nut-in-shell tonnes per hectare by percentile and region

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Table 6.4-4 shows the statistical differences between the average NIS tonnes per hectare in the four regions for all seasons from 2009 to 2014. The major differences are:

- The Northern Rivers of New South Wales and South East Queensland farms had a significantly higher average NIS tonnes per hectare than the Central Queensland and Mid North Coast of New South Wales farms.
- There was no significant difference in the average NIS tonnes per hectare between the Northern Rivers of New South Wales and South East Queensland farms.
- There was no significant difference in the average NIS tonnes per hectare between the Central Queensland and Mid North Coast of New South Wales farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Nut-in-shell tonnes per hectare	CQ	SEQ	-0.28	0.01***	CQ	2.15
		NRNSW	-0.36	0.00***		
		MNNSW	0.22	0.10		
	SEQ	CQ	0.28	0.01***	SEQ	2.43
		NRNSW	-0.08	0.37		
		MNNSW	0.50	0.00***		
	NRNSW	CQ	0.36	0.01***	NRNSW	2.51
		SEQ	0.08	0.37		
		MNNSW	0.58	0.00***		
	MNNSW	CQ	-0.22	0.10	MNNSW	1.92
		SEQ	-0.50	0.00***		
		NRNSW	-0.58	0.00***		

Table 6.4-4: Comparison of regional average farm NIS tonnes per hectare for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Saleable kernel tonnes per bearing hectare by region

Table 6.4-5 shows the average yield of saleable kernel in tonnes per bearing hectare for the top 25%, middle 50% and bottom 25% of participating farms in Central Queensland, South East Queensland, the Northern Rivers of New South Wales and the Mid North Coast of New South Wales in 2014 and for all years from 2009 to 2014. Saleable kernel in the benchmarking study includes both premium kernel and commercial kernel.

As with yields of NIS, the average yield of saleable kernel per bearing hectare across all regions in 2014 (0.82 tonnes) was higher than the average yield from 2009 to 2014 (0.75 tonnes). In 2014, the top 25% of farms averaged 1.42 tonnes, the middle 50% of farms averaged 0.81 tonnes and the bottom 25% averaged only 0.25 tonnes of saleable kernel per bearing hectare. In the six years from 2009 to 2014, the top 25% of farms averaged 1.31 tonnes, the middle 50% of farms averaged 0.72 tonnes and the bottom 25% averaged only 0.25 tonnes of saleable kernel per bearing hectare.

Average yields of saleable kernel per bearing hectare in 2014 were higher in the Northern Rivers and Mid North Coast of New South Wales and lower in Central and South East Queensland compared with the average regional yields per hectare from 2009 to 2014.

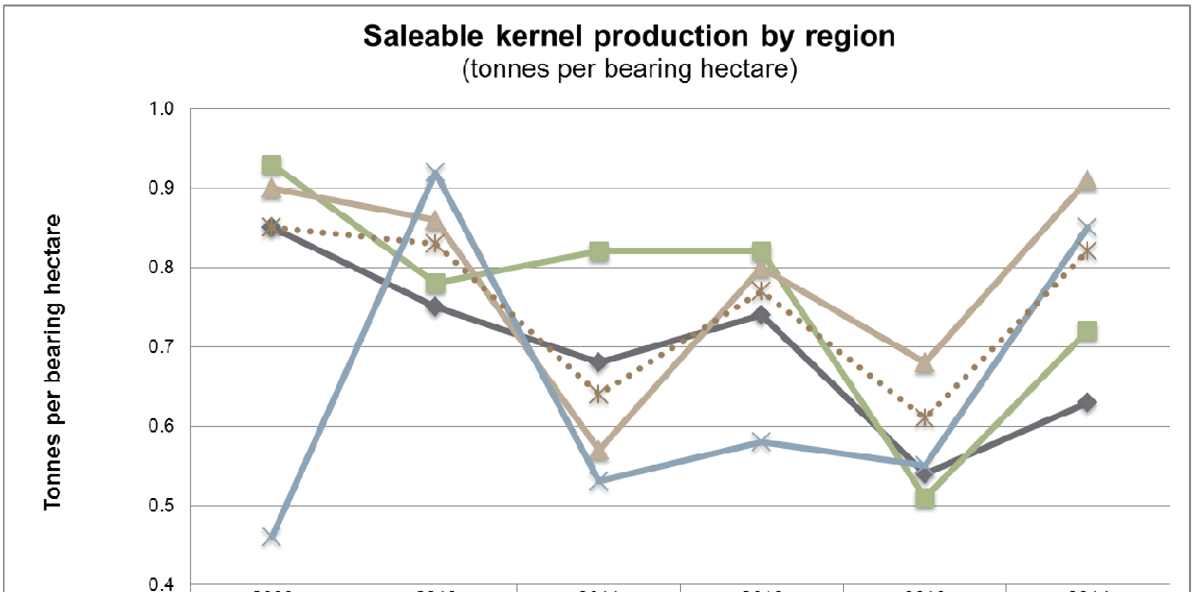
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=47)	**NRNSW** (n=142)	**MNNSW** (n=24)	**All** (n=265)	**CQ** (n=232)	**SEQ** (n=259)	**NRNSW** (n=700)	**MNNSW** (n=133)	**All** (n=1324)
Top 25%	0.97	1.25	1.48	1.90	1.42	1.07	1.33	1.34	1.40	1.31
Middle 50%	0.63	0.73	0.93	0.70	0.81	0.68	0.74	0.76	0.56	0.72
Bottom 25%	0.29	0.16	0.33	0.11	0.25	0.30	0.22	0.30	0.09	0.25
All percentiles	0.63	0.72	0.91	0.85	0.82	0.68	0.75	0.79	0.65	0.75

Table 6.4-5: Average saleable kernel tonnes per bearing hectare for 2014 and for all years from 2009 - 2014

CQ=Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales; SEQ = South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-3 shows a comparison of the average yields of saleable kernel per bearing hectare from 2009 to 2014 for each of the four regions. Farms in each region had an increase in average yield per bearing hectare in 2014 compared with 2013. Farms in the Central Queensland region had the smallest increase in average yield per hectare in 2014. Northern Rivers Farms had their largest average yield per hectare since the benchmarking began in 2009. Mid North Coast farms had their largest average yield per hectare since 2010. Farms in Central and South East Queensland had lower average yields per hectare in 2014 than in the years from 2009 to 2012.



	2009	2010	2011	2012	2013	2014
CQ	0.85	0.75	0.68	0.74	0.54	0.63
SEQ	0.93	0.78	0.82	0.82	0.51	0.72
NRNSW	0.90	0.86	0.57	0.80	0.68	0.91
MNNSW	0.46	0.92	0.53	0.58	0.55	0.85
All regions	0.85	0.83	0.64	0.77	0.61	0.82

Figure 6.4-3: Comparison of average regional yields of tonnes of saleable kernel per bearing hectare (2009 to 2014)

Table 6.4-6 shows that Central Queensland farm years were more concentrated in the middle 50% (21.2%) and less concentrated in the top 25% (10.7%) from 2009 to 2014. South East Queensland had a higher proportion in the top 25% (20.7%) and Mid North Coast New South Wales had a higher proportion in the bottom 25% (17.2%) of farm years. Northern Rivers of New South Wales farm years were also more concentrated in the top 25% (59.5%) and less concentrated in the bottom 25% (46.9%) for tonnes of saleable kernel per hectare.

This relationship between tonnes of saleable kernel per hectare and region is statistically significant.

Saleable kernel tonnes per hectare	Total farm years = 1324	Top 25% (>=1.01)	Middle 50% (>=0.44 to <1.01)	Bottom 25% (<0.44)	Total
CQ	Farm year	35	140	57	232
	% within percentile	10.7%	21.2%	16.9%	17.5%
	% of total	2.6%	10.6%	4.3%	17.5%
SEQ	Farm year	68	127	64	259
	% within percentile	20.7%	19.3%	19.0%	19.6%
	% of total	5.1%	9.6%	4.8%	19.6%
NRNSW	Farm year	195	347	158	700
	% within percentile	59.5%	52.7%	46.9%	52.9%
	% of total	14.7%	26.2%	11.9%	52.9%
MNNSW	Farm year	30	45	58	133
	% within percentile	9.1%	6.8%	17.2%	10.0%
	% of total	2.3%	3.4%	4.4%	10.0%
Total	Farm year	328	659	337	1324
	% of total	24.8%	49.8%	25.5%	100.0%

Table 6.4-6: Cross tabulation saleable kernel tonnes per hectare by percentile and region

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Table 6.4-7 shows the statistical differences between the average saleable kernel tonnes per hectare in the four regions for all seasons from 2009 to 2014. The major differences are:

- The Northern Rivers and South East Queensland farms had a significantly higher average saleable kernel tonnes per hectare than Central Queensland and Mid North Coast farms.
- There was no significant difference in average saleable kernel tonnes per hectare between the Northern Rivers and South East Queensland farms.
- There was no significant difference in average saleable kernel tonnes per hectare between Central Queensland and Mid North Coast farms.

Bearing farms	Least significant difference					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Saleable kernel tonnes per hectare	CQ	SEQ	-0.08	0.04**	CQ	0.68
		NRNSW	-0.11	0.00***		
		MNNSW	0.03	0.57		
	SEQ	CQ	0.08	0.04**	SEQ	0.75
		NRNSW	-0.03	0.27		
		MNNSW	0.10	0.02**		
	NRNSW	CQ	0.11	0.00***	NRNSW	0.79
		SEQ	0.03	0.27		
		MNNSW	0.13	0.00***		
	MNNSW	CQ	-0.03	0.57	MNNSW	0.65
		SEQ	-0.10	0.02**		
		NRNSW	-0.13	0.00***		

Table 6.4-7: Comparison of regional average farm saleable kernel tonnes per hectare for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Total kernel tonnes per bearing hectare

Table 6.4-8 shows the average yield of total kernel in tonnes per hectare for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, Northern Rivers of New South Wales, Mid North Coast of New South Wales and South East Queensland in 2014 and the average for all years from 2009 to 2014.

As with yields of NIS and saleable kernel, the average yield of total kernel per bearing hectare in 2014 across all regions (0.87 tonnes) was higher than the average from 2009 to 2014 (0.81 tonnes).

Average yields of total kernel per bearing hectare in 2014 were higher in Northern Rivers and Mid North Coast farms and lower in Central and South East Queensland farms compared with the average regional yields from 2009 to 2014.

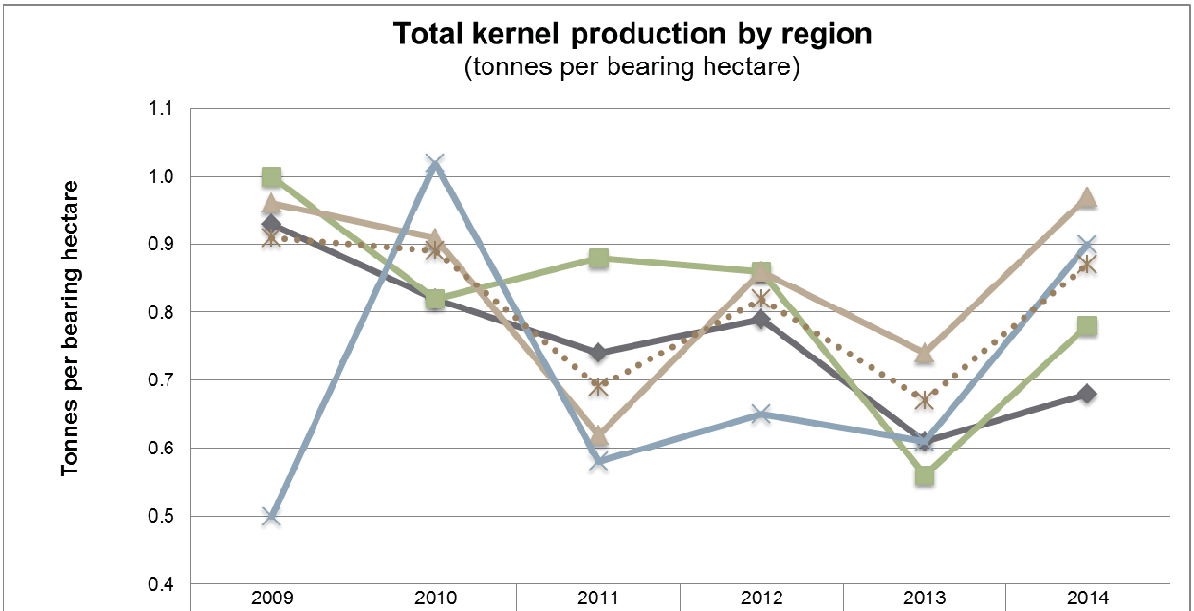
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=47)	**NRNSW** (n=142)	**MNNSW** (n=24)	**All** (n=265)	**CQ** (n=232)	**SEQ** (n=259)	**NRNSW** (n=700)	**MNNSW** (n=133)	**All** (n=1324)
Top 25%	1.06	1.33	1.55	1.99	1.49	1.15	1.40	1.42	1.55	1.39
Middle 50%	0.69	0.81	1.00	0.75	0.87	0.74	0.79	0.82	0.62	0.78
Bottom 25%	0.32	0.20	0.36	0.12	0.28	0.33	0.24	0.32	0.10	0.28
All percentiles	0.68	0.78	0.97	0.90	0.87	0.74	0.81	0.85	0.72	0.81

Table 6.4-8: Average total kernel tonnes per bearing hectare for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-4 shows that farms in each region had an increase in average yield of total kernel per bearing hectare in 2014 compared to 2013. Farms in the Central Queensland region had the smallest increase in average yield per hectare in 2014. Farms in the Northern Rivers region had their largest average yield per hectare since benchmarking began in 2009. Farms in the Mid North Coast region had their largest average yield per hectare since 2010. Farms in Central and South East Queensland had lower average yields per hectare in 2014 than in the years from 2009 to 2012.



	2009	2010	2011	2012	2013	2014
CQ	0.93	0.82	0.74	0.79	0.61	0.68
SEQ	1.00	0.82	0.88	0.86	0.56	0.78
NRNSW	0.96	0.91	0.62	0.86	0.74	0.97
MNNSW	0.50	1.02	0.58	0.65	0.61	0.90
All regions	0.91	0.89	0.69	0.82	0.67	0.87

Figure 6.4-4: Comparison of average regional yields of tonnes of total kernel per bearing hectare (2009 to 2014)

Table 6.4-9 shows the statistical differences between the average total kernel tonnes per hectare in the four regions for all seasons from 2009 to 2014. The major differences are:

- Northern Rivers and South East Queensland farms had a significantly higher average total kernel tonnes per hectare than the Central Queensland and Mid North Coast farms.
- There was no significant difference in the average total kernel tonnes per hectare between Northern Rivers and South East Queensland farms.
- There was no significant difference in the average total kernel tonnes per hectare between the Central Queensland and Mid North Coast farms

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Total kernel tonnes per hectare	CQ	SEQ	-0.07	0.08**	CQ	0.74
		NRNSW	-0.11	0.00***		
		MNNSW	0.02	0.65		
	SEQ	CQ	0.07	0.08**	SEQ	0.81
		NRNSW	-0.04	0.23		
		MNNSW	0.09	0.05*		
	NRNSW	CQ	0.11	0.00***	NRNSW	0.85
		SEQ	0.04	0.23		
		MNNSW	0.13	0.00***		
	MNNSW	CQ	-0.02	0.65	MNNSW	0.72
		SEQ	-0.09	0.05*		
		NRNSW	-0.13	0.00***		

Table 6.4-9: Comparison of regional average farm total kernel tonnes per hectare for all seasons combined

** The mean difference is significant at the 10% level*
*** The mean difference is significant at the 5% level*
**** The mean difference is significant at the 1% level*

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Quality by region

Table 6.4-10 provides a summary of regional averages for quality criteria analysed in the benchmarking survey. The averages are provided for Central Queensland, South East Queensland, Northern Rivers of New South Wales and Mid North Coast of New South Wales farms involved in the benchmarking for 2014 and for all years from 2009 to 2014. The quality differences are discussed in detail within this section.

Regional averages	2014					2009-2014				
	CQ	SEQ	NRNSW	MNNSW	All	CQ	SEQ	NRNSW	MNNSW	All
Saleable KR %	34.86	32.02	34.94	38.10	34.70	34.01	33.02	33.25	35.03	33.52
Premium KR %	32.20	30.36	30.70	32.36	31.09	31.44	31.86	29.69	30.93	30.54
Commercial KR %	2.65	1.66	4.24	5.74	3.61	2.56	1.15	3.56	4.10	2.97
Reject KR %	2.72	3.41	2.56	2.71	2.76	2.93	2.72	2.72	3.42	2.82
Moisture %	11.26	13.10	17.20	11.86	14.63	12.05	13.35	17.13	12.46	14.83
Whole kernel %	48.79	52.34	54.44	60.94	53.76	51.62	50.53	52.11	60.92	52.25
Insect damage %	0.68	0.50	0.79	0.96	0.73	0.58	0.73	0.94	1.48	0.89
Mould %	0.40	0.59	0.55	0.43	0.51	0.40	0.39	0.34	0.50	0.38
Discolouration %	0.32	0.09	0.30	0.22	0.26	0.51	0.26	0.30	0.31	0.33
Brown centres %	0.65	0.23	0.40	0.45	0.42	0.99	0.32	0.45	0.35	0.51
Immaturity %	0.61	1.95	0.43	0.56	0.75	0.49	0.99	0.57	0.59	0.64
Germination %	0.08	0.05	0.09	0.09	0.08	0.05	0.07	0.09	0.19	0.09

Table 6.4-10: Regional quality averages for 2014 and for all years from 2009 to 2014

CQ = Central Queensland; SEQ= South East Queensland; NRNSW = Northern Rivers New South Wales; and MNNSW = Mid North Coast New South Wales

Saleable kernel recovery (SKR) by region

Table 6.4-11 shows the average SKR for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers of New South Wales and Mid North Coast of New South Wales in 2014 and for all years from 2009 to 2014. Saleable kernel recovery is equivalent to the sum of premium (PKR) and commercial (CKR) kernel recovery in the benchmarking study.

The average SKR in 2014 (34.70%) was higher than the average from 2009 to 2014 (33.52%).

Average SKR was higher among Central Queensland, Northern Rivers and Mid North Coast farms and lower for South East Queensland farms in 2014 compared with the average SKR from 2009 to 2014.

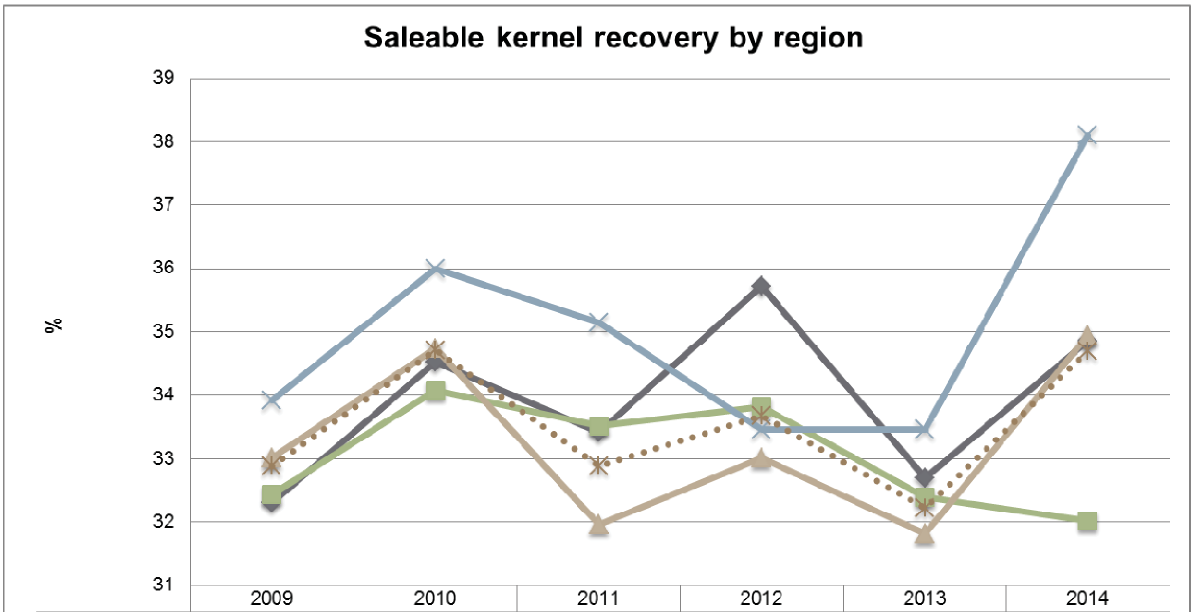
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=46)	**NRNSW** (n=141)	**MNNSW** (n=24)	**All** (n=263)	**CQ** (n=232)	**SEQ** (n=255)	**NRNSW** (n=698)	**MNNSW** (n=131)	**All** (n=1316)
Top 25%	38.63	35.98	39.46	42.68	39.54	37.87	37.00	38.03	40.45	38.23
Middle 50%	35.35	32.68	34.56	39.58	34.57	34.01	33.10	33.05	35.85	33.43
Bottom 25%	30.87	26.85	31.17	31.54	30.18	30.14	28.87	28.88	28.00	28.96
All percentiles	34.86	32.02	34.94	38.10	34.70	34.01	33.02	33.25	35.03	33.52

Table 6.4-11: Average saleable kernel recovery (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-5 shows a comparison of the average SKR from 2009 to 2014 for each of the four regions. The average SKR was higher in 2014 in Central Queensland, Northern Rivers and Mid North Coast and lower in South East Queensland than in 2013. Mid North Coast farms had the highest average SKR of all the regions in 2014. This is influenced by the high percentage of “A” series cultivars bred by Hidden Valley Plantations grown in this region, which tend to have high kernel recoveries. There was also a major reduction in the average reject kernel recovery (RKR) from 2013 to 2014 amongst the Mid North Coast farms.



	2009	2010	2011	2012	2013	2014
CQ	32.30	34.53	33.42	35.72	32.69	34.86
SEQ	32.44	34.07	33.52	33.81	32.39	32.02
NRNSW	33.01	34.74	31.96	33.01	31.81	34.94
MNNSW	33.92	35.99	35.14	33.45	33.45	38.10
All regions	32.88	34.71	32.88	33.67	32.22	34.70

Figure 6.4-5: Comparison of average regional saleable kernel recoveries (2009 to 2014)

Table 6.4-12 shows that Central Queensland farms had a higher relative proportion in the middle 50% (21.0%) and a lower relative proportion in the bottom 25% (10.8%) of farm years for SKR from 2009 to 2014. Mid North Coast farms had a higher relative proportion of farm years in the top 25% (20.6%) for SKR. South East Queensland farms had a higher relative proportion in the middle 50% (21.6%) and a lower relative proportion in the top 25% (15.0%). Northern Rivers farms had a higher relative proportion in the bottom 25% (60.2%) and a lower relative proportion in the top 25% (46.6%) of farm years for SKR.

This relationship between SKR and region is statistically significant.

Saleable kernel recovery %	Total farms years = 1316	Top 25% (=>35.99)	Middle 50% (>=31.01 to < 35.99)	Bottom 25% (< 31.01)	Total
CQ	Farm year	58	138	36	232
	% within percentile	17.8%	21.0%	10.8%	17.6%
	% of total	4.4%	10.5%	2.7%	17.6%
SEQ	Farm year	49	142	64	255
	% within percentile	15.0%	21.6%	19.3%	19.4%
	% of total	3.7%	10.8%	4.9%	19.4%
NRNSW	Farm year	152	346	200	698
	% within percentile	46.6%	52.6%	60.2%	53.0%
	% of total	11.6%	26.3%	15.2%	53.0%
MNNSW	Farm year	67	32	32	131
	% within percentile	20.6%	4.9%	9.6%	10.0%
	% of total	5.1%	2.4%	2.4%	10.0%
Total	Farm year	326	658	332	1316
	% of total	24.8%	50.0%	25.2%	100.0%

Table 6.4-12: Cross tabulation saleable kernel recovery by percentile and region

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Table 6.4-13 shows the statistical differences between average SKR in the four regions for all seasons from 2009 to 2014. The major differences are:

- Mid North Coast farms had a significantly higher average SKR than the farms from the other three regions.
- South East Queensland and Northern Rivers farms had a significantly lower average SKR than Central Queensland farms.

Figure 6.1-5 shows that farms in the benchmarking in the Mid North Coast and Central Queensland regions have a younger average tree age than farms in the South East Queensland and Northern Rivers regions. Table 6.5-4 shows that farms with a younger average tree age have a higher SKR than older farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Saleable kernel recovery %	CQ	SEQ	0.99	0.00***	CQ	34.01
		NRNSW	0.76	0.01***		
		MNNSW	-1.02	0.01**		
	SEQ	CQ	-0.99	0.00***	SEQ	33.02
		NRNSW	-0.23	0.38		
		MNNSW	-2.01	0.00***		
	NRNSW	CQ	-0.76	0.01***	NRNSW	33.25
		SEQ	0.23	0.38		
		MNNSW	-1.78	0.00***		
	MNNSW	CQ	1.02	0.01**	MNNSW	35.03
		SEQ	2.01	0.00***		
		NRNSW	1.78	0.00***		

Table 6.4-13: Comparison of regional average saleable kernel recovery (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Premium kernel recovery (PKR) by region

Table 6.4-14 shows the average premium kernel recovery (PKR) for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all years from 2009 to 2014.

The average PKR in 2014 (31.09%) was higher than the average from 2009 to 2014 (30.54%).

Average PKR was higher in 2014 in Central Queensland, Northern Rivers and Mid North Coast regions and lower in South East Queensland compared to the average PKR from 2009 to 2014.

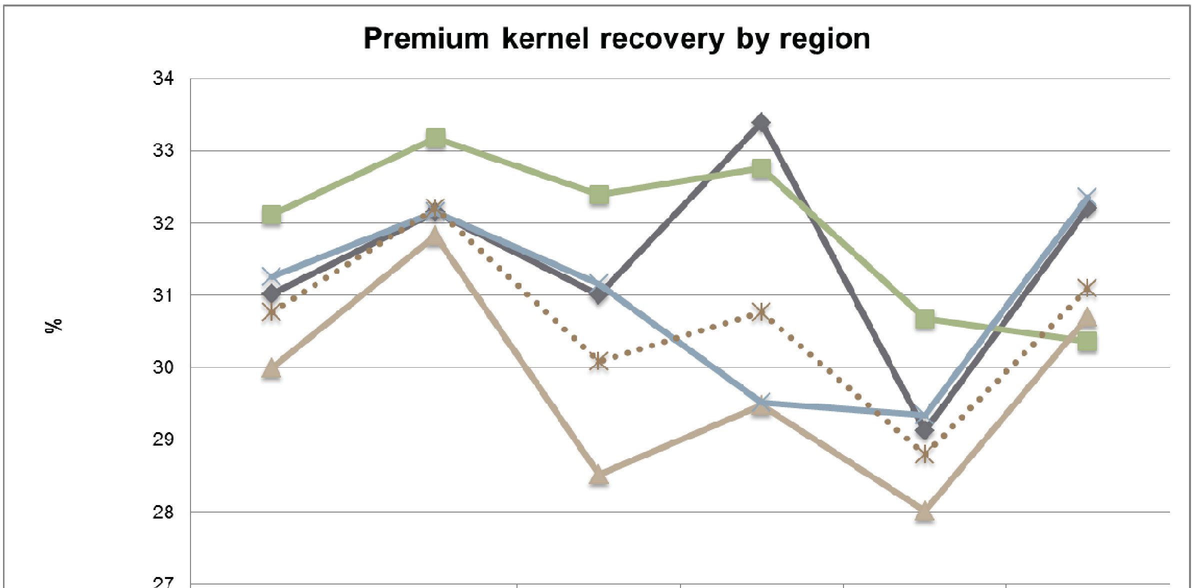
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=46)	**NRNSW** (n=141)	**MNNSW** (n=24)	**All** (n=263)	**CQ** (n=232)	**SEQ** (n=255)	**NRNSW** (n=698)	**MNNSW** (n=131)	**All** (n=1316)
Top 25%	36.25	34.80	35.03	37.03	35.50	35.67	36.27	34.46	35.97	35.34
Middle 50%	32.40	31.08	30.45	32.27	31.11	31.41	32.08	29.50	31.24	30.50
Bottom 25%	28.36	24.61	26.86	27.86	26.64	27.29	27.08	25.28	25.27	25.78
All percentiles	32.20	30.36	30.70	32.36	31.09	31.44	31.86	29.69	30.93	30.54

Table 6.4-14: Average premium kernel recovery (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-6 shows a comparison of the average PKR from 2009 to 2014 for each of the four regions. The average PKR was higher in 2014 in Central Queensland, Northern Rivers and Mid North Coast and lower in South East Queensland than in 2013. The lower PKR in South East Queensland in 2013 and 2014 was largely due to the increased reject kernel recovery (RKR) in those years. This was mainly driven by the increase in the reject levels due to immaturity in that region.



	2009	2010	2011	2012	2013	2014
CQ	31.02	32.15	31.01	33.39	29.12	32.20
SEQ	32.12	33.18	32.39	32.76	30.67	30.36
NRNSW	29.99	31.83	28.52	29.48	28.02	30.70
MNNSW	31.25	32.15	31.15	29.51	29.34	32.36
All regions	30.76	32.20	30.08	30.76	28.80	31.09

Figure 6.4-6: Comparison of average regional premium kernel recoveries (2009 to 2014)

Table 6.4-15 shows that Central Queensland (22.3%), Mid North Coast of New South Wales (12%) and South East Queensland (29.5%) farms had higher relative proportions of farm years in the top 25% and a lower relative proportion in the bottom 25% for PKR from 2009 to 2014. Northern Rivers farms had a higher relative proportion in the bottom 25% (71.4%) and a lower relative proportion in the top 25% (36.1%) of farm years for PKR.

This relationship between PKR and region is statistically significant.

Premium kernel recovery %	Total farm years = 1316	Top 25% (>=33.20	Middle 50% (>=28.05 to <33.20)	Bottom 25% (<28.05)	Total
CQ	Farm year	74	123	35	232
	% within percentile	22.3%	18.8%	10.6%	17.6%
	% of total	5.6%	9.3%	2.7%	17.6%
SEQ	Farm year	98	129	28	255
	% within percentile	29.5%	19.7%	8.5%	19.4%
	% of total	7.4%	9.8%	2.1%	19.4%
NRNSW	Farm year	120	343	235	698
	% within percentile	36.1%	52.4%	71.4%	53.0%
	% of total	9.1%	26.1%	17.9%	53.0%
MNNSW	Farm year	40	60	31	131
	% within percentile	12.0%	9.2%	9.4%	10.0%
	% of total	3.0%	4.6%	2.4%	10.0%
Total	Farm year	332	655	329	1316
	% of total	25.2%	49.8%	25.0%	100.0%

Table 6.4-15: Cross tabulation premium kernel recovery by percentile and region

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Table 6.4-16 shows the statistical differences between the average PKR's in the four regions for all seasons from 2009 to 2014. The major differences are:

- South East Queensland farms had a significantly higher average PKR than Northern Rivers and Mid North Coast farms.
- Central Queensland and Mid North Coast farms had a significantly higher average PKR than Northern Rivers farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Premium kernel recovery %	CQ	SEQ	-0.42	0.21	CQ	31.44
		NRNSW	1.76	0.00***		
		MNNSW	0.51	0.20		
	SEQ	CQ	0.42	0.21	SEQ	31.86
		NRNSW	2.17	0.00***		
		MNNSW	0.93	0.02**		
	NRNSW	CQ	-1.76	0.00***	NRNSW	29.69
		SEQ	-2.17	0.00***		
		MNNSW	-1.24	0.00***		
	MNNSW	CQ	-0.51	0.20	MNNSW	30.93
		SEQ	-0.93	0.02**		
		NRNSW	1.24	0.00***		

Table 6.4-16: Comparison of regional average premium kernel recovery (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Commercial kernel recovery (CKR) by region

Table 6.4-17 shows the average commercial kernel recovery (CKR) for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers of New South Wales, and Mid North Coast of New South Wales in 2014 and for all years from 2009 to 2014.

Average CKR in 2014 (3.61%) was greater than the average from 2009 to 2014 (2.97%). This reflected 2014 CKR increases across all of the regions.

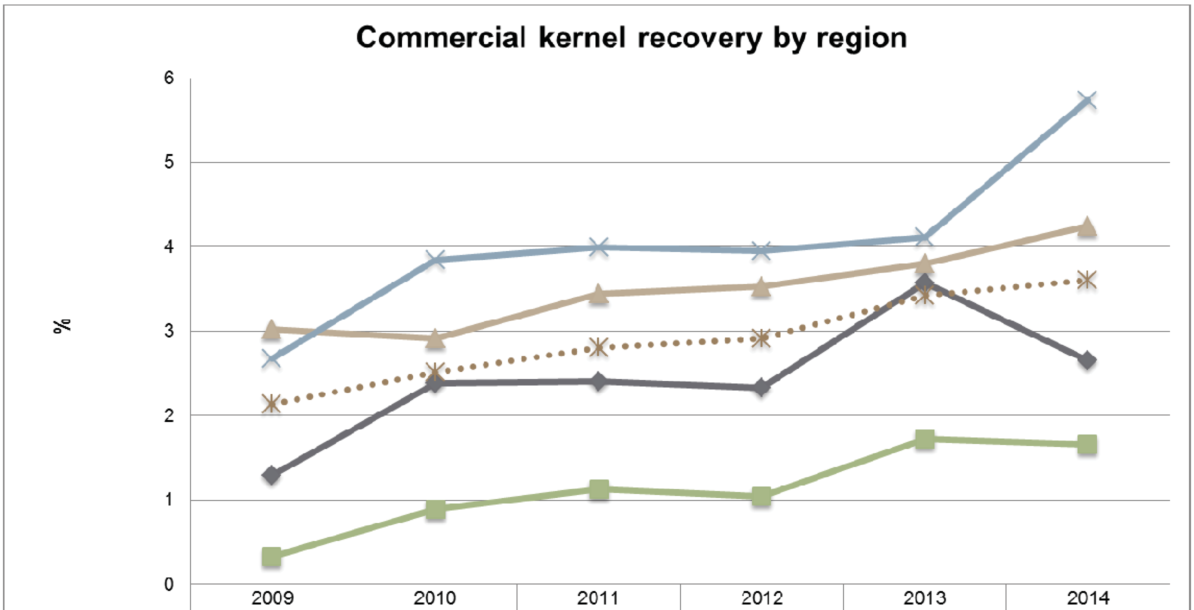
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=46)	**NRNSW** (n=141)	**MNNSW** (n=24)	**All** (n=263)	**CQ** (n=232)	**SEQ** (n=255)	**NRNSW** (n=698)	**MNNSW** (n=131)	**All** (n=1316)
Top 25%	3.80	3.66	7.55	9.60	6.89	4.21	2.94	5.99	7.58	5.61
Middle 50%	2.62	1.57	3.98	4.80	3.18	2.64	1.14	3.40	3.73	2.80
Bottom 25%	1.57	0.00	1.77	2.97	1.24	0.78	0.00	1.52	1.34	0.63
All percentiles	2.65	1.66	4.24	5.74	3.61	2.56	1.15	3.56	4.10	2.97

Table 6.4-17: Average commercial kernel recovery (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-7 shows a comparison of the average CKR from 2009 to 2014 for each of the four regions. The average CKR increased significantly from 2009 to 2014 in each of the regions. South East Queensland farms had the lowest average CKR levels each year from 2009 to 2014. It is important to note that one processor in South East Queensland does not report CKR so that will reduce potential average CKR levels in that region. Another processor based in South East Queensland only began reporting CKR in 2010. Mid North Coast farms had the highest average CKR from 2010 to 2014, including a substantial increase from 2013 to 2014. Central Queensland farms had a decrease in average CKR from 2013 to 2014.



	2009	2010	2011	2012	2013	2014
CQ	1.29	2.38	2.41	2.33	3.57	2.65
SEQ	0.33	0.89	1.13	1.04	1.72	1.66
NRNSW	3.02	2.91	3.44	3.53	3.80	4.24
MNNSW	2.67	3.84	3.99	3.95	4.11	5.74
All regions	2.13	2.51	2.80	2.91	3.42	3.61

Figure 6.4-7: Comparison of average regional commercial kernel recoveries (2009 to 2014)

Table 6.4-18 shows that Central Queensland farms had a higher relative proportion of farm years in the middle 50% (22.7%) for CKR and a lower relative proportion in the top 25% (6.7%) from 2009 to 2014. South East Queensland farms had a higher relative proportion in the bottom 25% (51.2%) and a lower relative proportion in the top 25% (3%) and middle 50% (12%). Northern Rivers farms had a higher relative proportion in the top 25% (72.7%) and a lower relative proportion in the bottom 25% (23.6%). Mid North Coast farms also had a higher relative proportion in the top 25% (17.6%) and a lower relative proportion in the middle 50% (7.7%) and bottom 25% (6.8%) of farm years for CKR.

This relationship between CKR and region is statistically significant.

Commercial kernel recovery %	**Total farms years = 1316**	**Top 25%** (>=4.1)	**Middle 50%** (>=1.60 to <4.1)	**Bottom 25%** (<1.60)	**Total**
CQ	Farm year	22	151	59	232
	% within percentile	6.7%	22.7%	18.3%	17.6%
	% of total	1.7%	11.5%	4.5%	17.6%
SEQ	Farm year	10	80	165	255
	% within percentile	3.0%	12.0%	51.2%	19.4%
	% of total	0.8%	6.1%	12.5%	19.4%
NRNSW	Farm year	240	382	76	698
	% within percentile	72.7%	57.5%	23.6%	53.0%
	% of total	18.2%	29.0%	5.8%	53.0%
MNNSW	Farm year	58	51	22	131
	% within percentile	17.6%	7.7%	6.8%	10.0%
	% of total	4.4%	3.9%	1.7%	10.0%
Total	Farm year	330	664	322	1316
	% of total	25.1%	50.5%	24.5%	100.0%

Table 6.4-18: Cross tabulation commercial kernel recovery by percentile and region

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Table 6.4-19 shows the statistical differences between average CKR in the four regions for all seasons from 2009 to 2014. The major differences are:

- South East Queensland farms had a significantly lower average CKR than farms from the other three regions.
- Mid North Coast farms had a significantly higher average CKR than farms from the other three regions.
- Northern Rivers farms had a significantly higher average CKR than Central Queensland farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Commercial kernel recovery %	CQ	SEQ	1.41	0.00***	CQ	2.56
		NRNSW	-1.00	0.00***		
		MNNSW	-1.53	0.00***		
	SEQ	CQ	-1.41	0.00***	SEQ	1.15
		NRNSW	-2.41	0.00***		
		MNNSW	-2.94	0.00***		
	NRNSW	CQ	1.00	0.00***	NRNSW	3.56
		SEQ	2.41	0.00***		
		MNNSW	-0.53	0.00***		
	MNNSW	CQ	1.53	0.00***	MNNSW	4.10
		SEQ	2.94	0.00***		
		NRNSW	0.53	0.00***		

Table 6.4-19: Comparison of regional average commercial kernel recovery (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Reject kernel recovery (RKR) by region

The average RKR for all farms in the benchmarking survey in 2014 (2.76%) was lower than the average from 2009 to 2014 (2.82%).

The average RKR was highest in 2014 for South East Queensland farms (3.41%), similar for Mid North Coast farms (2.71%) and Central Queensland farms (2.72%) and lowest for Northern Rivers of farms (2.56%).

By comparison, the average RKR for the six years from 2009 to 2014 was highest for Mid North Coast farms (3.42%) and lowest for South East Queensland and Northern Rivers farms (both 2.72%).

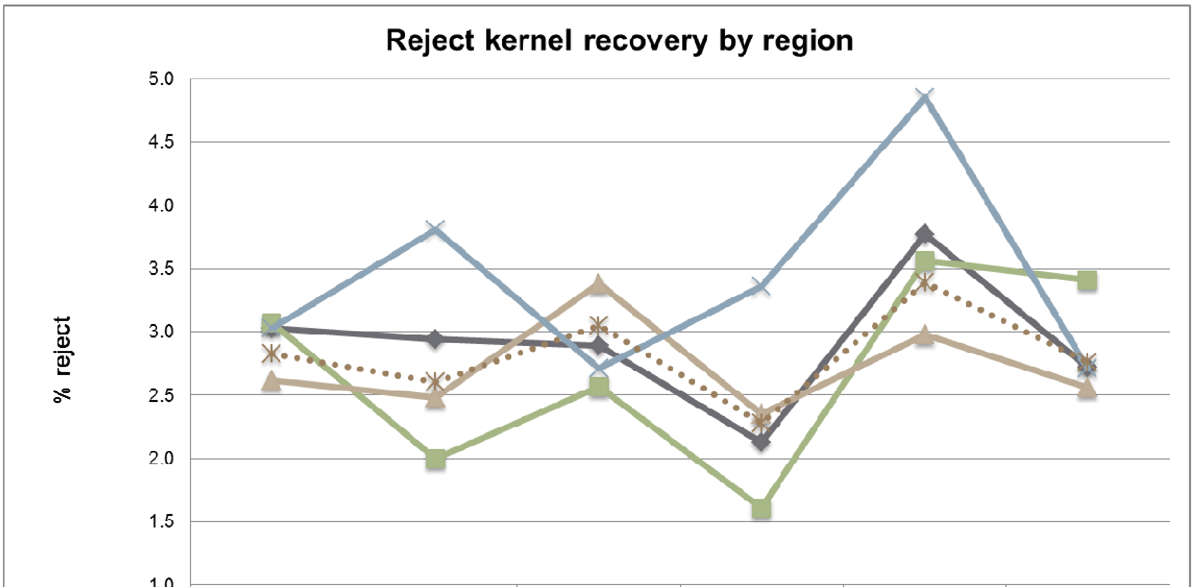
	2014					2009-2014				
	CQ (n=52)	**SEQ** (n=46)	**NRNSW** (n=141)	**MNNSW** (n=24)	**All** (n=263)	**CQ** (n=232)	**SEQ** (n=255)	**NRNSW** (n=698)	**MNNSW** (n=131)	**All** (n=1316)
Top 25%	1.02	1.09	1.37	1.17	1.22	1.24	0.95	1.26	1.44	1.19
Middle 50%	2.46	2.53	2.37	2.57	2.41	2.71	2.20	2.44	2.80	2.48
Bottom 25%	4.62	7.13	4.10	4.95	4.93	4.99	5.59	4.71	6.56	5.10
All percentiles	2.72	3.41	2.56	2.71	2.76	2.93	2.72	2.72	3.42	2.82

Table 6.4-20: Average reject kernel recovery (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-8 shows a comparison of the average RKR from 2009 to 2014 for each of the four regions. There was a major decrease from 2013 to 2014 in the average RKR amongst Central Queensland and Mid North Coast farms and a lesser decrease amongst South East Queensland and Northern Rivers farms. This was following an increase in the average RKR amongst farms from all the four regions from 2012 to 2013.

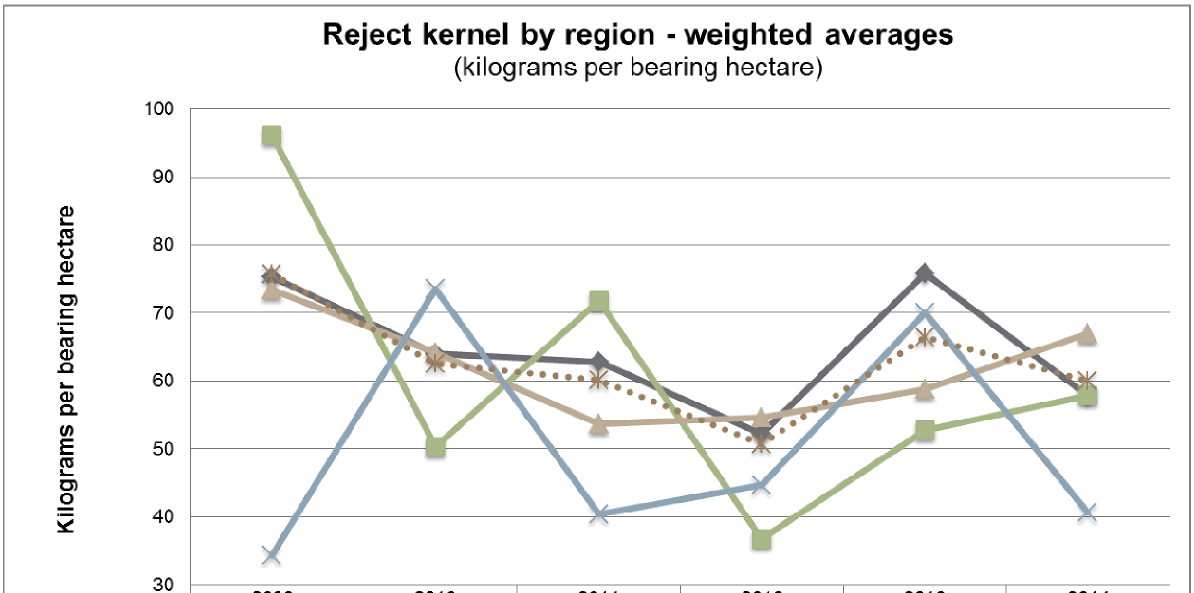


	2009	2010	2011	2012	2013	2014
CQ	3.03	2.94	2.89	2.13	3.77	2.72
SEQ	3.07	2.00	2.57	1.61	3.56	3.41
NRNSW	2.62	2.48	3.38	2.35	2.98	2.56
MNNSW	3.03	3.81	2.71	3.36	4.85	2.71
All regions	2.83	2.60	3.05	2.28	3.39	2.76

Figure 6.4-8: Comparison of average regional reject kernel recoveries (2009 to 2014)

Figure 6.4-9 shows the average kilograms rejected per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages that are calculated by dividing the total kilograms of reject kernel by the total bearing hectares from the farms in the relevant regions. Both yield per hectare and RKR impact on the average calculation. Farms with higher yields and RKR's will exert more influence (weight of reject kernel) than farms with smaller yields and RKR's.

There was a decrease in the average kilograms of reject kernel per bearing hectare from 2013 to 2014 amongst Mid North Coast (from 70.04 kg to 40.66 kg) and Central Queensland (from 75.82 kg to 57.82 kg) farms. By comparison, there was an increase in the average kilograms of reject kernel per bearing hectare from 2013 to 2014 amongst South East Queensland (from 52.69 kg to 57.82 kg) and Northern Rivers (from 58.85 kg to 66.96 kg) farms. The increase amongst South East Queensland and Northern Rivers farms was due to the increased average yield of NIS per hectare despite the lower average RKR.



	2009	2010	2011	2012	2013	2014
CQ	75.26	64.07	62.77	52.23	75.82	57.82
SEQ	96.16	50.27	71.81	36.75	52.69	57.82
NRNSW	73.40	64.17	53.63	54.65	58.85	66.96
MNNSW	34.32	73.59	40.38	44.67	70.04	40.66
All regions	75.73	62.49	60.16	50.74	66.50	60.06

Figure 6.4-9: Comparison of regional weighted average reject kernel in kilograms per bearing hectare (2009 to 2014)

Table 6.4-21 shows that there is a higher relative proportion of Central Queensland farms amongst the bottom 25% (19.1%) and a lower relative proportion amongst the top 25% (14.9%) of farm years for RKR from 2009 to 2014. There is a higher relative proportion of South East Queensland farms (27.7%) in the top 25% and a lower relative proportion of Mid North Coast farms in the top 25% (5.2%) of farm years for RKR. Northern Rivers farm years are relatively evenly spread for RKR.

This relationship between RKR and region is statistically significant.

Reject kernel recovery %	**Total farm years =1316**	**Top 25%** (<=1.69)	**Middle 50%** (> 1.69 to <=3.39)	**Bottom 25%** (> 3.39)	**Total**
CQ	Farm year	49	119	64	232
	% within percentile	14.9%	18.3%	19.1%	17.6%
	% of total	3.7%	9.0%	4.9%	17.6%
SEQ	Farm year	91	101	63	255
	% within percentile	27.7%	15.5%	18.8%	19.4%
	% of total	6.9%	7.7%	4.8%	19.4%
NRNSW	Farm year	172	357	169	698
	% within percentile	52.3%	54.8%	50.4%	53.0%
	% of total	13.1%	27.1%	12.8%	53.0%
MNNSW	Farm year	17	75	39	131
	% within percentile	5.2%	11.5%	11.6%	10.0%
	% of total	1.3%	5.7%	3.0%	10.0%
Total	Farm years	329	652	335	1316
	% of total	25.0%	49.5%	25.5%	100.0%

Table 6.4-21: Cross tabulation reject kernel recovery by percentile and region

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Table 6.4-22 shows the statistical differences between average RKR between the four regions for all seasons from 2009 to 2014. The major differences are:

- Mid North Coast farms had a significantly higher average RKR than farms in the other three regions.
- There was no significant difference between average RKR from Central Queensland, South East Queensland and Northern Rivers farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Reject kernel recovery %	CQ	SEQ	0.20	0.20	CQ	2.93
		NRNSW	0.21	0.11		
		MNNSW	-0.49	0.01***		
	SEQ	CQ	-0.20	0.20	SEQ	2.72
		NRNSW	0.01	0.95		
		MNNSW	-0.70	0.00***		
	NRNSW	CQ	-0.21	0.11	NRNSW	2.72
		SEQ	-0.01	0.95		
		MNNSW	-0.70	0.00***		
	MNNSW	CQ	0.49	0.01***	MNNSW	3.42
		SEQ	0.70	0.00***		
		NRNSW	0.70	0.00***		

Table 6.4-22: Comparison of regional average reject kernel recovery (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Reject analysis by region

Central Queensland

Figure 6.4-10 shows the average reject analysis trends from 2009 to 2014 for Central Queensland farms in the benchmarking. There was an average of 39 farms participating in the benchmarking each year from the Central Queensland region with increasing numbers of farms each year.

There were significant decreases in the average level of rejects due to brown centres, immaturity and discolouration amongst Central Queensland farms in 2014 compared to 2013. Brown centres had been the major cause of reject losses amongst Central Queensland farms in previous years. The *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008) found that the average level of brown centres increased with increasing farm size, maximum silo size and nut storage bed depth. Farms in the Central Queensland region are on average much larger than farms from the other regions.

By comparison, the average levels of rejects due to insect damage, mould and germination were similar in 2014 in Central Queensland farms compared to 2013.

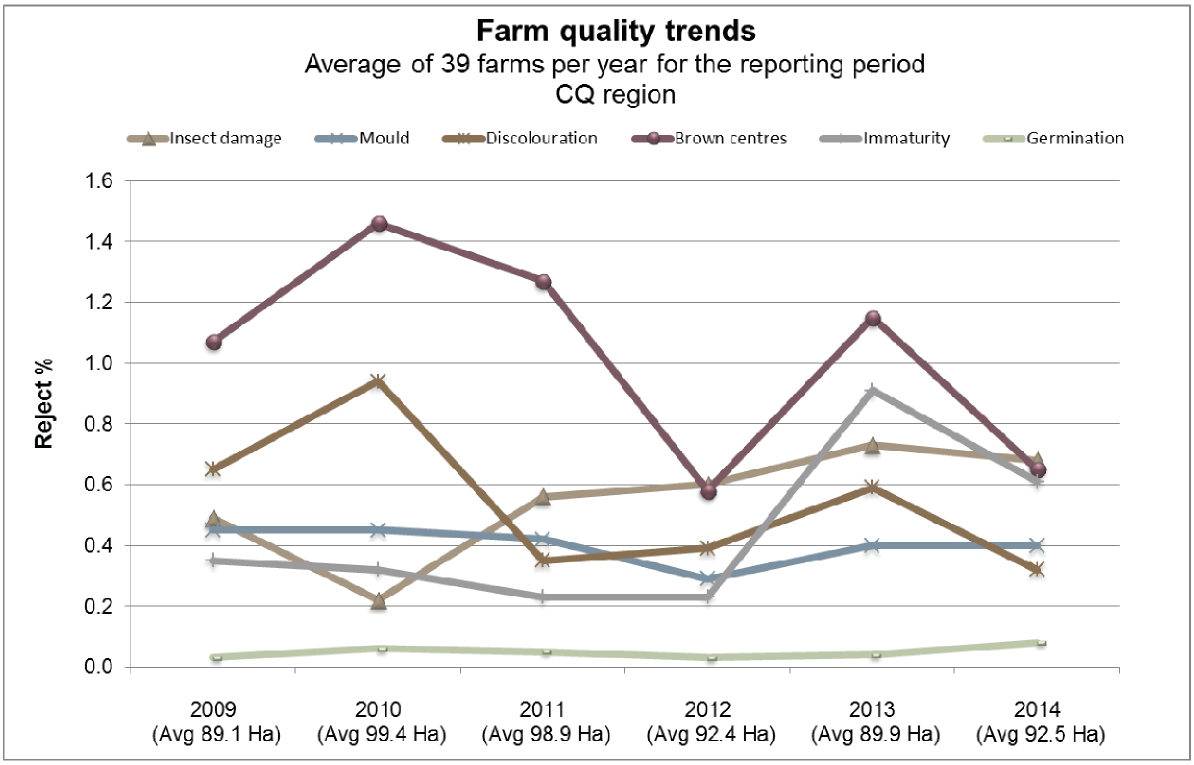


Figure 6.4-10: Comparison of consigned reject analysis for farms in Central Queensland region (2009 to 2014 seasons)

South East Queensland

Figure 6.4-11 shows the average reject analysis trends from 2009 to 2014 for South East Queensland farms in the benchmarking. There was an average of 43 farms participating in the benchmarking each year from the South East Queensland region.

Immaturity was on average the major cause of reject losses amongst South East Queensland farms in 2013 and 2014. These high levels of immaturity have largely been attributed to very dry conditions leading to moisture stress during nut growth and development and oil accumulation in the latter parts of 2012 and 2013 following very wet conditions earlier in 2012. The immaturity levels were particularly high amongst farms without access to adequate irrigation and on soils with poor water holding capacity and farms who missed opportune spring storms.

Husk spot was not as prevalent during 2012/13 and 2013/14 and was not considered a major cause of immaturity in the 2013 and 2014 crops.

There was a significant reduction in the average level of rejects due to insect damage in 2014 amongst South East Queensland farms compared to 2013. Insect damage had been the main cause of reject losses amongst these farms from 2010 to 2012. There was also a reduction in the average level of rejects due to brown centres and discolouration amongst South East Queensland farms from 2013 to 2014.

By comparison, there was an increase in the average level of rejects due to mould amongst South East Queensland farms in 2014.

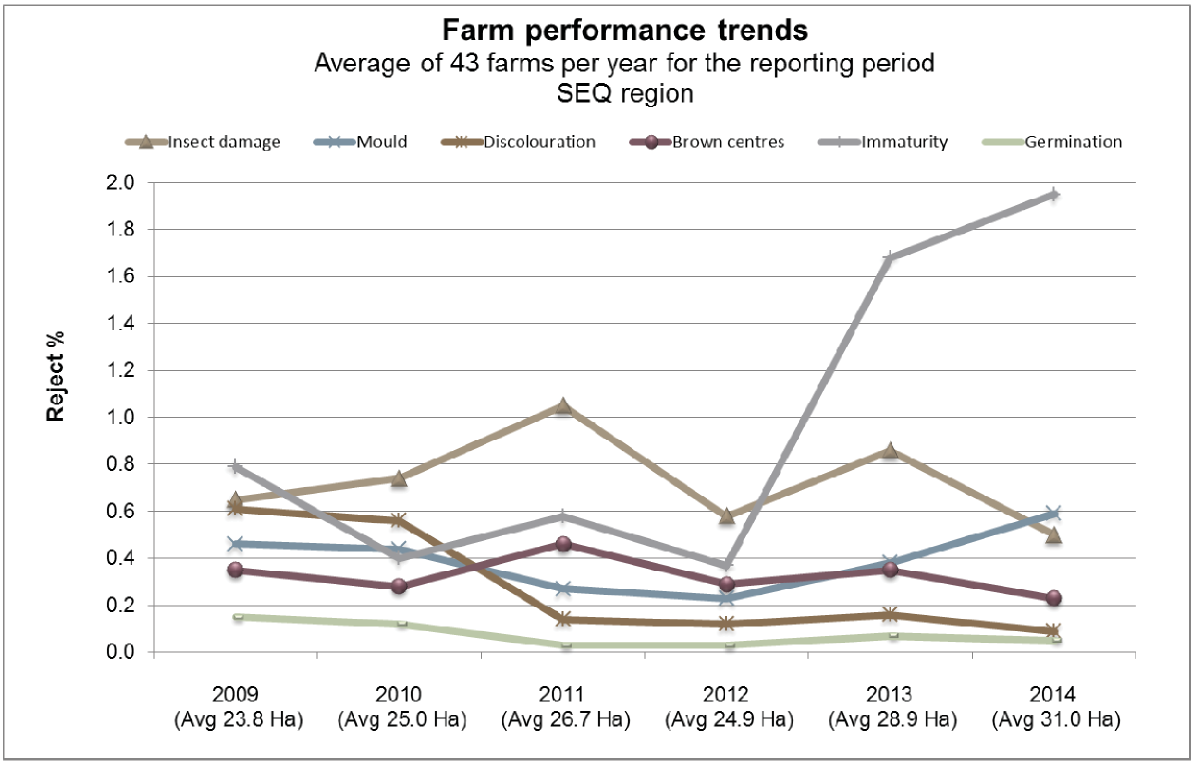


Figure 6.4-11: Comparison of consigned reject analysis for farms in South East Queensland region (2009 to 2014 seasons)

Northern Rivers of New South Wales

Figure 6.4-12 shows the average reject analysis trends from 2009 to 2014 for Northern Rivers farms in the benchmarking. There was an average of 117 farms participating in the benchmarking each year from the Northern Rivers region.

Insect damage has been, on average, the major cause of rejects amongst the Northern Rivers farms in each year of the benchmarking. Insect damage was still the major cause of reject losses amongst the Northern Rivers farms in 2014, although there was a significant reduction compared to the three previous years. There has been a major campaign in recent years to improve insect spray coverage and timing amongst macadamia farms in this region.

There were also significant reductions in the average levels of rejects due to immaturity and brown centres in 2014. The levels of rejects due to discolouration and germination were similar in 2013 and 2014.

By comparison, there was an increase in the average level of rejects due to mould amongst the Northern Rivers farms from 2013 to 2014. This was similar to the increase in the average level of rejects due to mould amongst the South East Queensland farms.

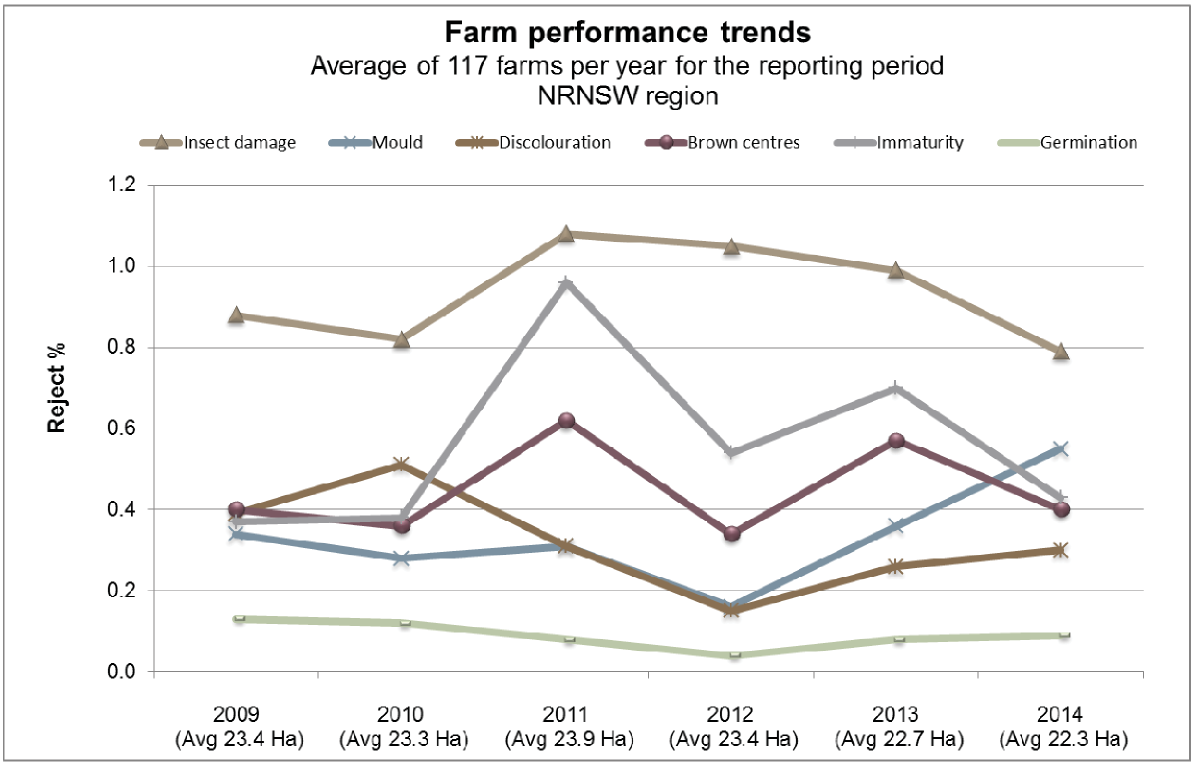


Figure 6.4-12: Comparison of consigned reject analysis for farms in Northern Rivers New South Wales region (2009 to 2014 seasons)

Mid North Coast of New South Wales

Figure 6.4-13 shows the average reject analysis trends from 2009 to 2014 for Mid North Coast farms in the benchmarking. There was an average of 22 farms participating in the benchmarking each year from the Northern Rivers region.

Insect damage remained, on average, the major cause of rejects amongst the Mid North Coast farms in 2014, but the average level of rejects due to insect damage in 2014 was less than half the average level in 2013. This is also partly due to the campaign to reduce the level of insect damage amongst New South Wales macadamia farms.

The average level of rejects for immaturity, mould, brown centres, discolouration and germination were also less in 2014 than in 2013 for the Mid North Coast farms.

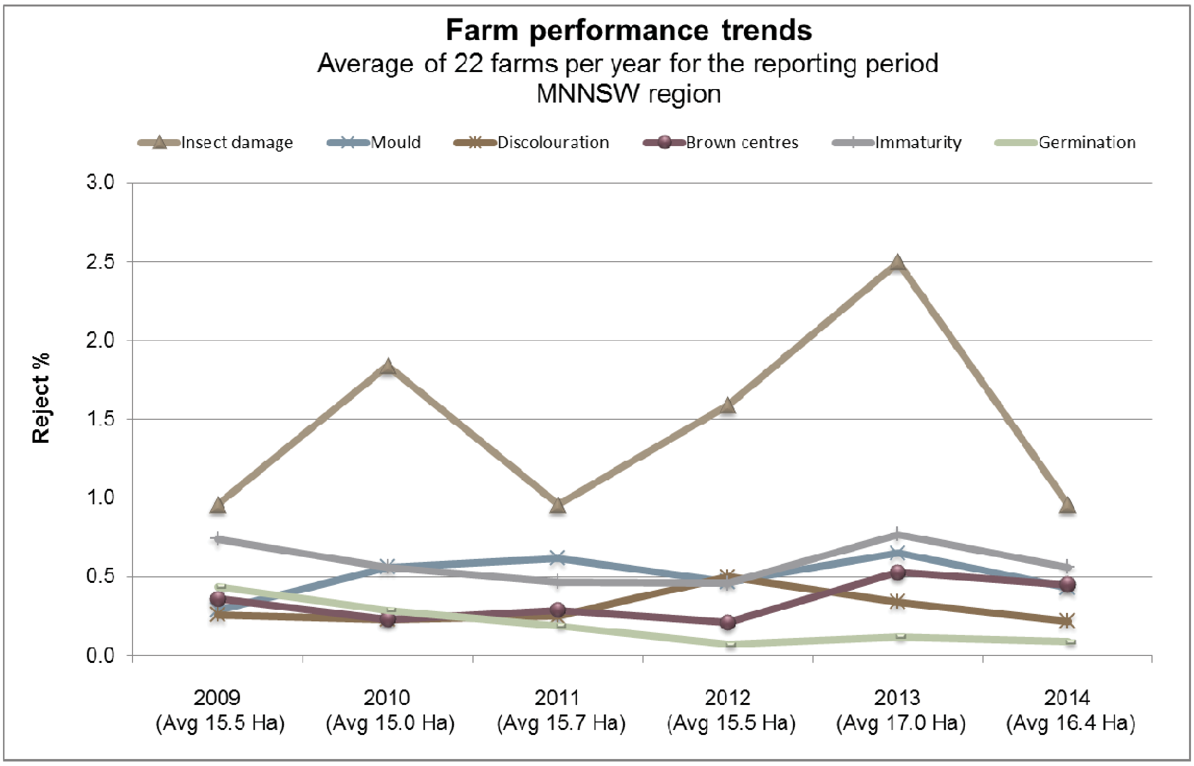


Figure 6.4-13: Comparison of consigned reject analysis for farms in Mid North Coast New South Wales region (2009 to 2014 seasons)

Insect damage by region

Table 6.4-23 shows the average consigned rejects due to insect damage for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers of New South Wales and Mid North Coast of New South Wales in 2014 and for all years from 2009 to 2014. As with RKR, the figures are inverted (i.e. the lower levels are in the top 25%) as low levels of rejects due to insect damage represent better quality.

The average level of rejects due to insect damage in 2014 (0.73%) was much lower than the average from 2009 to 2014 (0.89%).

Mid North Coast farms had the highest average level of rejects due to insect damage in 2014 (0.96%) and over the six years from 2009 to 2014 (1.48%). South East Queensland farms had the lowest average level of rejects due to insect damage in 2014 (0.50%). Central Queensland farms had the lowest average level of rejects over the six years (0.58%).

	2014					2009-2014				
	CQ (n=51)	**SEQ** (n=46)	**NRNSW** (n=138)	**MNNSW** (n=24)	**All** (n=259)	**CQ** (n=229)	**SEQ** (n=249)	**NRNSW** (n=689)	**MNNSW** (n=131)	**All** (n=1298)
Top 25%	0.17	0.02	0.25	0.30	0.15	0.14	0.06	0.24	0.27	0.17
Middle 50%	0.59	0.20	0.63	0.55	0.56	0.42	0.40	0.67	0.93	0.61
Bottom 25%	1.45	1.46	1.52	2.16	1.65	1.35	2.06	2.14	3.68	2.18
All percentiles	0.68	0.50	0.79	0.96	0.73	0.58	0.73	0.94	1.48	0.89

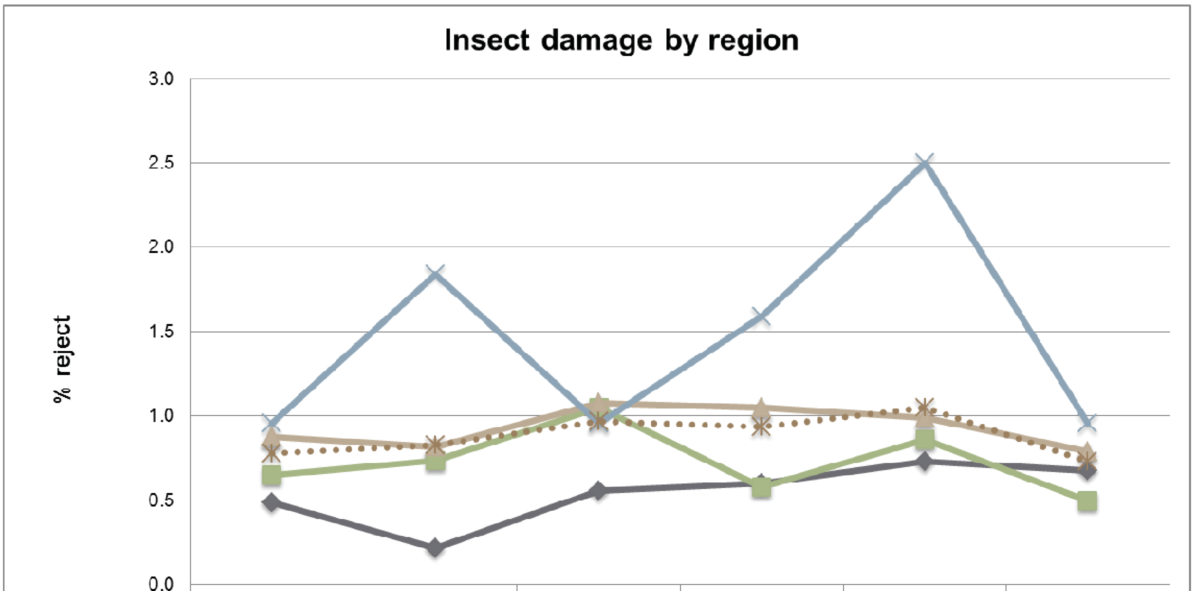
Table 6.4-23: Average insect damage rejects (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-14 shows a comparison of the average rejects due to insect damage from 2009 to 2014 for each of the four regions. There was a decrease in the average level of rejects due to insect damage in each of the regions from 2013 to 2014. The South East Queensland, Northern Rivers and Mid North Coast farms had their lowest average level since the benchmarking began in 2009.

The reduction in the average level of rejects due to insect damage was largely due to a campaign to improve pest spray coverage and timing following the 2013 season, particularly amongst New South Wales farms. The greatest decrease from 2013 to 2014 was amongst the Mid North Coast farms (from 2.5% to 0.96%) after they had experienced a major increase from 2011 to 2013.

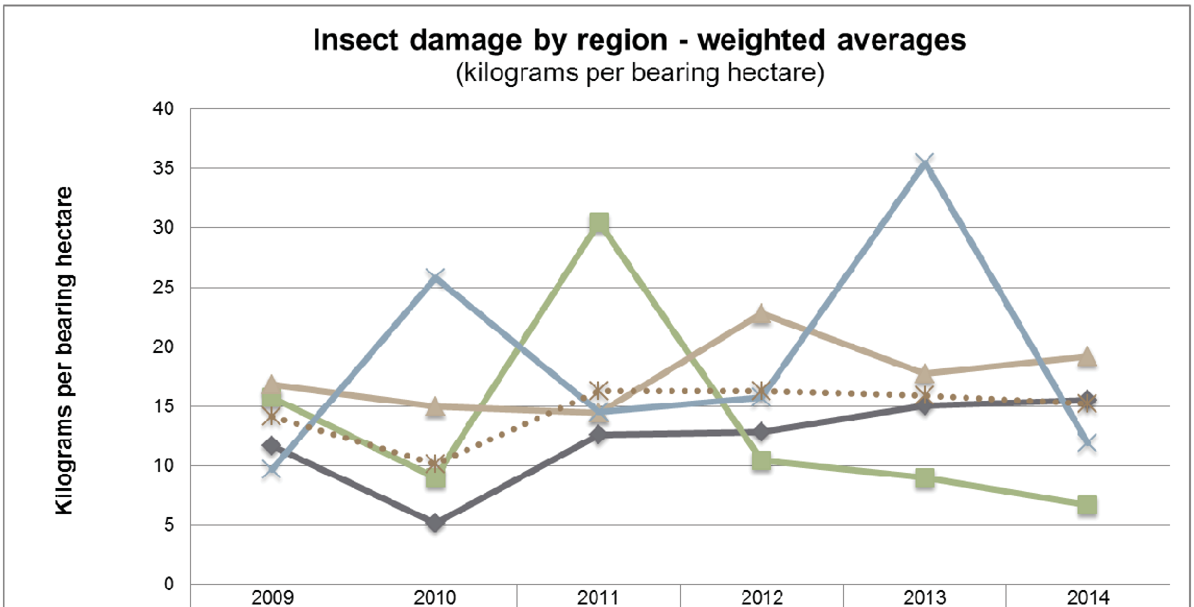


	2009	2010	2011	2012	2013	2014
CQ	0.49	0.22	0.56	0.60	0.73	0.68
SEQ	0.65	0.74	1.05	0.58	0.86	0.50
NRNSW	0.88	0.82	1.08	1.05	0.99	0.79
MNNSW	0.96	1.84	0.96	1.59	2.50	0.96
All regions	0.78	0.83	0.97	0.94	1.05	0.73

Figure 6.4-14: Comparison of average regional insect damage reject levels (2009 to 2014)

Figure 6.4-15 shows the average kilograms rejected due to insect damage per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of reject kernel due to insect damage by the total bearing hectares from the farms in the relevant regions.

There was a major decrease in the average kilograms of reject kernel per bearing hectare due to insect damage from 2013 to 2014 amongst Mid North Coast farms (from 35.46 kg to 11.92 kg). By comparison, there was an increase from 2013 to 2014 amongst Northern Rivers (from 17.73 kg to 19.2 kg) farms. The increase amongst Northern Rivers farms was due to the increased average yield of NIS per hectare despite the lower average percentage of rejects due to insect damage.



	2009	2010	2011	2012	2013	2014
CQ	11.73	5.16	12.63	12.88	15.09	15.52
SEQ	15.77	9.02	30.50	10.46	8.98	6.68
NRNSW	16.83	14.96	14.46	22.83	17.73	19.20
MNNSW	9.66	25.83	14.56	15.77	35.46	11.92
All regions	14.16	10.19	16.28	16.32	15.90	15.25

Figure 6.4-15: Comparison of regional weighted average insect damage reject levels in kilograms per bearing hectare (2009 to 2014)

Table 6.4-24 shows the statistical differences between the average levels of rejects due to insect damage between the four regions for all seasons from 2009 to 2014. The major differences are:

- Mid North Coast farms had a significantly higher average level of rejects due to insect damage than farms in the other three regions.
- Northern Rivers farms had a significantly higher average level of rejects due to insect damage than the Central Queensland and South East Queensland farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Insect damage %	CQ	SEQ	-0.15	0.13	CQ	0.58
		NRNSW	-0.36	0.00***		
		MNNSW	-0.90	0.00***		
	SEQ	CQ	0.15	0.13	SEQ	0.73
		NRNSW	-0.21	0.01***		
		MNNSW	-0.75	0.00***		
	NRNSW	CQ	0.36	0.00***	NRNSW	0.94
		SEQ	0.21	0.01***		
		MNNSW	-0.54	0.00***		
	MNNSW	CQ	0.90	0.00***	MNNSW	1.48
		SEQ	0.75	0.00***		
		NRNSW	0.54	0.00***		

Table 6.4-24: Comparison of regional average consignment insect damage (%) rejects for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Mould by region

Table 6.4-25 shows the average consigned rejects due to mould for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all years from 2009 to 2014. As with RKR, the figures are inverted (i.e. the lower levels are in the top 25%) as low levels of rejects due to mould represent better quality.

The average level of rejects due to mould in 2014 (0.51%) was higher than the average from 2009 to 2014 (0.38%).

South East Queensland farms had the highest average level of rejects due to mould in 2014 (0.59%). Mid North Coast farms had the highest average level over the six years from 2009 to 2014 (0.50%).

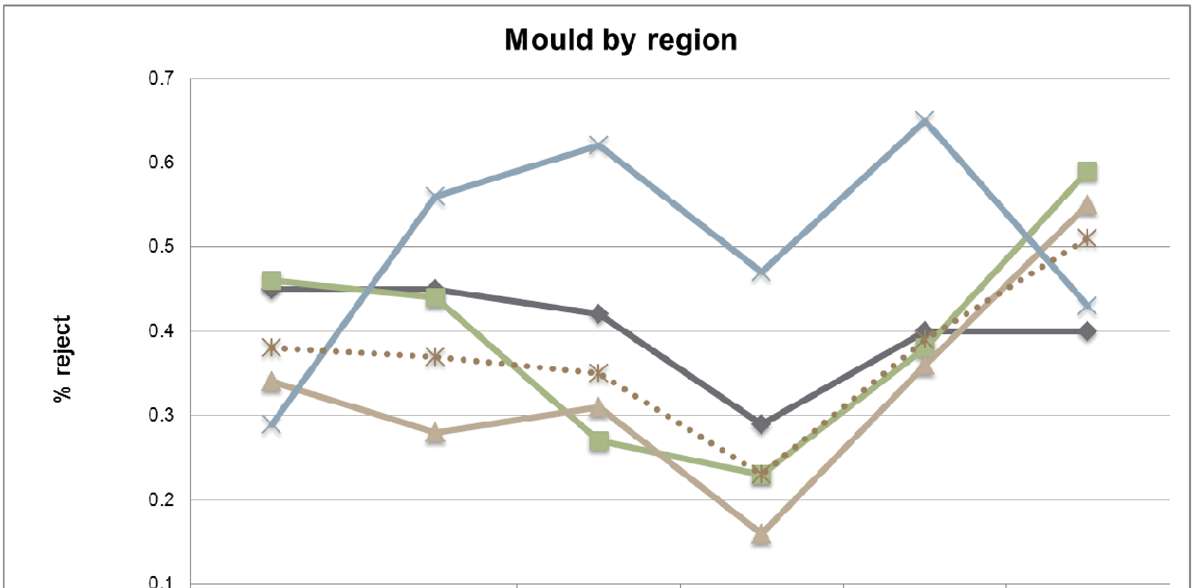
	2014					2009-2014				
	CQ (n=51)	**SEQ** (n=46)	**NRNSW** (n=138)	**MNNSW** (n=24)	**All** (n=259)	**CQ** (n=229)	**SEQ** (n=249)	**NRNSW** (n=690)	**MNNSW** (n=131)	**All** (n=1299)
Top 25%	0.22	0.09	0.09	0.07	0.13	0.14	0.06	0.03	0.07	0.06
Middle 50%	0.32	0.32	0.40	0.32	0.39	0.35	0.28	0.21	0.38	0.27
Bottom 25%	0.68	1.26	1.31	0.74	1.18	0.77	0.96	0.87	1.20	0.90
All percentiles	0.40	0.59	0.55	0.43	0.51	0.40	0.39	0.34	0.50	0.38

Table 6.4-25: Average mould rejects (%) for 2014 and for all years from 2009 to 2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-16 shows a comparison of the average level of rejects due to mould from 2009 to 2014 for each of the four regions. There was a major increase in the average level of rejects due to mould amongst South East Queensland and Northern Rivers farms from 2012 to 2014. By comparison, there was a substantial decrease in the average level amongst Mid North Coast farms from 2013 to 2014 and the level stayed steady from 2013 to 2014 amongst Central Queensland farms.

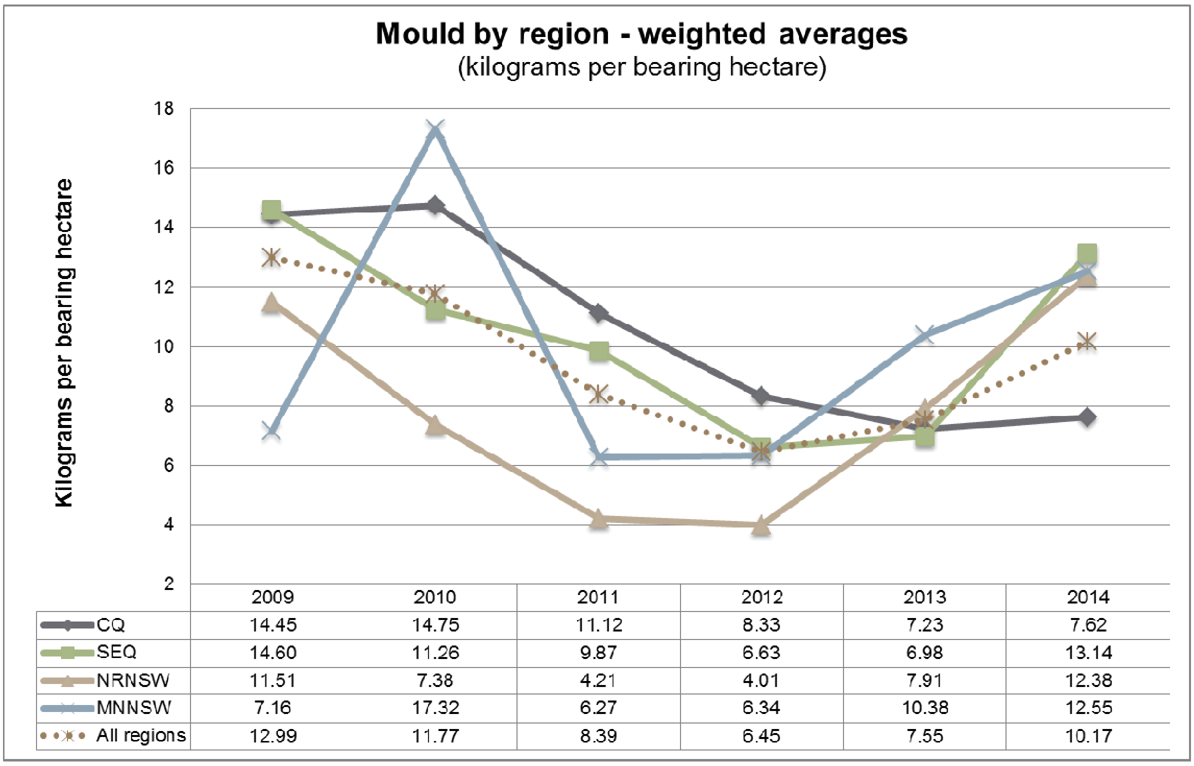


	2009	2010	2011	2012	2013	2014
CQ	0.45	0.45	0.42	0.29	0.40	0.40
SEQ	0.46	0.44	0.27	0.23	0.38	0.59
NRNSW	0.34	0.28	0.31	0.16	0.36	0.55
MNNSW	0.29	0.56	0.62	0.47	0.65	0.43
All regions	0.38	0.37	0.35	0.23	0.39	0.51

Figure 6.4-16: Comparison of average regional mould reject levels (2009 to 2014)

Figure 6.4-17 shows the average kilograms rejected due to mould per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of reject kernel due to mould by the total bearing hectares from the farms in the relevant regions.

There was an increase in the average kilograms of reject kernel per bearing hectare due to mould from 2013 to 2014 amongst all four regions. The largest increase was amongst Northern Rivers (from 7.91 kg to 12.38 kg) and South East Queensland (from 6.98 kg to 13.14 kg) farms. The increase amongst Mid North Coast and Central Queensland farms from 2013 to 2014 was due to the increase in NIS yield per hectare despite no increase in the average percentage of rejects due to mould.



	2009	2010	2011	2012	2013	2014
CQ	14.45	14.75	11.12	8.33	7.23	7.62
SEQ	14.60	11.26	9.87	6.63	6.98	13.14
NRNSW	11.51	7.38	4.21	4.01	7.91	12.38
MNNSW	7.16	17.32	6.27	6.34	10.38	12.55
All regions	12.99	11.77	8.39	6.45	7.55	10.17

Figure 6.4-17: Comparison of regional weighted average mould reject levels in kilograms per bearing hectare (2009 to 2014)

Table 6.4-26 shows the statistical differences between the average levels of rejects due to mould between the four regions for all seasons from 2009 to 2014. The major differences are:

- Mid North Coast farms had a significantly higher average level of rejects due to mould than farms in the other three regions.
- Northern Rivers farms had a significantly lower average level of rejects due to mould than the Central Queensland farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Mould %	CQ	SEQ	0.01	0.84	CQ	0.40
		NRNSW	0.06	0.08*		
		MNNSW	-0.11	0.01***		
	SEQ	CQ	-0.01	0.84	SEQ	0.39
		NRNSW	0.05	0.12		
		MNNSW	-0.11	0.01***		
	NRNSW	CQ	-0.06	0.08*	NRNSW	0.34
		SEQ	-0.05	0.12		
		MNNSW	-0.16	0.00***		
	MNNSW	CQ	0.11	0.01***	MNNSW	0.50
		SEQ	0.11	0.01***		
		NRNSW	0.16	0.00***		

Table 6.4-26: Comparison of regional average consignment mould (%) rejects for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Discolouration by region

Table 6.4-27 shows the average level of consigned rejects due to discolouration for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all years from 2009 to 2014. As with RKR, the figures are inverted (i.e. the lower levels are in the top 25%) as low levels of rejects due to discolouration represent better quality.

The average level of rejects due to discolouration in 2014 (0.26%) was lower than the average from 2009 to 2014 (0.33%). In 2014, the top 25% of farms averaged only 0.02% rejects due to discolouration, the middle 50% averaged 0.20% and the bottom 25% averaged 0.60%. In the six years from 2009 to 2014, the top 25% of farms averaged only 0.02% rejects due to discolouration, the middle 50% averaged 0.20% and the bottom 25% averaged 0.86%.

South East Queensland farms (0.09%) had the lowest average levels of rejects due to discolouration in 2014 and over the six years from 2009 to 2014 (0.26%). Central Queensland farms had the highest average levels in 2014 (0.32%) and over the six years (0.51%).

	2014					2009-2014				
	CQ (n=51)	**SEQ** (n=46)	**NRNSW** (n=138)	**MNNSW** (n=24)	**All** (n=259)	**CQ** (n=229)	**SEQ** (n=249)	**NRNSW** (n=689)	**MNNSW** (n=129)	**All** (n=1296)
Top 25%	0.09	0.00	0.06	0.01	0.02	0.13	0.00	0.03	0.00	0.02
Middle 50%	0.26	0.08	0.25	0.16	0.20	0.36	0.12	0.18	0.24	0.20
Bottom 25%	0.69	0.25	0.67	0.41	0.60	1.13	0.79	0.79	0.78	0.86
All percentiles	0.32	0.09	0.30	0.22	0.26	0.51	0.26	0.30	0.31	0.33

Table 6.4-27: Average discolouration rejects (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-18 shows a comparison of the average level of rejects due to discolouration from 2009 to 2014 for each of the four regions. Central Queensland, South East Queensland and Mid North Coast farms had the lowest average levels of rejects due to discolouration in 2014 since the benchmarking began in 2009. Northern Rivers farms had an increase in the average level of rejects due to discolouration from 2012 to 2014.

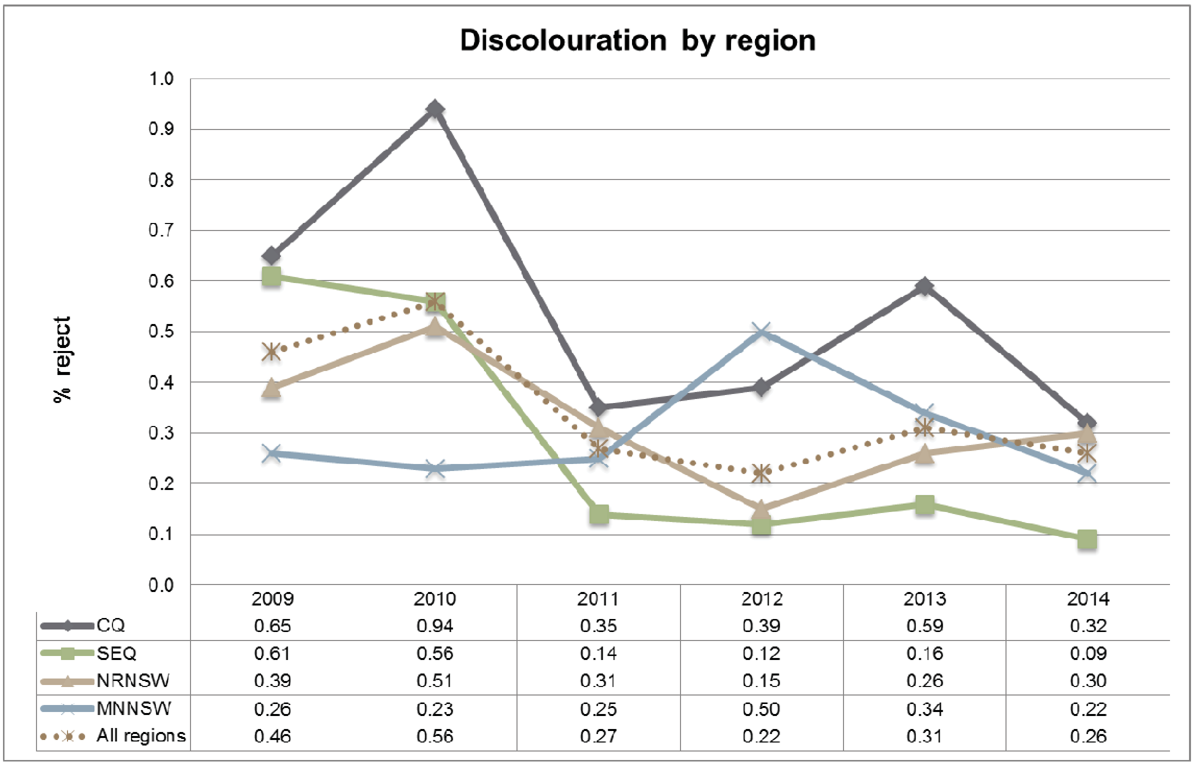
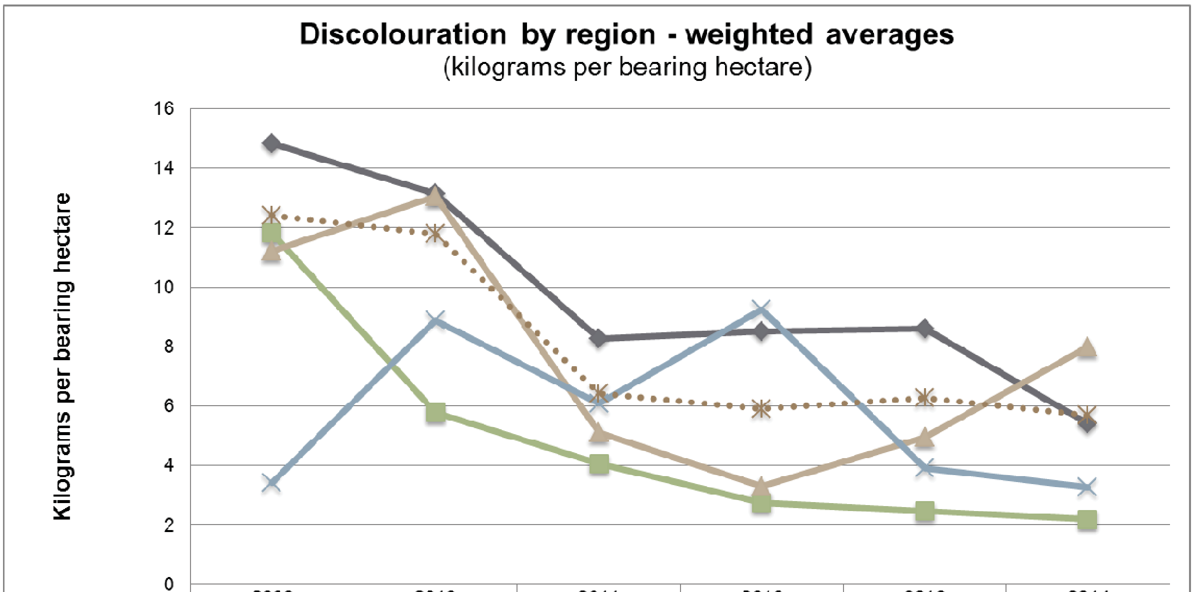


Figure 6.4-18: Comparison of average regional discolouration reject levels (2009 to 2014)

Figure 6.4-19 shows the average kilograms rejected due to discolouration per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of reject kernel due to discolouration by the total bearing hectares from the farms in the relevant regions.

There was a decrease in the average kilograms of reject kernel per bearing hectare from 2013 to 2014 amongst Central Queensland, South East Queensland and Mid North Coast farms. There was an increase amongst Northern Rivers farms from 4.96 kg in 2013 to 7.98 kg in 2014. This increase was driven by both the increase in the average NIS yield per hectare and the level of rejects due to discolouration.



	2009	2010	2011	2012	2013	2014
CQ	14.84	13.14	8.28	8.51	8.59	5.41
SEQ	11.82	5.77	4.07	2.74	2.47	2.18
NRNSW	11.21	13.04	5.12	3.31	4.96	7.98
MNNSW	3.43	8.89	6.08	9.24	3.91	3.25
All regions	12.40	11.80	6.43	5.91	6.28	5.68

Figure 6.4-19: Comparison of regional weighted average discolouration reject levels in kilograms per bearing hectare (2009 to 2014)

Table 6.4-28 shows the statistical differences between the average levels of rejects due to discolouration between the four regions for all seasons from 2009 to 2014. The major differences are:

- The Central Queensland farms had a significantly higher average level of rejects due to discolouration than farms in the other three regions.
- There was no significant difference between the average levels of rejects due to discolouration amongst the South East Queensland and Mid North Coast and Northern Rivers farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Discolouration %	CQ	SEQ	0.25	0.00***	CQ	0.51
		NRNSW	0.21	0.00***		
		MNNSW	0.21	0.00***		
	SEQ	CQ	-0.25	0.00***	SEQ	0.26
		NRNSW	-0.04	0.22		
		MNNSW	-0.04	0.38		
	NRNSW	CQ	-0.21	0.00***	NRNSW	0.30
		SEQ	0.04	0.22		
		MNNSW	0.00	0.96		
	MNNSW	CQ	-0.21	0.00***	MNNSW	0.31
		SEQ	0.04	0.38		
		NRNSW	0.00	0.96		

Table 6.4-28: Comparison of regional average consignment discolouration (%) rejects for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Brown centres by region

Table 6.4-29 shows the average level of consigned rejects due to brown centres (also known as internal discolouration) for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all six years from 2009 to 2014. As with RKR, the figures are inverted (i.e. the lower levels are in the top 25%) as low levels of rejects due to brown centres represent better quality.

The average level of rejects due to brown centres in 2014 (0.42%) was lower than the average from 2009 to 2014 (0.51%). Central Queensland farms had the highest average levels of rejects due to brown centres in 2014 (0.65%) and over the six years from 2009 to 2014 (0.99%). South East Queensland farms had the lowest average levels of rejects due to brown centres in 2014 (0.23%) and over the six years from 2009 to 2014 (0.32%).

	2014					2009-2014				
	CQ (n=51)	**SEQ** (n=46)	**NRNSW** (n=138)	**MNNSW** (n=24)	**All** (n=259)	**CQ** (n=229)	**SEQ** (n=249)	**NRNSW** (n=688)	**MNNSW** (n=128)	**All** (n=1294)
Top 25%	0.15	0.03	0.09	0.08	0.07	0.17	0.03	0.06	0.00	0.06
Middle 50%	0.54	0.13	0.33	0.31	0.32	0.86	0.20	0.34	0.29	0.35
Bottom 25%	1.40	0.59	0.81	0.77	0.97	1.96	0.82	1.05	0.86	1.27
All percentiles	0.65	0.23	0.40	0.45	0.42	0.99	0.32	0.45	0.35	0.51

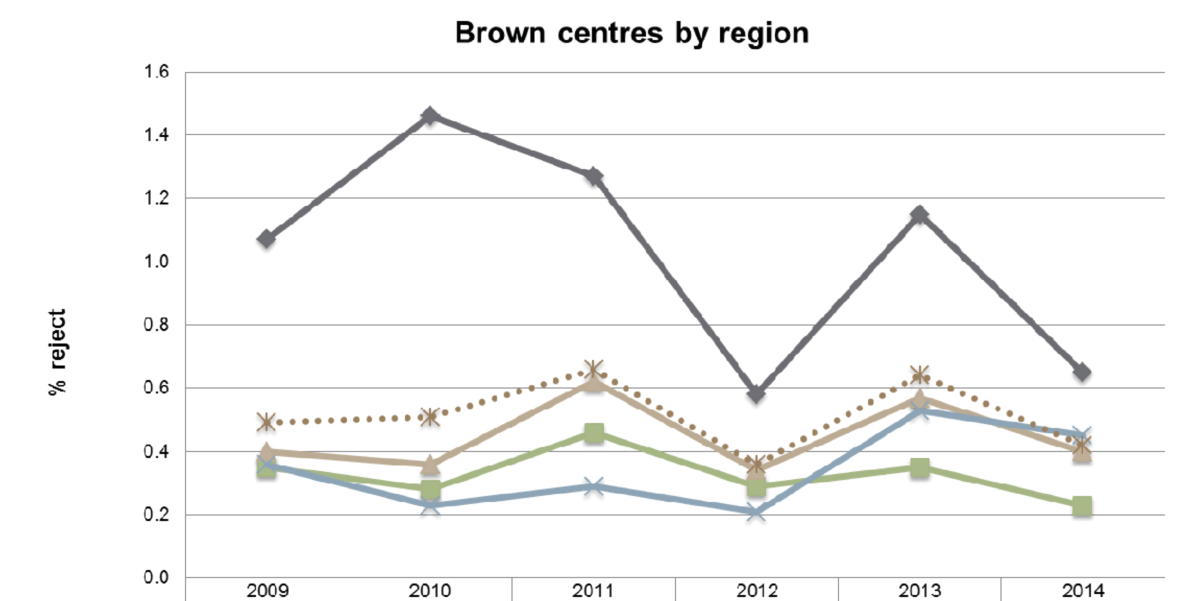
Table 6.4-29: Average brown centre rejects (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-20 shows a comparison of the average level of rejects due to brown centres from 2009 to 2014 for each of the four regions. There was a decrease in the level of rejects due to brown centres from 2013 to 2014 in each of the regions. The largest decrease from 2013 to 2014 was amongst Central Queensland farms.

Central Queensland farms had a higher average level of rejects due to brown centres in all six years than farms in the other three regions. Central Queensland farms are on average much larger than farms in the other regions. The grower surveys from the *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008) found that the average level of brown centres significantly increased with increasing farm size, maximum silo size and nut storage bed depth.

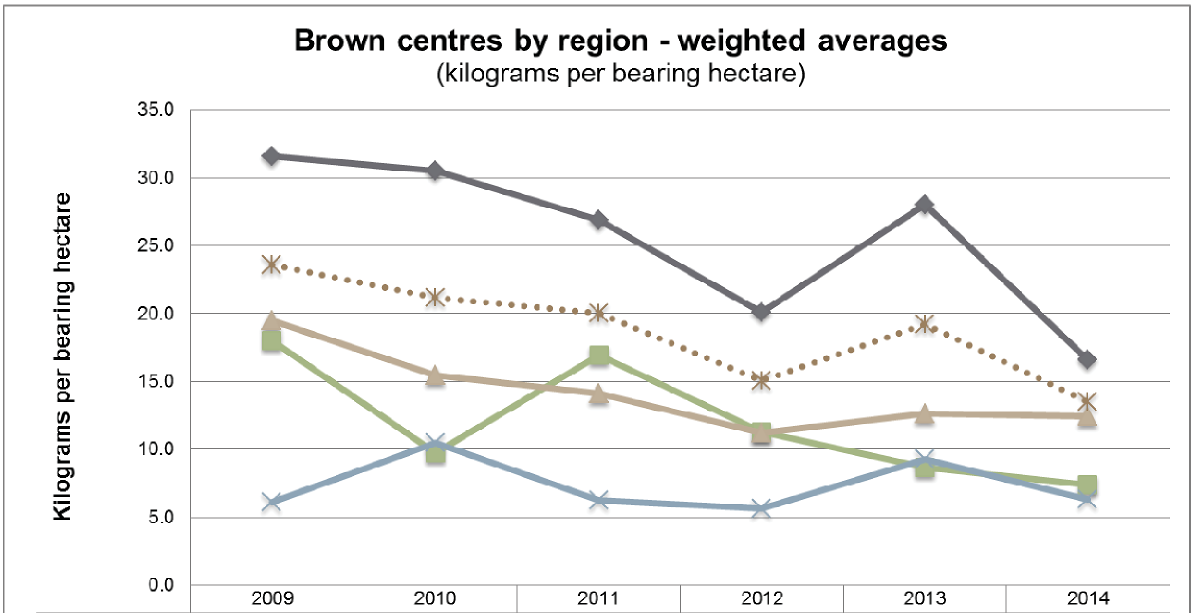


	2009	2010	2011	2012	2013	2014
CQ	1.07	1.46	1.27	0.58	1.15	0.65
SEQ	0.35	0.28	0.46	0.29	0.35	0.23
NRNSW	0.40	0.36	0.62	0.34	0.57	0.40
MNNSW	0.36	0.23	0.29	0.21	0.53	0.45
All regions	0.49	0.51	0.66	0.36	0.64	0.42

Figure 6.4-20: Comparison of average regional brown centre reject levels (2009 to 2014)

Figure 6.4-21 shows the average kilograms rejected due to brown centres per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of reject kernel due to brown centres by the total bearing hectares from the farms in the relevant regions.

There was a decrease in the average kilograms of reject kernel due to brown centres per bearing hectare from 2013 to 2014 amongst farms from all four regions. The largest decrease from 2013 to 2014 was amongst Central Queensland farms (from 28.03 kg to 16.64 kg). This decrease was due to the reduced percentage of rejects due to brown centres despite the increased yield of NIS per bearing hectare.



	2009	2010	2011	2012	2013	2014
CQ	31.58	30.53	26.86	20.09	28.03	16.64
SEQ	18.05	9.75	16.97	11.29	8.72	7.43
NRNSW	19.48	15.47	14.14	11.24	12.65	12.46
MNNSW	6.14	10.50	6.28	5.66	9.30	6.31
All regions	23.56	21.17	20.05	15.05	19.24	13.51

Figure 6.4-21: Comparison of regional weighted average brown centre reject levels in kilograms per bearing hectare (2009 to 2014)

Table 6.4-30 shows the statistical differences between the average levels of rejects due to brown centres between the four regions for all seasons from 2009 to 2014. The major differences are:

- Central Queensland farms had a significantly higher average level of rejects due to brown centres than farms in the other three regions.
- Northern Rivers farms had a significantly higher average level of rejects due to brown centres than the South East Queensland and Mid North Coast farms.

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Brown centres %	CQ	SEQ	0.66	0.00***	CQ	0.99
		NRNSW	0.54	0.00***		
		MNNSW	0.64	0.00***		
	SEQ	CQ	-0.66	0.00***	SEQ	0.32
		NRNSW	-0.13	0.00***		
		MNNSW	-0.02	0.68		
	NRNSW	CQ	-0.54	0.00***	NRNSW	0.45
		SEQ	0.13	0.00***		
		MNNSW	0.10	0.03**		
	MNNSW	CQ	-0.64	0.00***	MNNSW	0.35
		SEQ	0.02	0.68		
		NRNSW	-0.10	0.03**		

Table 6.4-30: Comparison of regional average consignment brown centre (%) rejects for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Immaturity by region

Table 6.4-31 shows the average consigned level of rejects due to immaturity for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all years from 2009 to 2014. As with RKR, the figures are inverted (i.e. the lower levels are in the top 25%) as low levels of rejects due to immaturity represent better quality.

The average level of rejects due to immaturity in 2014 (0.75%) was higher than the average from 2009 to 2014 (0.64%).

South East Queensland farms had the highest average levels of rejects due to immaturity in 2014 (1.95%) and over the six years from 2009 to 2014 (0.99%). Northern Rivers farms had the lowest average level of rejects due to immaturity in 2014 (0.43%) and Central Queensland farms had the lowest average level of rejects over the six years (0.49%).

	2014					2009-2014				
	CQ (n=51)	**SEQ** (n=46)	**NRNSW** (n=138)	**MNNSW** (n=24)	**All** (n=259)	**CQ** (n=229)	**SEQ** (n=249)	**NRNSW** (n=688)	**MNNSW** (n=131)	**All** (n=1297)
Top 25%	0.10	0.28	0.13	0.24	0.14	0.12	0.15	0.14	0.16	0.14
Middle 50%	0.34	1.05	0.39	0.54	0.44	0.29	0.51	0.46	0.46	0.44
Bottom 25%	1.64	5.20	0.77	1.03	1.92	1.26	2.77	1.20	1.26	1.54
All percentiles	0.61	1.95	0.43	0.56	0.75	0.49	0.99	0.57	0.59	0.64

Table 6.4-31: Average immaturity rejects (%) for 2014 and for all years from 2009 - 2014

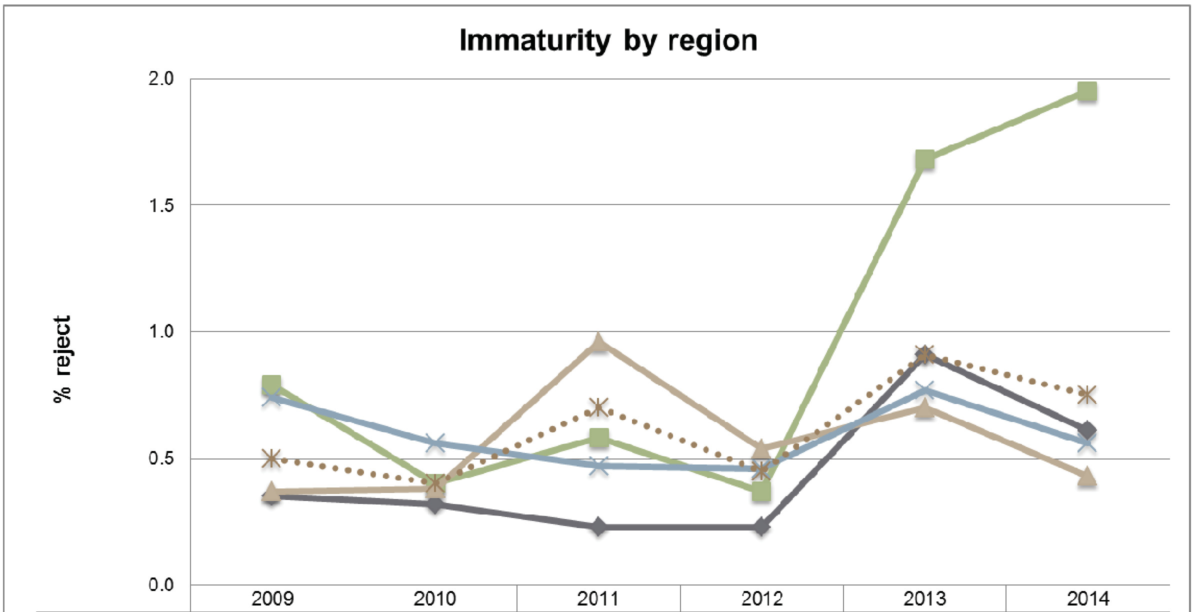
CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-22 shows a comparison of the average levels of rejects due to immaturity from 2009 to 2014 for each of the four regions. There was an increase in the average level of rejects due to immaturity from 2013 to 2014 amongst South East Queensland farms and a decrease amongst farms from the other three regions.

South East Queensland farms had the highest average level of rejects due to immaturity in 2013 and 2014. This increase has largely been attributed to very dry conditions leading to moisture stress during nut growth and development and oil accumulation in the latter halves of 2012 and 2013 following very wet conditions earlier in 2012.

In previous years at the annual macadamia industry pest consultants meetings, pest consultants from Northern Rivers and Mid North Coast and South East Queensland attributed most of the rejects to immaturity resulting from premature nut drop caused by husk spot. Husk spot was not as prevalent during 2012/13 and 2013/14 and was not considered a major cause of immaturity in the 2013 and 2014 crops.

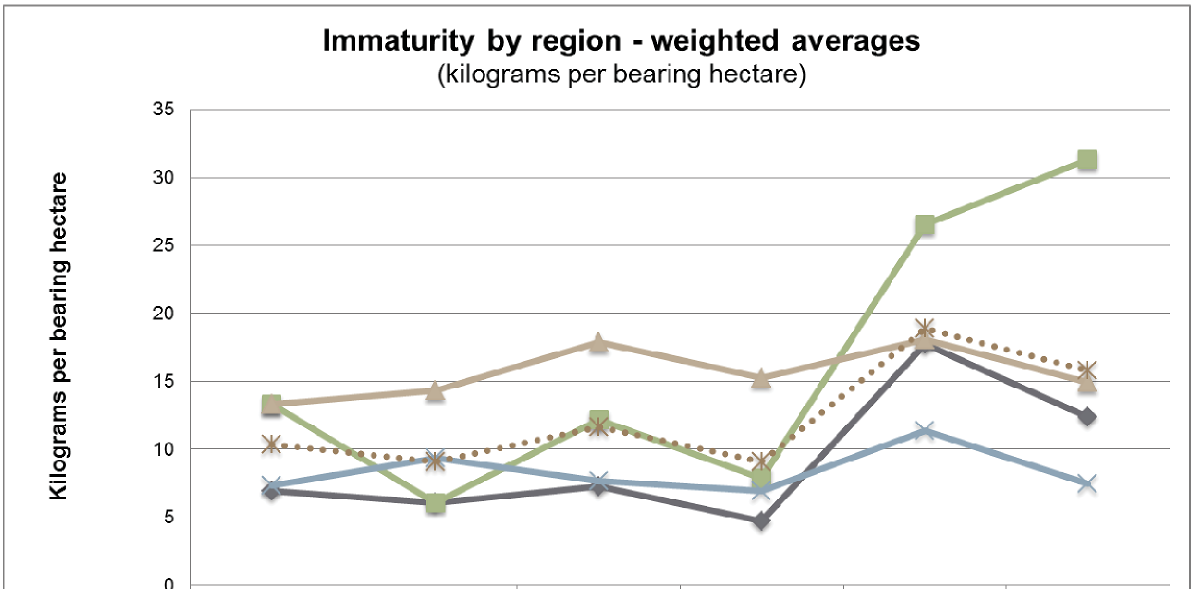


	2009	2010	2011	2012	2013	2014
CQ	0.35	0.32	0.23	0.23	0.91	0.61
SEQ	0.79	0.40	0.58	0.37	1.68	1.95
NRNSW	0.37	0.38	0.96	0.54	0.70	0.43
MNNSW	0.74	0.56	0.47	0.46	0.77	0.56
All regions	0.50	0.40	0.70	0.45	0.91	0.75

Figure 6.4-22: Comparison of average regional immaturity reject levels (2009 to 2014)

Figure 6.4-23 shows the average kilograms rejected due to immaturity per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of reject kernel due to immaturity by the total bearing hectares from the farms in the relevant regions.

There was a decrease in the average kilograms of reject kernel due to immaturity per bearing hectare from 2013 to 2014 amongst farms from Central Queensland, Northern Rivers and Mid North Coast. There was an increase amongst South East Queensland farms from 2012 (7.86 kg) to 2013 (26.55 kg) and to 2014 (31.30 kg). The increase in 2014 was due to the increased average yield of NIS per bearing hectare and the increased percentage of rejects due to immaturity.



	2009	2010	2011	2012	2013	2014
CQ	6.95	6.07	7.30	4.75	17.75	12.41
SEQ	13.29	6.06	12.16	7.86	26.55	31.30
NRNSW	13.30	14.31	17.87	15.27	18.10	14.94
MNNSW	7.37	9.33	7.67	6.91	11.39	7.48
All regions	10.35	9.12	11.64	9.07	18.90	15.83

Figure 6.4-23: Comparison of regional weighted average immaturity reject levels in kilograms per bearing hectare (2009 to 2014)

Table 6.4-32 shows the statistical differences between the average levels of rejects due to immaturity between the four regions for all seasons from 2009 to 2014. The major differences are:

- The South East Queensland farms had a significantly higher average level of rejects due to immaturity than farms in the other three regions.
- There was not a significant difference in the average level of rejects due to immaturity between the Northern Rivers, Central Queensland and Mid North Coast farms.

Bearing farms	Least significant difference					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Immaturity %	CQ	SEQ	-0.51	0.00***	CQ	0.49
		NRNSW	-0.08	0.22		
		MNNSW	-0.11	0.22		
	SEQ	CQ	0.51	0.00***	SEQ	0.99
		NRNSW	0.43	0.00***		
		MNNSW	0.40	0.00***		
	NRNSW	CQ	0.08	0.22	NRNSW	0.57
		SEQ	-0.43	0.00***		
		MNNSW	-0.03	0.66		
	MNNSW	CQ	0.11	0.22	MNNSW	0.59
		SEQ	-0.40	0.00***		
		NRNSW	0.03	0.66		

Table 6.4-32: Comparison of regional average consignment immaturity (%) rejects for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Germination by region

Table 6.4-33 shows the average consigned rejects due to germination for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all years from 2009 to 2014. As with RKR, the figures are inverted (i.e. the lower levels are in the top 25%) as low levels of rejects due to germination represent better quality.

Reject analysis in figures 6.3-8 and 6.3-9 show that the average level of rejects due to germination was the lowest of all the reject categories in each season from 2009 to 2014.

The average level of rejects due to germination in 2014 (0.08%) was similar to the average from 2009 to 2014 (0.09%).

The average level of rejects due to germination was lowest amongst South East Queensland farms in 2014 (0.05%) and was lowest amongst Central Queensland farms in the six years from 2009 to 2014 (0.05%).

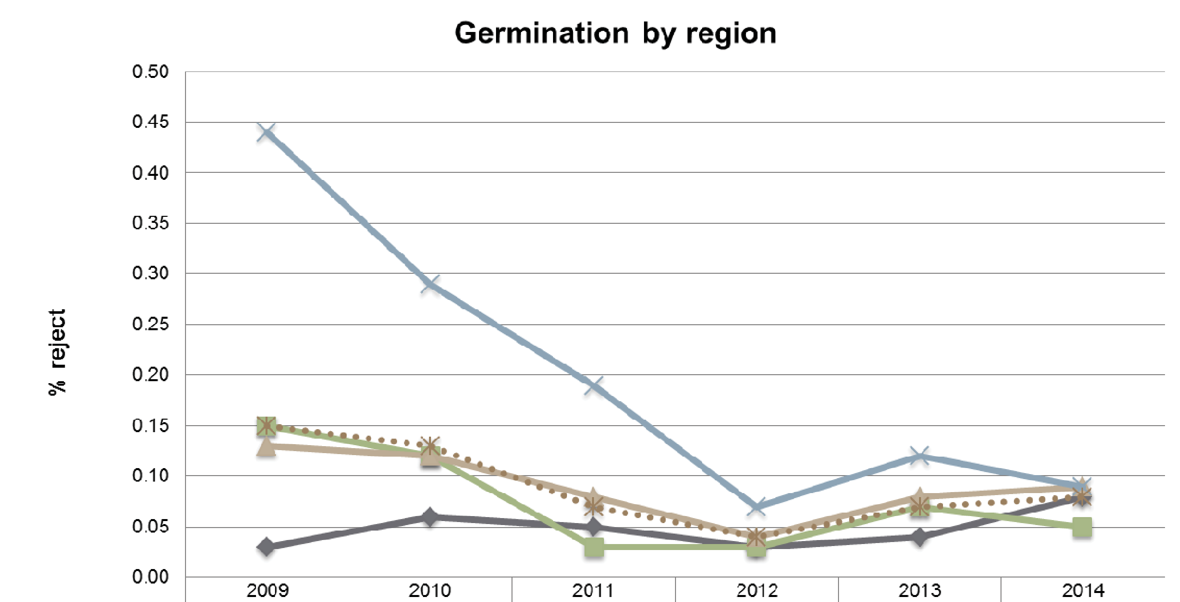
	2014					2009-2014				
	CQ (n=51)	SEQ (n=46)	NRNSW (n=138)	MNNSW (n=24)	All (n=259)	CQ (n=229)	SEQ (n=248)	NRNSW (n=688)	MNNSW (n=129)	All (n=1294)
Top 25%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Middle 50%	0.03	0.01	0.07	0.08	0.07	0.03	0.02	0.05	0.13	0.06
Bottom 25%	0.20	0.14	0.25	0.38	0.25	0.15	0.28	0.32	0.64	0.32
All percentiles	0.08	0.05	0.09	0.09	0.08	0.05	0.07	0.09	0.19	0.09

Table 6.4-33: Average germination rejects (%) for 2014 and for all years from 2009 - 2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-24 shows a comparison of the average level of rejects due to germination from 2009 to 2014 for each of the four regions. Mid North Coast farms had the highest average level of rejects due to germination in each of the six years and particularly from 2009 to 2011. The level of rejects due to germination from Mid North Coast farms decreased sharply from 2009 to 2012. Farms from the other three regions had a similar low level of rejects due to germination from 2011 to 2014.

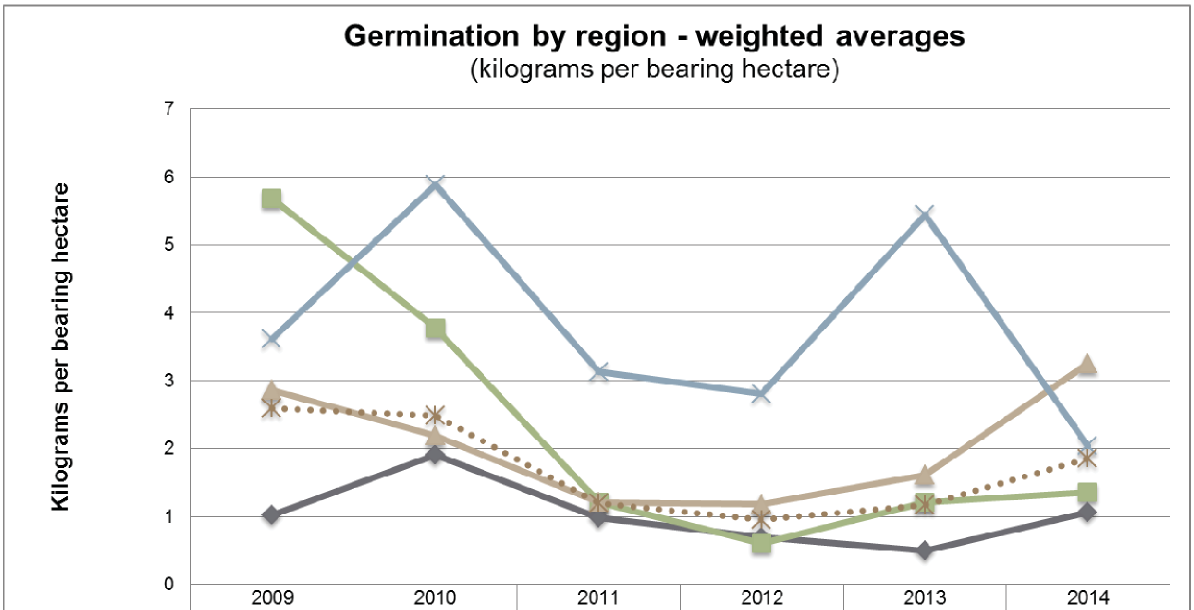


	2009	2010	2011	2012	2013	2014
CQ	0.03	0.06	0.05	0.03	0.04	0.08
SEQ	0.15	0.12	0.03	0.03	0.07	0.05
NRNSW	0.13	0.12	0.08	0.04	0.08	0.09
MNNSW	0.44	0.29	0.19	0.07	0.12	0.09
All regions	0.15	0.13	0.07	0.04	0.07	0.08

Figure 6.4-24: Comparison of average regional germination reject levels (2009 to 2014)

Figure 6.4-25 shows the average kilograms rejected due to germination per bearing hectare for participating farms from each of the regions from 2009 to 2014. It is important to note that these are weighted averages and are calculated by dividing the total kilograms of reject kernel due to germination by the total bearing hectares from the farms in the relevant regions.

There was a large decrease in the average kilograms of reject kernel due to germination per bearing hectare from 2013 to 2014 amongst Mid North Coast farms (from 5.44 kg to 2.04 kg). There was an increase in the average kilograms of reject kernel due to germination per bearing hectare from 2013 to 2014 amongst South East Queensland, Central Queensland and Northern Rivers farms mainly due to the increased yield of NIS per bearing hectare.



	2009	2010	2011	2012	2013	2014
CQ	1.03	1.91	0.98	0.70	0.50	1.07
SEQ	5.69	3.78	1.22	0.61	1.22	1.36
NRNSW	2.87	2.19	1.22	1.19	1.61	3.26
MNNSW	3.62	5.89	3.13	2.81	5.44	2.04
All regions	2.60	2.49	1.20	0.96	1.18	1.86

Figure 6.4-25: Comparison of regional weighted average germination reject levels in kilograms per bearing hectare (2009 to 2014)

Table 6.4-34 shows the statistical differences between the average levels of rejects due to germination between the four regions for all seasons from 2009 to 2014. The major differences are:

- Mid North Coast farms had a significantly higher average level of rejects due to germination than farms in the other three regions.
- Northern Rivers farms had a significantly higher average level of rejects due to germination than the Central Queensland farms.

Bearing farms	Least significant difference					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Germination %	CQ	SEQ	-0.02	0.19	CQ	0.05
		NRNSW	-0.04	0.01***		
		MNNSW	-0.14	0.00***		
	SEQ	CQ	0.02	0.19	SEQ	0.07
		NRNSW	-0.02	0.31		
		MNNSW	-0.12	0.00***		
	NRNSW	CQ	0.04	0.01***	NRNSW	0.09
		SEQ	0.02	0.31		
		MNNSW	-0.11	0.00***		
	MNNSW	CQ	0.14	0.00***	MNNSW	0.19
		SEQ	0.12	0.00***		
		NRNSW	0.11	0.00***		

Table 6.4-34: Comparison of regional average consignment germination (%) rejects for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

NIS moisture content (NIS MC) by region

Table 6.4-35 shows the average nut-in-shell moisture content (NIS MC) at delivery to the processor for the highest 25%, middle 50% and lowest 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and for all years from 2009 to 2014.

The average NIS MC in 2014 (14.63%) was only slightly less than the average from 2009 to 2014 (14.83%).

Average NIS MC was substantially higher in 2014 for Northern Rivers farms (17.2%) than for South East Queensland (13.1%), Mid North Coast (11.86%) and Central Queensland farms (11.26%). This reflects the higher average rainfall during the harvest season in the Northern Rivers and the lower average rainfall during the harvest season in Central Queensland.

The average NIS MC for all six years from 2009 to 2014 was also significantly higher amongst Northern Rivers farms (17.13%) than for South East Queensland (13.35%), Central Queensland (12.05%) and Mid North Coast farms (12.46%).

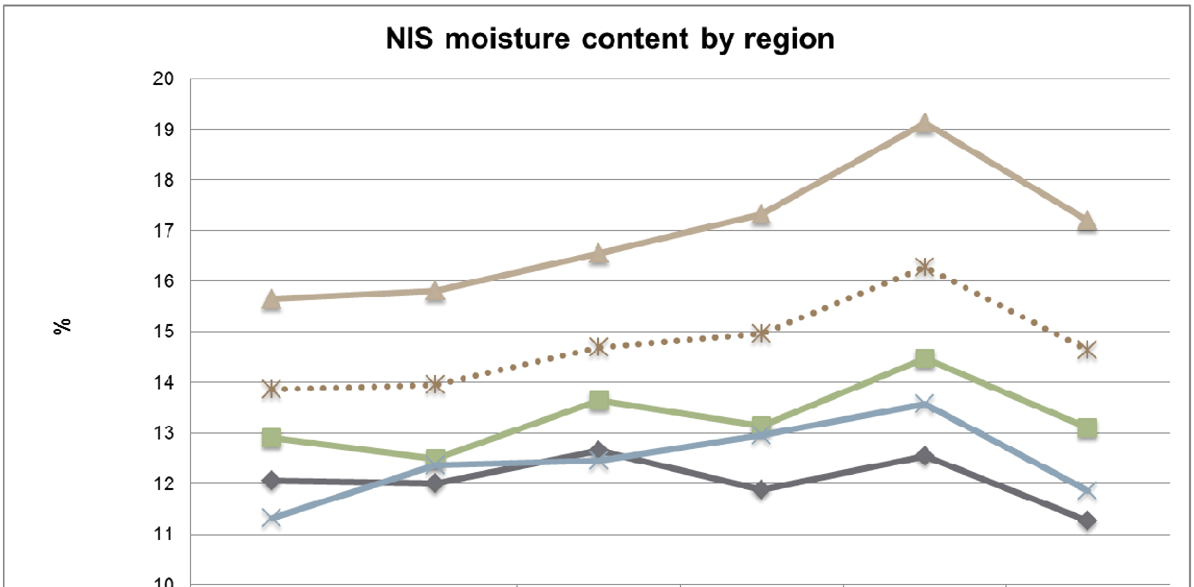
	2014					2009-2014				
	CQ (n=41)	**SEQ** (n=44)	**NRNSW** (n=106)	**MNNSW** (n=24)	**All** (n=215)	**CQ** (n=199)	**SEQ** (n=218)	**NRNSW** (n=503)	**MNNSW** (n=118)	**All** (n=1038)
Top 25%	13.29	17.82	21.29	14.93	19.85	14.70	18.08	21.95	15.38	20.28
Middle 50%	11.02	12.59	17.25	12.10	14.31	11.86	12.79	16.96	12.39	14.26
Bottom 25%	9.72	9.38	13.09	9.26	10.03	9.71	9.72	12.79	9.78	10.47
All percentiles	11.26	13.10	17.20	11.86	14.63	12.05	13.35	17.13	12.46	14.83

Table 6.4-35: Average consigned NIS moisture content (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-26 shows a comparison of the average NIS MC from 2009 to 2014 for each of the four regions. Average NIS MC was less in 2014 for farms in all four regions than in 2013. Northern Rivers farms had the highest average consigned NIS MC in each year from 2009 to 2014. Central Queensland farms had the lowest average consigned NIS MC in 2010, 2012, 2013 and 2014 and Mid North Coast farms the lowest in 2009 and 2011.



	2009	2010	2011	2012	2013	2014
CQ	12.07	12.00	12.65	11.88	12.54	11.26
SEQ	12.91	12.50	13.64	13.14	14.48	13.10
NRNSW	15.65	15.81	16.55	17.32	19.12	17.20
MNNSW	11.33	12.37	12.45	12.97	13.57	11.86
All regions	13.86	13.95	14.69	14.96	16.27	14.63

Figure 6.4-26: Comparison of average regional consigned moisture content (2009 to 2014)

Table 6.4-36 shows the statistical differences between average NIS MC for each region for all seasons from 2009 to 2014. The major differences are:

- Northern Rivers farms had a significantly higher average NIS MC than the farms in the other three regions.
- South East Queensland farms had a significantly higher average NIS MC than Central Queensland and Mid North Coast farms.

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig.	Mean	
Moisture content %	CQ	SEQ	-1.31	0.00***	CQ	12.05
		NRNSW	-5.09	0.00***		
		MNNSW	-0.42	0.15		
	SEQ	CQ	1.31	0.00***	SEQ	13.35
		NRNSW	-3.78	0.00***		
		MNNSW	0.89	0.03**		
	NRNSW	CQ	5.09	0.00***	NRNSW	17.13
		SEQ	3.78	0.00***		
		MNNSW	4.67	0.00***		
	MNNSW	CQ	0.42	0.15	MNNSW	12.46
		SEQ	-0.89	0.03**		
		NRNSW	-4.67	0.00***		

Table 6.4-36: Comparison of regional average consigned NIS moisture content (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

Percentage of whole kernels

Table 6.4-37 shows the average percentage of whole kernels for the top 25%, middle 50% and bottom 25% of farms in Central Queensland, South East Queensland, Northern Rivers and Mid North Coast in 2014 and the average for all years from 2009 to 2014.

The average percentage of whole kernels in all participating farms in 2014 (53.76%) was slightly higher than the average from 2009 to 2014 (52.25%).

The average percentage of whole kernels in 2014 was highest for Mid North Coast farms (60.94%) and lowest for Central Queensland (48.79%), farms. Mid North Coast farms also had the highest average percentage of whole kernels (60.92%) over the six years from 2009 to 2014. South East Queensland farms (50.53%) had the lowest average level of whole kernels over the six years from 2009 to 2014.

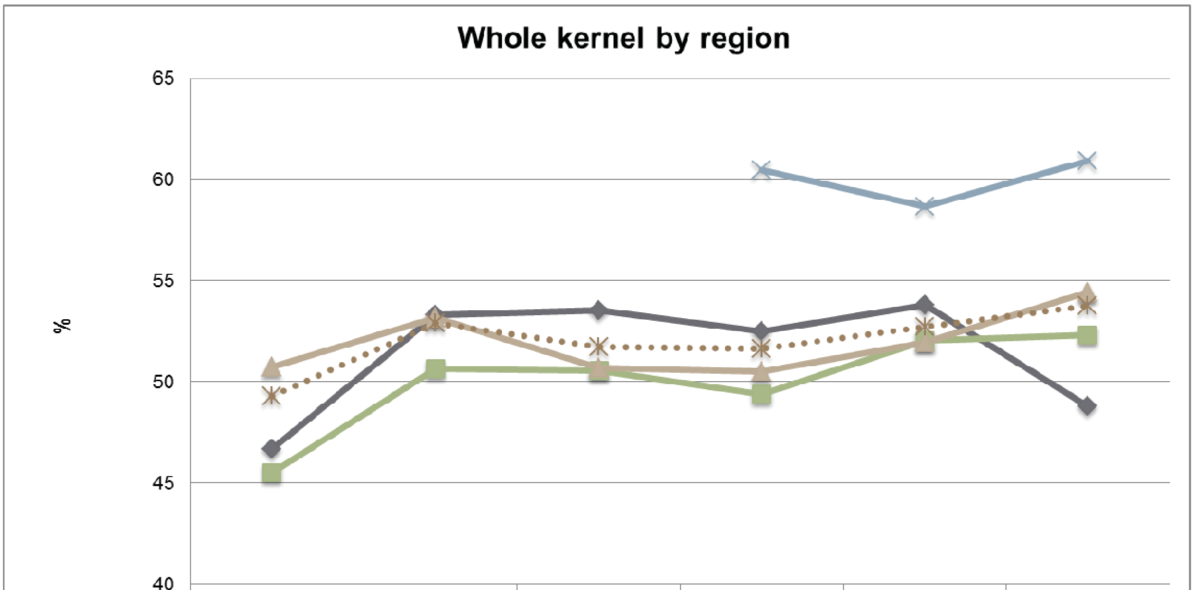
	2014					2009-2014				
	CQ (n=22)	**SEQ** (n=30)	**NRNSW** (n=87)	**MNNSW** (n=13)	**All** (n=152)	**CQ** (n=129)	**SEQ** (n=128)	**NRNSW** (n=385)	**MNNSW** (n=41)	**All** (n=683)
Top 25%	59.23	59.18	64.97	63.7	63.77	60.09	60.78	62.89	65.88	62.69
Middle 50%	51.77	53.93	54.45	61.63	54.46	52.45	50.76	51.99	61.78	52.37
Bottom 25%	35.90	42.72	43.88	54.04	42.37	41.49	39.82	41.68	53.33	41.58
All percentiles	48.79	52.34	54.44	60.94	53.76	51.62	50.53	52.11	60.92	52.25

Table 6.4-37: Average whole kernel (%) for 2014 and for all years from 2009-2014

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

n = the number of farms within the survey sample in each region in each year

Figure 6.4-27 shows a comparison of the average percentage of whole kernels from 2009 to 2014 for each of the four regions. It is important to note that there was only limited data for the percentage of whole kernels from Mid North Coast farms in 2009, 2010 and 2011 so averages for these years from this region have not been included. There was a decrease in the average percentage of whole kernels from Central Queensland farms in 2014 and an increase in the average for farms from the other three regions.



	2009	2010	2011	2012	2013	2014
CQ	46.69	53.33	53.54	52.52	53.81	48.79
SEQ	45.51	50.64	50.54	49.40	52.06	52.34
NRNSW	50.72	53.19	50.68	50.53	51.97	54.44
MNNSW				60.47	58.65	60.94
All regions	49.30	52.89	51.74	51.63	52.74	53.76

Figure 6.4-27: Comparison of average regional percentage whole kernels (2009 to 2014)

*** There was insufficient data from Mid Coast New South Wales to calculate average of whole kernel % for 2009 to 2011.**

Table 6.4-38 shows the statistical differences between the average percentages of whole kernel between the four regions for all seasons from 2009 to 2014. The major differences are:

- Mid North Coast farms had a significantly higher average percentage of whole kernels than the farms in the other three regions.
- Northern Rivers farms had a significantly higher average percentage of whole kernels than the South East Queensland farm

Bearing farms	**Least significant difference**					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig.**	**Mean**	
Whole kernel %	CQ	SEQ	1.09	0.27	CQ	51.62
		NRNSW	-0.48	0.55		
		MNNSW	-9.30	0.00***		
	SEQ	CQ	-1.09	0.27	SEQ	50.53
		NRNSW	-1.58	0.05**		
		MNNSW	-10.39	0.00***		
	NRNSW	CQ	0.48	0.55	NRNSW	52.11
		SEQ	1.58	0.05**		
		MNNSW	-8.81	0.00***		
	MNNSW	CQ	9.30	0.00***	MNNSW	60.92
		SEQ	10.39	0.00***		
		NRNSW	8.81	0.00***		

Table 6.4-38: Comparison of regional average whole kernel (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

CQ = Central Queensland; NRNSW = Northern Rivers New South Wales; MNNSW = Mid North Coast New South Wales and SEQ= South East Queensland

6.5 Results by tree age

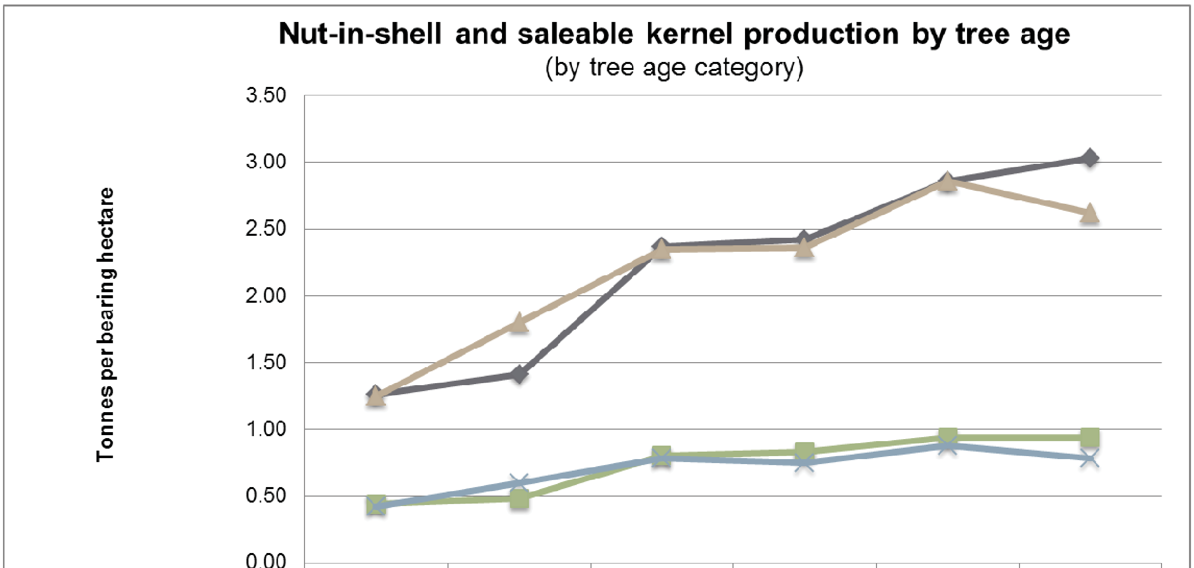
Yield by tree age

Figure 6.5-1 shows a comparison of average yields of NIS and saleable kernel per bearing hectare for 2014 and for all years from 2009 to 2014 for farms from the different tree age categories. Planting densities varied between the farms and this may impact on yields per hectare, particularly during the early bearing years.

There was a similar average yield of NIS and saleable kernel per bearing hectare in 2014 compared with the averages from 2009 to 2014 for the tree age categories from 5 to 7, 10 to 14, 15 to 19 and 20 to 24 years. The average yield per bearing hectare for both NIS and saleable kernel for 25+ year old farms was higher in 2014 than the averages from 2009 to 2014. The reverse was true for farms with trees ages 8 to 9 years.

Average NIS and saleable kernel per bearing hectare for 2009 to 2014 was highest for the 20 to 24 year old category. Average saleable kernel per bearing hectare in 2014 was the same for 20 to 24 year old farms and farms with 25+ year old trees. By comparison, average NIS in 2014 was higher for 25+ year old tree than for those between 20 and 24 years. The difference between NIS and saleable kernel yield was due to higher SKR in 20 to 24 year old farms.

The rate of yield increase was greatest in the early bearing stages. This rate of increase slowed by the time the farms reached an average tree age of between 10 to 14 years.



	5 to 7	8 to 9	10 to 14	15 to 19	20 to 24	25 +
Nut-in-shell 2014	1.26	1.41	2.37	2.42	2.86	3.03
Nut-in-shell 2009-14	1.25	1.80	2.35	2.36	2.86	2.62
Saleable kernel 2014	0.44	0.48	0.80	0.83	0.94	0.94
Saleable kernel 2009-14	0.42	0.60	0.78	0.75	0.88	0.78

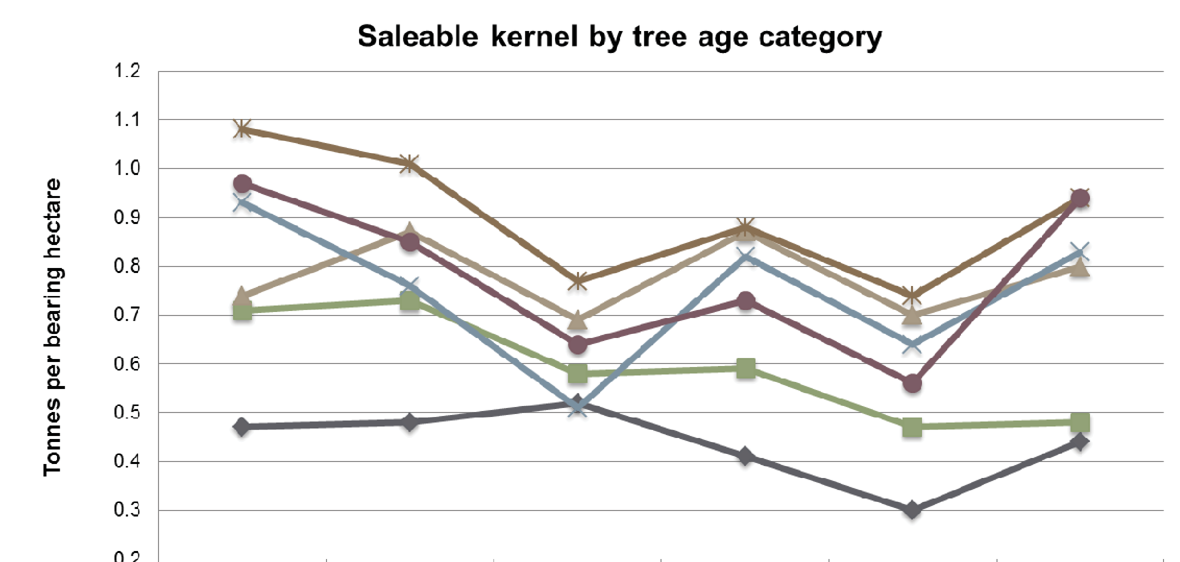
Average tree age (bearing trees only)

Figure 6.5-1: Comparison of tonnes of nut-in-shell (NIS) and saleable kernel per bearing hectare for farms of different average tree ages for 2014 and for all years from 2009-2014.

Figures 6.5-2 and 6.5-3 show trends of average yields of saleable kernel and NIS per bearing hectare by season from 2009 to 2014 for farms from the different average tree age categories. All the tree age categories had an increase in average yield of saleable kernel per bearing hectare from 2013 to 2014. The tree age category of 8 to 9 years had the smallest increase in the yield per bearing hectare of saleable kernel and a decrease in the yield of NIS per bearing hectare from 2013 to 2014. The difference between these two results was due to the higher SKR in 2014. The tree age category of 25 years and older had the largest increase in average yield of both saleable kernel and NIS per bearing hectare from 2013 to 2014.

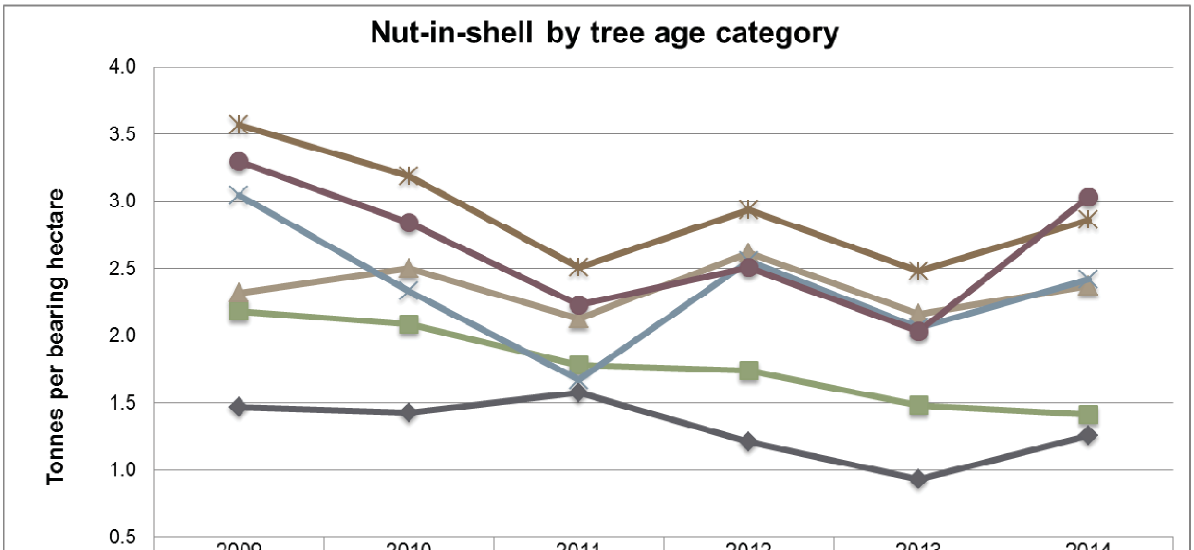
Farms aged 20 to 24 years consistently had the highest average NIS and saleable kernel yield from 2009 to 2013. From 2009 to 2013 the average annual yield difference between 20-24 year old farms and 25+ year old farms ranged between 110 to 180 kilograms of saleable kernel per bearing hectare. This is equivalent to between 270 and 450 kilograms of NIS.

In 2014, 25+ year old farms had the highest NIS yield. These farms equalled the 20-24 year old trees for saleable kernel and exceeded NIS yield by 170 kg per bearing hectare. It is important however to note that there is variability between farms within each of these categories.



	2009	2010	2011	2012	2013	2014
5 to 7	0.47	0.48	0.52	0.41	0.30	0.44
8 to 9	0.71	0.73	0.58	0.59	0.47	0.48
10 to 14	0.74	0.87	0.69	0.87	0.70	0.80
15 to 19	0.93	0.76	0.51	0.82	0.64	0.83
20 to 24	1.08	1.01	0.77	0.88	0.74	0.94
25 +	0.97	0.85	0.64	0.73	0.56	0.94

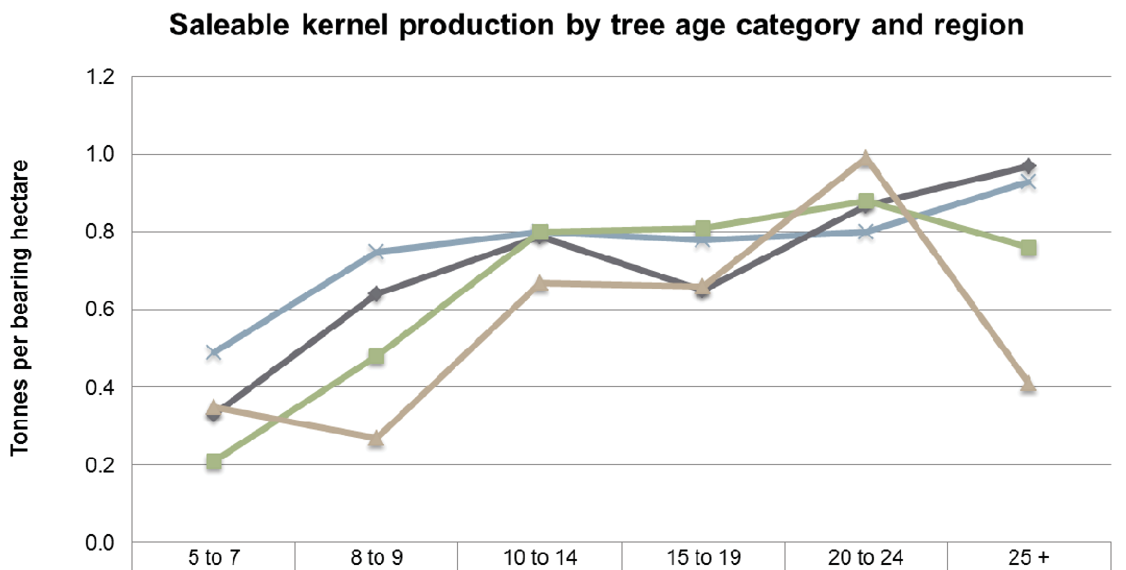
Figure 6.5-2: Saleable kernel per bearing hectare trends for farms of different average tree ages from 2009 to 2014



	2009	2010	2011	2012	2013	2014
5 to 7	1.47	1.43	1.58	1.21	0.93	1.26
8 to 9	2.18	2.09	1.78	1.74	1.48	1.41
10 to 14	2.32	2.50	2.13	2.62	2.16	2.37
15 to 19	3.05	2.33	1.67	2.56	2.06	2.42
20 to 24	3.57	3.19	2.51	2.94	2.48	2.86
25 +	3.30	2.84	2.23	2.51	2.03	3.03

Figure 6.5-3: Nut-in-shell (NIS) per bearing hectare yield trends for farms of different average tree ages from 2009 to 2014.

Figure 6.5-4 shows the average yield of saleable kernel per bearing hectare for farms in the different tree age categories for the four production regions for all years from 2009 to 2014. 25+ year old trees from Central and South East Queensland had a higher yield per bearing hectare than 20 to 24 year old trees. By comparison, 25+ year old farms in the Northern Rivers and Mid North Coast of New South Wales had a lower yield per bearing hectare than 20 to 24 year old farms.



	5 to 7	8 to 9	10 to 14	15 to 19	20 to 24	25 +
CQ	0.49	0.75	0.8	0.78	0.8	0.93
SEQ	0.33	0.64	0.79	0.65	0.87	0.97
NRNSW	0.21	0.48	0.8	0.81	0.88	0.76
MNNSW	0.35	0.27	0.67	0.66	0.99	0.41

Average tree age (bearing trees only)

Figure 6.5-4: Saleable kernel production by tree age category and region for all years from 2009 to 2014.

Figure 6.5-5 shows tonnes of saleable kernel per bearing hectare ranked by tree age for 2009 to 2014. Each point on the chart represents the average yield per hectare (for 2009-2014) for an individual farm.

Farms are colour coded by tree age category based on the weighted average age of trees on the farm over their period of participation in the benchmarking. Farms with the oldest trees (25 years and older) are represented by the dark blue points on the right of the chart and farms with the youngest bearing trees (5 to 7 years) are represented by the light blue points on the left. The red trend line represents the smoothed moving average of the previous 20 points and this has been centred on the chart. Farms with an average bearing tree age of 20 to 24 years (the second group from the right) had the greatest concentration of the highest average yields of saleable kernel per hectare on the trend line.

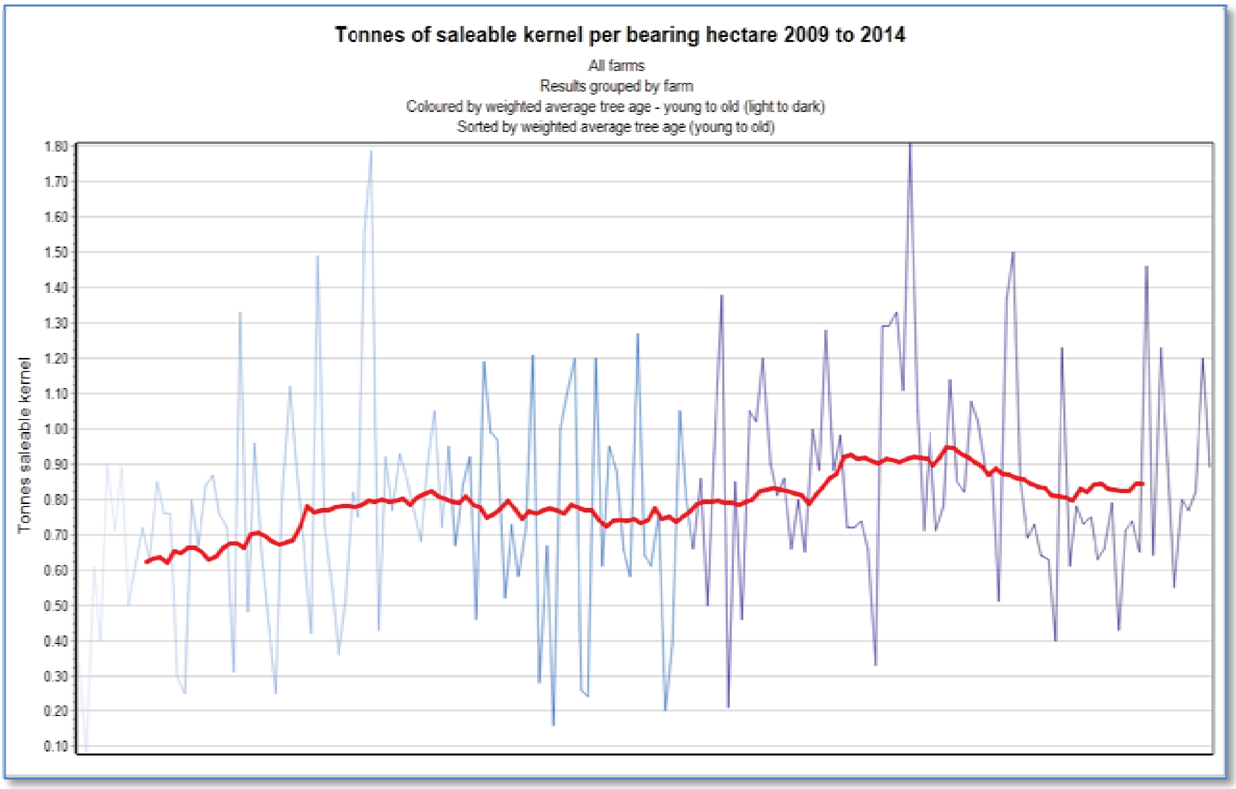


Figure 6.5-5: Tonnes of saleable kernel per bearing hectare by weighted average tree age 2009 to 2014.

Figure 6.5-6 shows the average kilograms of saleable kernel per bearing tree. The youngest farms are on the left and the oldest farms are on the right, based on their weighted average tree age during their period of participation in the benchmarking. The red trend line represents the smoothed moving average of the 20 previous points to the left on the chart.

Kilograms of saleable kernel per bearing tree tend to increase as tree age increases. By comparison, tonnes of saleable kernel per bearing hectare tend to peak in 20 to 24 year old farms. The difference is due to farms aged 25+ years tending to be planted at wider average planting densities (fewer trees per hectare) than 20 to 24 year old farms.

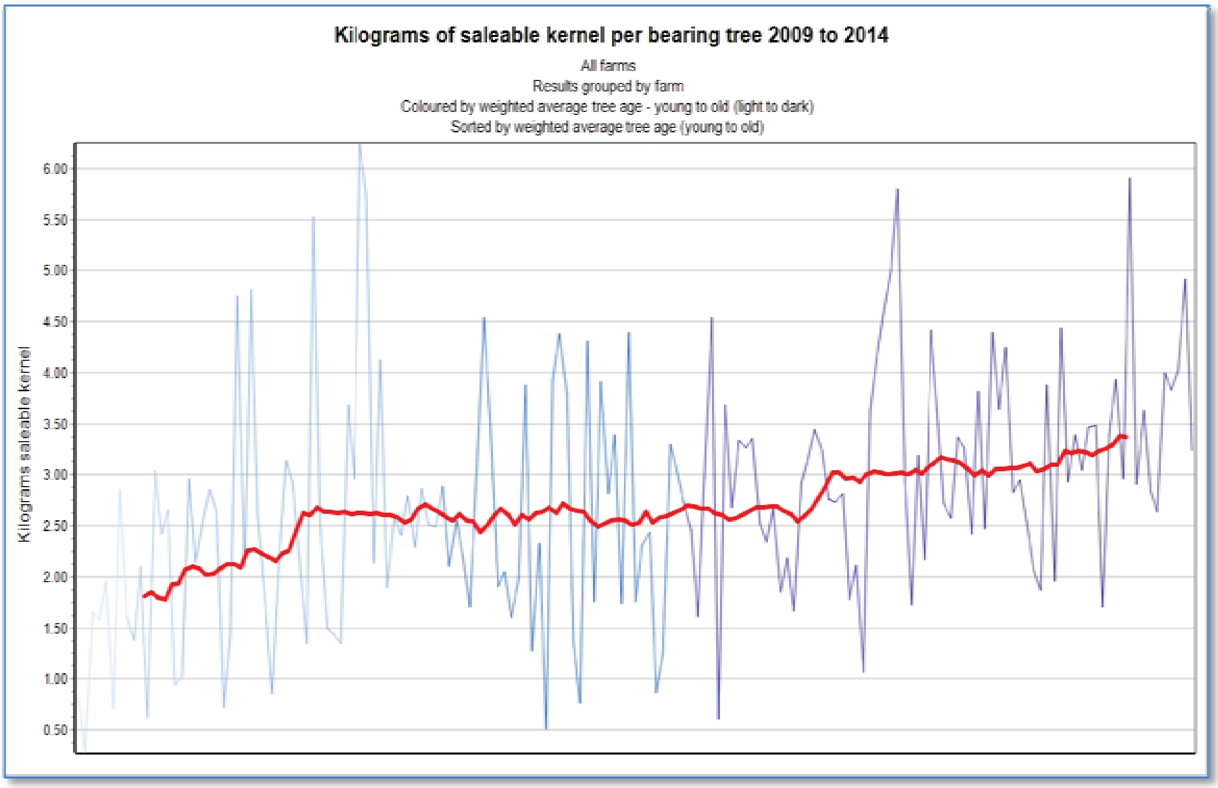


Figure 6.5-6: Kilograms of saleable kernel by weighted average tree age 2009 to 2014.

NIS tonnes per hectare by tree age

Table 6.5-1 shows the statistical differences for average NIS tonnes per hectare for farms in different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 20 to 24 years had significantly higher average NIS tonnes per hectare than farms in all the other tree age categories.
- 25+ year old trees had a significantly higher average NIS tonnes per hectare than farms younger than 20 years.
- Farms aged 15 to 19 years and 10 to 14 years did not have a significantly different average NIS tonnes per hectare. Farms in both of these tree age categories had significantly higher average NIS tonnes per hectare than farms younger than 10 years.
- Also, as expected, farms aged 8 to 9 years had a significantly higher average NIS tonnes per hectare than farms aged 5 to 7 years.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
NIS tonnes per hectare	5 - 7	8 - 9	-0.55	0.00***	1.25
		10 - 14	-1.10	0.00***	
		15 - 19	-1.11	0.00***	
		20 - 24	-1.61	0.00***	
		25+	-1.37	0.00***	
	8 - 9	5 - 7	0.55	0.00***	1.80
		10 - 14	-0.55	0.00***	
		15 - 19	-0.56	0.00***	
		20 - 24	-1.05	0.00***	
		25+	-0.82	0.00***	
	10 - 14	5 - 7	1.10	0.00***	2.35
		8 - 9	0.55	0.00***	
		15 - 19	-0.01	0.95	
		20 - 24	-0.51	0.00***	
		25+	-0.27	0.01***	
	15 - 19	5 - 7	1.11	0.00***	2.36
		8 - 9	0.56	0.00***	
		10 - 14	0.01	0.95	
		20 - 24	-0.50	0.00***	
		25+	-0.27	0.01***	
	20 - 24	5 - 7	1.61	0.00***	2.86
		8 - 9	1.05	0.00***	
		10 - 14	0.51	0.00***	
		15 - 19	0.50	0.00***	
		25+	0.23	0.02**	
	25+	5 - 7	1.37	0.00***	2.62
		8 - 9	0.82	0.00***	
		10 - 14	0.27	0.01***	
		15 - 19	0.27	0.01***	
		20 - 24	-0.23	0.02**	

Table 6.5-1: Comparison of tree age average NIS kernel tonnes per hectare for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Saleable kernel tonnes per hectare by tree age

Table 6.5-2 and 6.5-3 show the statistical differences for average saleable and total kernel tonnes per hectare for farms in different tree age categories for all seasons from 2009 to 2014. The major differences in each of these tables are:

- Farms aged 20 to 24 years had significantly higher saleable kernel tonnes per hectare than farms in all other tree age categories.
- Farms aged 25+ years, 15 to 19 years and 10 to 14 years all had similar saleable kernel tonnes per hectare. Farms in these tree age categories had significantly higher saleable kernel than farms younger than 10 years.
- Also, as expected, farms aged 8 to 9 years had significantly higher average saleable kernel tonnes per hectare than farms aged 5 to 7 years.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Saleable kernel tonnes per hectare	5 - 7	8 - 9	-0.18	0.00***	0.42
		10 - 14	-0.36	0.00***	
		15 - 19	-0.34	0.00***	
		20 - 24	-0.46	0.00***	
		25+	-0.36	0.00***	
	8 - 9	5 - 7	0.18	0.00***	0.60
		10 - 14	-0.18	0.00***	
		15 - 19	-0.15	0.00***	
		20 - 24	-0.28	0.00***	
		25+	-0.17	0.00***	
	10 - 14	5 - 7	0.36	0.00***	0.78
		8 - 9	0.18	0.00***	
		15 - 19	0.03	0.44	
		20 - 24	-0.10	0.00***	
		25+	0.01	0.88	
	15 - 19	5 - 7	0.34	0.00***	0.75
		8 - 9	0.15	0.00***	
		10 - 14	-0.03	0.44	
		20 - 24	-0.13	0.00***	
		25+	-0.02	0.56	
	20 - 24	5 - 7	0.46	0.00***	0.88
		8 - 9	0.28	0.00***	
		10 - 14	0.10	0.00***	
		15 - 19	0.13	0.00***	
		25+	0.11	0.00***	
	25+	5 - 7	0.36	0.00***	0.78
		8 - 9	0.17	0.00***	
		10 - 14	-0.01	0.88	
		15 - 19	0.02	0.56	
		20 - 24	-0.11	0.00	

Table 6.5-2: Comparison of tree age average saleable kernel tonnes per hectare for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Total kernel tonnes per ha	5 – 7	8 - 9	-0.20	0.00***	0.44
		10 - 14	-0.40	0.00***	
		15 - 19	-0.37	0.00***	
		20 - 24	-0.50	0.00***	
		25+	-0.39	0.00***	
	8 – 9	5 - 7	0.20	0.00***	0.65
		10 - 14	-0.19	0.00***	
		15 - 19	-0.17	0.00***	
		20 - 24	-0.30	0.00***	
		25+	-0.19	0.00***	
	10 – 14	5 - 7	0.40	0.00***	0.84
		8 - 9	0.19	0.00***	
		15 - 19	0.03	0.42	
		20 - 24	-0.10	0.00***	
		25+	0.01	0.87	
	15 – 19	5 - 7	0.37	0.00***	0.81
		8 - 9	0.17	0.00***	
		10 - 14	-0.03	0.42	
		20 - 24	-0.13	0.00***	
		25+	-0.02	0.54	
	20 - 24	5 - 7	0.50	0.00***	0.94
		8 - 9	0.30	0.00***	
		10 - 14	0.10	0.00***	
		15 - 19	0.13	0.00***	
		25+	0.11	0.00***	
	25+	5 - 7	0.39	0.00***	0.84
		8 - 9	0.19	0.00***	
		10 - 14	-0.01	0.87	
		15 - 19	0.02	0.54	
		20 - 24	-0.11	0.00***	

Table 6.5-3: Comparison of tree age average total kernel tonnes per hectare for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

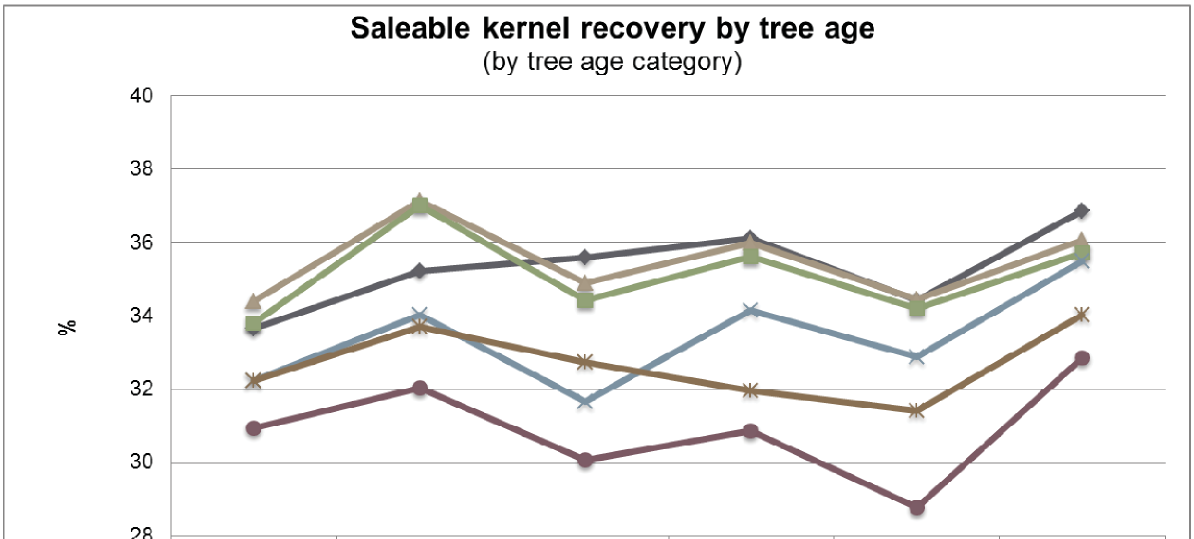
Quality by tree age

Saleable kernel recovery (SKR) by tree age

Figure 6.5-8 shows the average SKR from 2009 to 2014 for farms in different tree age categories. SKR is equivalent to the sum of premium (PKR) and commercial (CKR) kernel recovery in the benchmarking study.

25+ year old farms had the lowest average SKR in each year of the benchmarking study. Farms younger than 15 years had a higher average SKR each year than farms aged 15 years or older. Much of this difference is due to many of the cultivars planted on the older farms having a lower potential kernel recovery than cultivars planted on younger farms. The difference in average SKR for the 5 to 7 year old farms compared with 25+ year older farms ranged from 2.73% in 2009 to 5.66% in 2013.

There was a general increase in average SKR from 2013 to 2014 across all tree age categories. The largest increase was amongst farms in the tree age category of 25 years and older from 28.77% in 2013 to 32.85% in 2014 (an increase of 4.08%). Farms aged 5 to 7 years or 15 years and older achieved their highest average SKR in 2014 since the benchmarking began in 2009. Although there were modest SKR gains for farms aged 8 to 14 years in 2014, these were generally in lined with their longer term average performance.



	2009	2010	2011	2012	2013	2014
5 to 7	33.66	35.23	35.60	36.13	34.43	36.87
8 to 9	34.40	37.14	34.89	36.00	34.45	36.06
10 to 14	33.80	37.02	34.42	35.62	34.20	35.71
15 to 19	32.24	34.02	31.67	34.16	32.88	35.49
20 to 24	32.24	33.71	32.72	31.95	31.41	34.02
25 +	30.93	32.03	30.07	30.86	28.77	32.85

Figure 6.5-8: Saleable kernel recovery by tree age category for each year from 2009 to 2014.

Figure 6.5-9 shows average SKR for all farms sorted by average tree age. The youngest farms are on the left and the oldest farms on the right based on the average tree age of the farm over their period of participation in the benchmarking. The red trend line represents the smoothed moving average of the 20 previous points. There is a general downward trend in SKR as average tree increases.

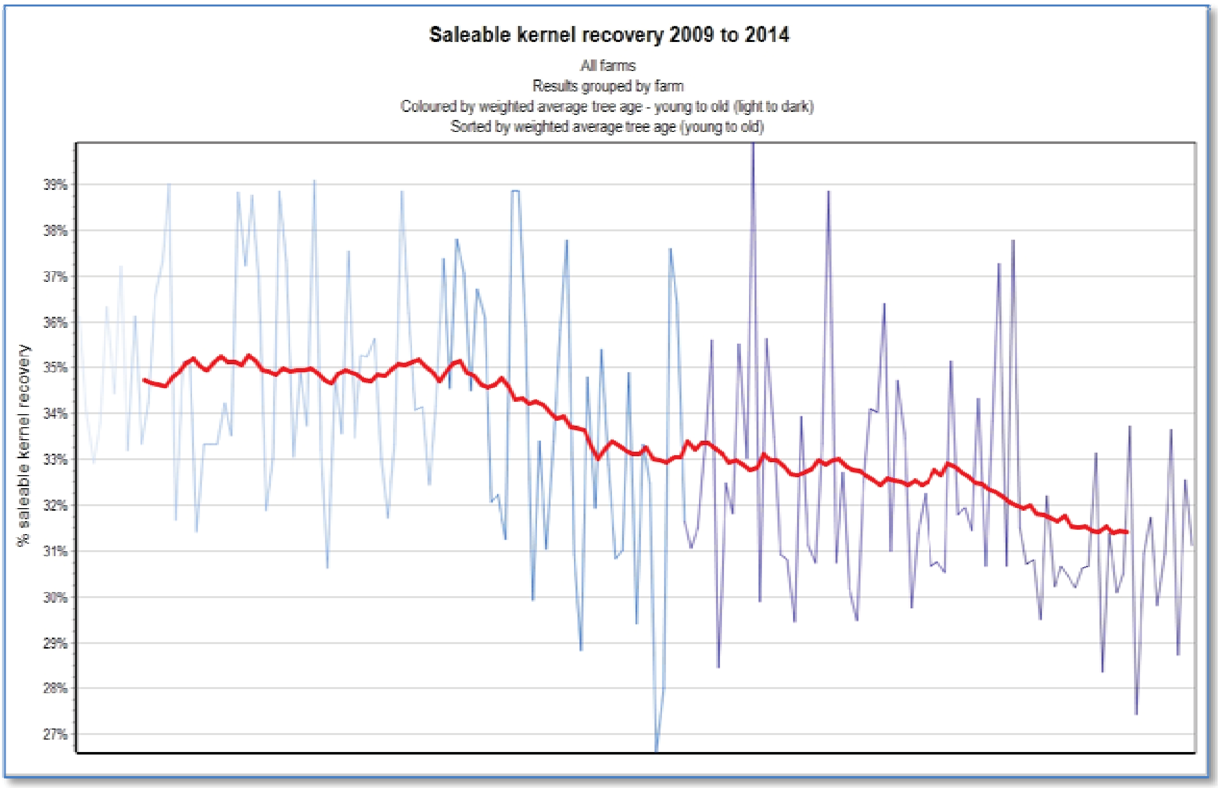


Figure 6.5-9: Saleable kernel recovery by weighted average tree age for all years 2009 to 2014.

Table 6.5-4 shows the statistical differences between average SKR for farms in different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms 25+ years and older had significantly lower average SKR than farms in all the other tree age categories.
- Farms aged from 20 to 24 years had a significantly lower average SKR than farms younger than 20 years.
- Farms aged 15 to 19 years had a significantly lower average SKR than farms younger than 15 years.
- Farms aged from 5 to 7 years, 8 to 9 years and 10 to 14 years had similar average SKR.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Saleable kernel recovery %	5 - 7	8 - 9	-0.07	0.88	35.40
		10 - 14	0.30	0.39	
		15 - 19	1.84	0.00***	
		20 - 24	2.82	0.00***	
		25+	4.37	0.00***	
	8 - 9	5 - 7	0.07	0.88	35.47
		10 - 14	0.37	0.35	
		15 - 19	1.90	0.00***	
		20 - 24	2.89	0.00***	
		25+	4.44	0.00***	
	10 - 14	5 - 7	-0.30	0.39	35.10
		8 - 9	-0.37	0.35	
		15 - 19	1.53	0.00***	
		20 - 24	2.52	0.00***	
		25+	4.07	0.00***	
	15 - 19	5 - 7	-1.84	0.00***	33.57
		8 - 9	-1.90	0.00***	
		10 - 14	-1.53	0.00***	
		20 - 24	0.98	0.00***	
		25+	2.54	0.00***	
	20 - 24	5 - 7	-2.82	0.00***	32.58
		8 - 9	-2.89	0.00***	
		10 - 14	-2.52	0.00***	
		15 - 19	-0.98	0.00***	
		25+	1.55	0.00***	
	25+	5 - 7	-4.37	0.00***	31.03
		8 - 9	-4.44	0.00***	
		10 - 14	-4.07	0.00***	
		15 - 19	-2.54	0.00***	
		20 - 24	-1.55	0.00***	

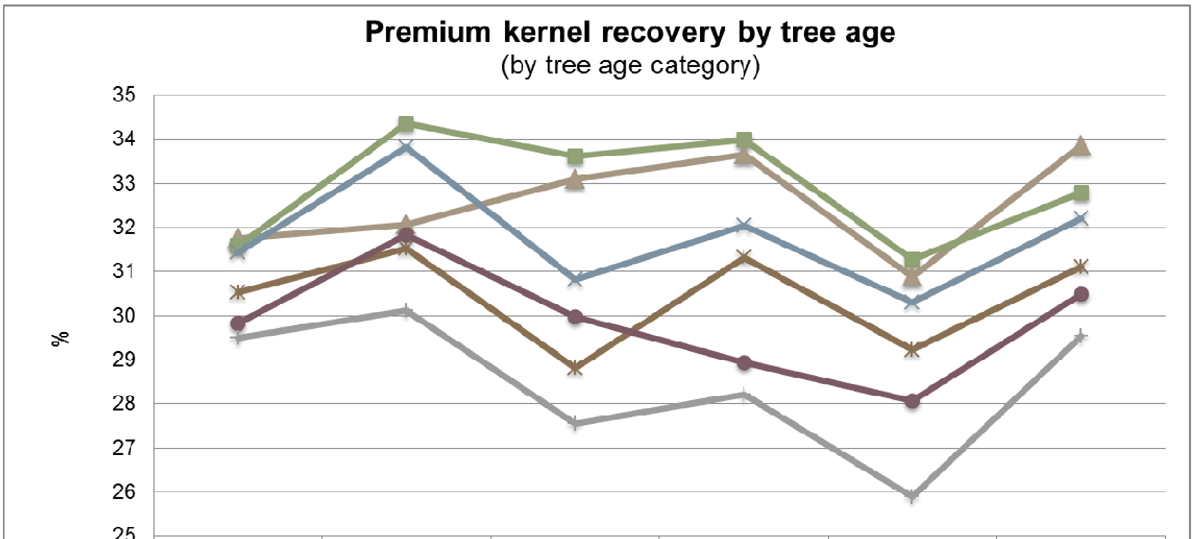
Table 6.5-4: Comparison of tree age average saleable kernel recovery for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Premium kernel recovery (PKR) by tree age

Figure 6.5-10 shows average PKR from 2009 to 2014 for farms in different tree age categories. Farms in each of the tree age categories younger than 15 years had a higher average PKR each year than 15+ year old farms. Much of this difference is due to many cultivars planted on older farms having a potentially lower kernel recovery than cultivars planted on younger farms. The difference in average PKR for farms aged 5 to 7 years compared with farms aged 25+ varied from 2.26% in 2009 to 5.44% in 2012.

There was an increase in the average PKR from 2013 to 2014 amongst farms in all the tree age categories. The largest increase was amongst 25+ year old farms from 25.89% in 2013 to 29.54% in 2014 (an increase of 3.65%). By comparison, there was a smaller increase from 2013 to 2014 amongst 8 to 9 year old farms (1.52%). The 5 to 7 year old category achieved the highest average PKR (33.87%) since the benchmarking began in 2009. Farms aged from 10 to 14 years, 20 to 24 years and 25+ years achieved their highest average PKR since 2010.



	2009	2010	2011	2012	2013	2014
5 to 7	31.76	32.06	33.11	33.66	30.89	33.87
8 to 9	31.59	34.36	33.62	33.98	31.28	32.80
10 to 14	31.44	33.82	30.83	32.05	30.31	32.21
15 to 19	30.54	31.53	28.82	31.33	29.24	31.11
20 to 24	29.83	31.83	29.98	28.94	28.08	30.50
25 +	29.50	30.12	27.56	28.22	25.89	29.54

Figure 6.5-10: Premium kernel recovery by tree age category for each year from 2009 to 2014.

Table 6.5-5 shows the statistical differences between average PKR for farms in each of the tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 25+ years had a significantly lower average PKR than farms in all the other tree age categories.
- Farms aged 20 to 24 years had significantly lower average PKR than farms younger than 20 years.
- Farms aged 15 to 19 years had significantly lower average PKR than farms younger than 15 years.
- Farms age 10 to 14 years had significantly lower average PKR than farms younger than 10 years.
- Farms aged 5 to 7 years and 8 to 9 years had similar PKR.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Premium kernel recovery %	5 - 7	8 - 9	-0.28	0.55	32.55
		10 - 14	0.79	0.03**	
		15 - 19	2.10	0.00***	
		20 - 24	2.91	0.00***	
		25+	4.18	0.00***	
	8 - 9	5 - 7	0.28	0.55	32.84
		10 - 14	1.08	0.01***	
		15 - 19	2.38	0.00***	
		20 - 24	3.19	0.00***	
		25+	4.47	0.00***	
	10 - 14	5 - 7	-0.79	0.03**	31.76
		8 - 9	-1.08	0.01***	
		15 - 19	1.30	0.00***	
		20 - 24	2.11	0.00***	
		25+	3.39	0.00***	
	15 - 19	5 - 7	-2.10	0.00***	30.46
		8 - 9	-2.38	0.00***	
		10 - 14	-1.30	0.00***	
		20 - 24	0.81	0.00***	
		25+	2.09	0.00***	
	20 - 24	5 - 7	-2.91	0.00***	29.64
		8 - 9	-3.19	0.00***	
		10 - 14	-2.11	0.00***	
		15 - 19	-0.81	0.00***	
		25+	1.28	0.00***	
	25+	5 - 7	-4.18	0.00***	28.37
		8 - 9	-4.47	0.00***	
		10 - 14	-3.39	0.00***	
		15 - 19	-2.09	0.00***	
		20 - 24	-1.28	0.00***	

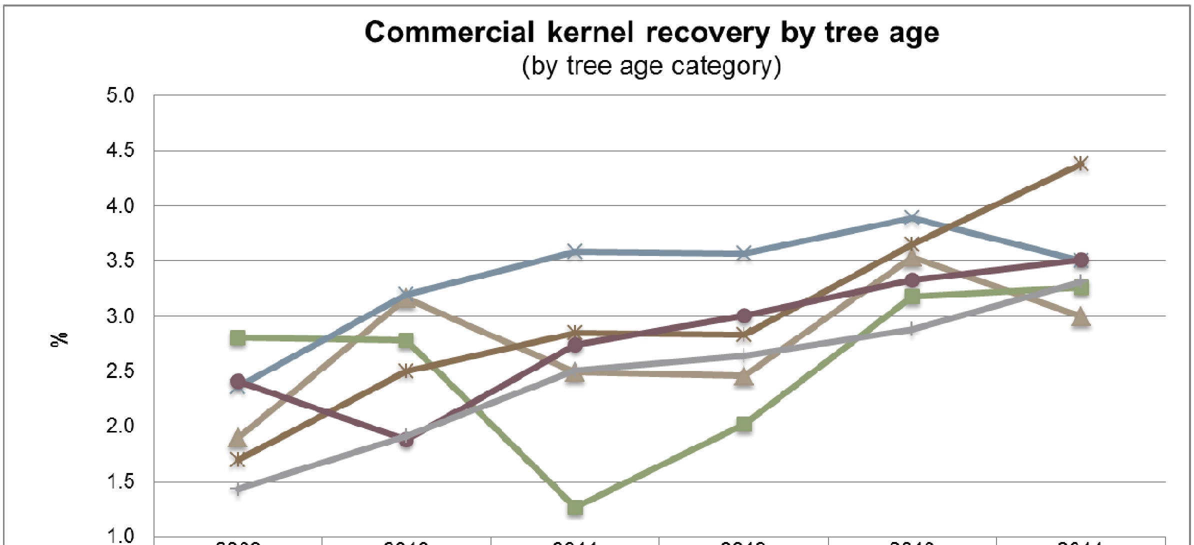
Table 6.5-5: Comparison of tree age average premium kernel recovery for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Commercial kernel recovery (CKR) by tree age

Figure 6.5-11 shows average CKR from 2009 to 2014 for farms in the different tree age categories. There has been an increasing trend in average CKR amongst farms in the benchmarking from 2009 to 2014. It is important to note that one processor in South East Queensland does not report CKR and another processor in South East Queensland only introduced the reporting of CKR in 2010.

The greatest increase in average CKR has been amongst farms aged 15 to 19 years from 2009 to 2014 (2.68%) and from 2013 to 2014 (0.73%). By comparison, there was a decrease in average CKR from 2013 to 2014 amongst farms 5 to 7 year old farms (0.54%) and 10 to 14 year old farms (0.39%). Farms aged 8 to 9, 20 to 24 and 25+ years had a small increase in average CKR from 2013 to 2014. Farms aged 10 to 14 years had the highest average CKR from 2010 to 2013.



	2009	2010	2011	2012	2013	2014
5 to 7	1.90	3.16	2.49	2.46	3.54	3.00
8 to 9	2.81	2.78	1.27	2.02	3.18	3.26
10 to 14	2.36	3.20	3.59	3.57	3.89	3.50
15 to 19	1.70	2.50	2.85	2.83	3.65	4.38
20 to 24	2.41	1.88	2.74	3.01	3.33	3.51
25 +	1.43	1.91	2.51	2.64	2.88	3.31

Figure 6.5-11: Commercial kernel recovery by tree age category for each year from 2009 to 2014.

Table 6.5-6 shows the statistical differences between average CKR for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 10 to 14 years had a significantly higher average CKR than farms in all the other tree age categories except for 15 to 19 year old farms.
- Farms aged 15 to 19 had a significantly higher average CKR than farms aged 8 to 9 years and 25+ years.

Bearing farms	Least significant difference				
Dependent variable	Tree age (I)	Tree Age (J)	Mean difference (I-J)	Sig	Mean
Commercial kernel recovery %	5 - 7	8 - 9	0.21	0.42	2.85
		10 - 14	-0.49	0.02**	
		15 - 19	-0.26	0.22	
		20 - 24	-0.09	0.67	
		25+	0.19	0.39	
	8 - 9	5 - 7	-0.21	0.42	2.63
		10 - 14	-0.70	0.00***	
		15 - 19	-0.47	0.04**	
		20 - 24	-0.30	0.19	
		25+	-0.03	0.92	
	10 - 14	5 - 7	0.49	0.02**	3.34
		8 - 9	0.70	0.00***	
		15 - 19	0.23	0.17	
		20 - 24	0.40	0.02**	
		25+	0.68	0.00***	
	15 - 19	5 - 7	0.26	0.22	3.11
		8 - 9	0.47	0.04**	
		10 - 14	-0.23	0.17	
		20 - 24	0.17	0.30	
		25+	0.45	0.01***	
	20 - 24	5 - 7	0.09	0.67	2.94
		8 - 9	0.30	0.19	
		10 - 14	-0.40	0.02**	
		15 - 19	-0.17	0.30	
		25+	0.28	0.11	
	25+	5 - 7	-0.19	0.39	2.66
		8 - 9	0.03	0.92	
		10 - 14	-0.68	0.00***	
		15 - 19	-0.45	0.01***	
		20 - 24	-0.28	0.11	

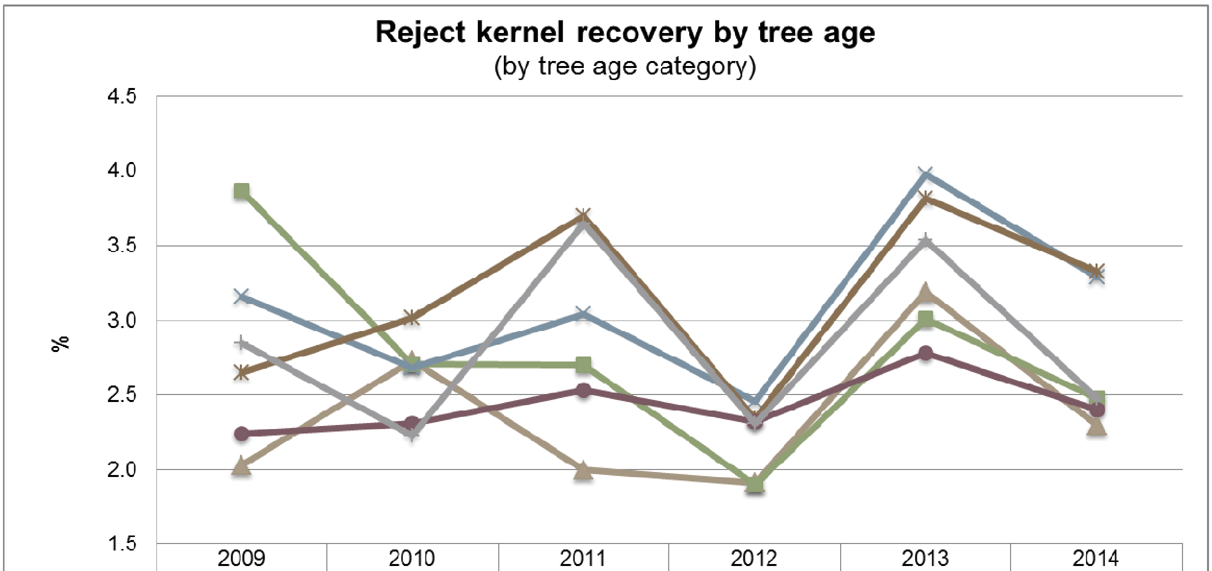
Table 6.5-6: Comparison of tree age average commercial kernel recovery for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Reject kernel recovery (RKR)

Figure 6.5-12 shows the average RKR from 2009 to 2014 for farms in the different tree age categories. Farms in each of the tree age categories had a decrease in average RKR from 2013 to 2014 after an increase from 2012 to 2013. Farms aged 25+ years had the largest decrease (1.06%) from 3.54% in 2013 to 2.48% in 2014. Farms aged 20 to 24 years had the smallest decrease (0.38%) from 2013 to 2014 after having the smallest increase (0.23%) from 2012 to 2013.

Farms aged 10 to 14, 15 to 19 and 25+ years had the highest average RKR in each year from 2011 to 2014.



	2009	2010	2011	2012	2013	2014
5 to 7	2.03	2.73	2.00	1.91	3.19	2.30
8 to 9	3.87	2.71	2.70	1.90	3.01	2.48
10 to 14	3.16	2.68	3.04	2.46	3.98	3.29
15 to 19	2.65	3.02	3.70	2.34	3.82	3.33
20 to 24	2.24	2.31	2.53	2.32	2.78	2.40
25 +	2.85	2.23	3.65	2.31	3.54	2.48

Figure 6.5-12: Reject kernel recovery by tree age category for each year from 2009 to 2014.

Figure 6.5-13 shows the average RKR for all farms in the benchmarking sorted by average tree age. The youngest farms are on the left and the oldest farms on the right, based on the average tree age of each farm during its period of participation in benchmarking. The red trend line represents the smoothed moving average of the 20 previous points. There is no significant trend as average tree age increases.

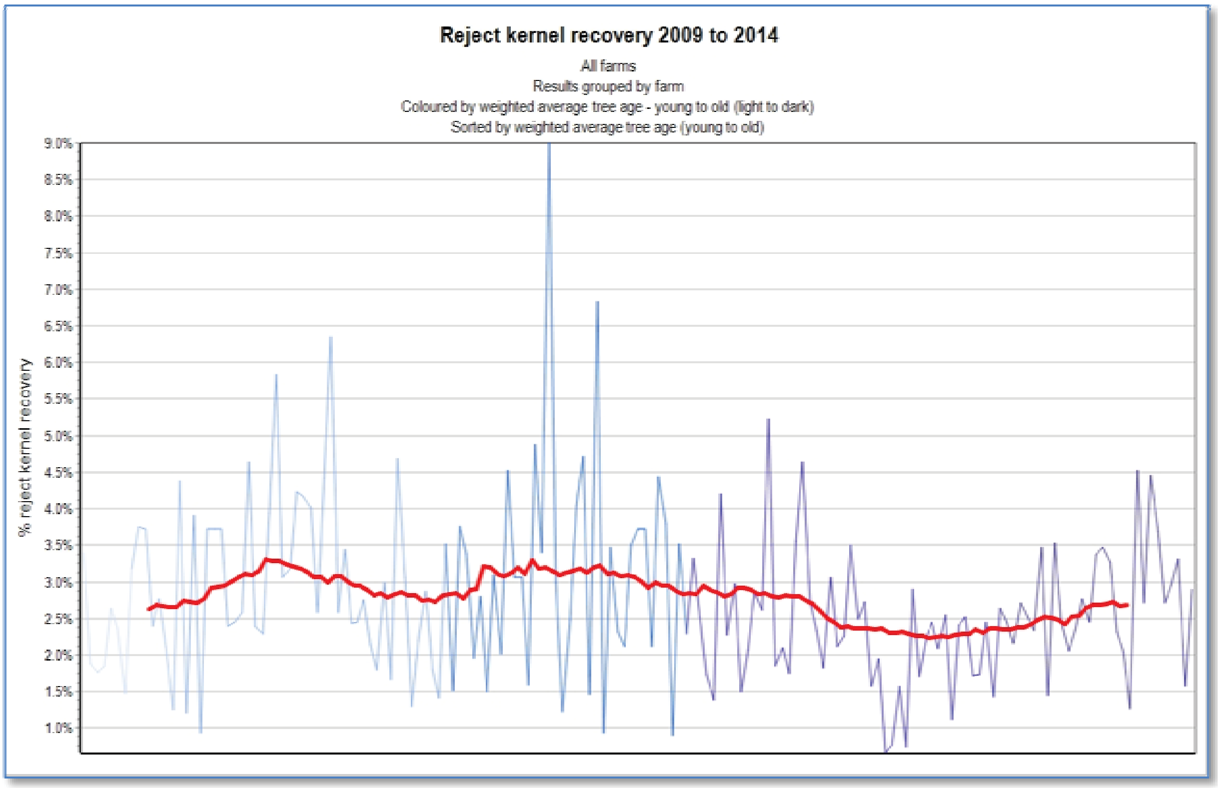


Figure 6.5-13: Average reject kernel recovery by weighted average tree age for all years 2009-2014.

Table 6.5-7 shows the statistical differences between average RKR for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 5 to 7 years and 20 to 24 years had a significantly lower average RKR than farms in all the other tree age categories.
- Farms aged 15 to 19 years had a significantly higher average RKR than farms aged 20+ years.

Bearing farms	Least significant difference				
Dependent variable	Tree age (I)	Tree Age (J)	Mean difference (I-J)	Sig	Mean
Reject kernel recovery %	5 - 7	8 - 9	-0.46	0.05**	2.41
		10 - 14	-0.67	0.00***	
		15 - 19	-0.75	0.00***	
		20 - 24	-0.05	0.80	
		25+	-0.42	0.03**	
	8 - 9	5 - 7	0.46	0.05**	2.87
		10 - 14	-0.21	0.32	
		15 - 19	-0.29	0.17	
		20 - 24	0.42	0.04**	
		25+	0.04	0.84	
	10 - 14	5 - 7	0.67	0.00***	3.08
		8 - 9	0.21	0.32	
		15 - 19	-0.08	0.60	
		20 - 24	0.62	0.00***	
		25+	0.25	0.12	
	15 - 19	5 - 7	0.75	0.00***	3.16
		8 - 9	0.29	0.17	
		10 - 14	0.08	0.60	
		20 - 24	0.70	0.00***	
		25+	0.33	0.03**	
	20 - 24	5 - 7	0.05	0.80	2.46
		8 - 9	-0.42	0.04**	
		10 - 14	-0.62	0.00***	
		15 - 19	-0.70	0.00***	
		25+	-0.37	0.01***	
	25+	5 - 7	0.42	0.03**	2.83
		8 - 9	-0.04	0.84	
		10 - 14	-0.25	0.12	
		15 - 19	-0.33	0.03**	
		20 - 24	0.37	0.01***	

Table 6.5-7: Comparison of tree age average reject kernel recovery for all seasons combined

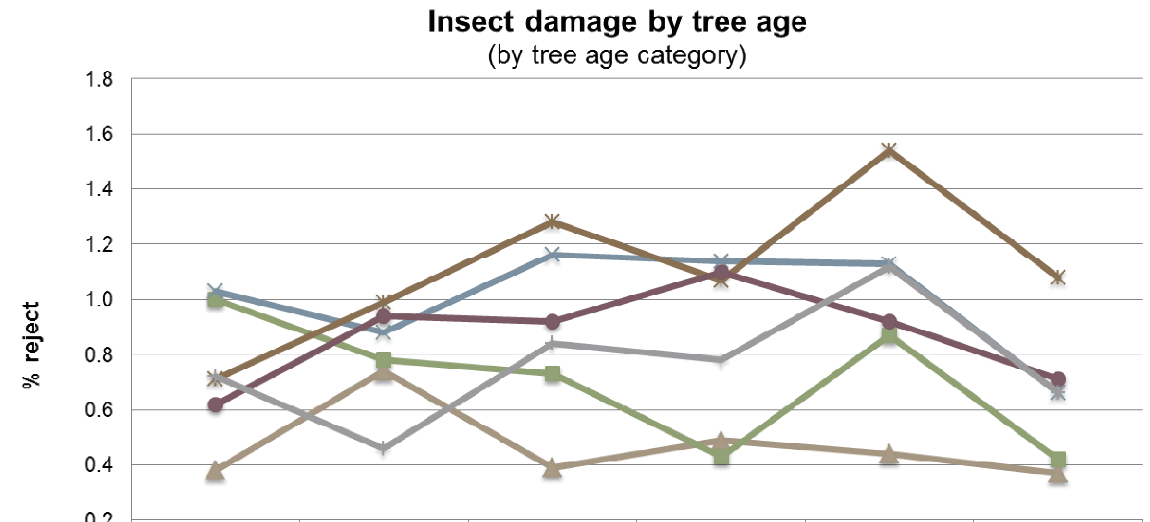
* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Insect damage by tree age

Figure 6.5-14 shows average consigned rejects due to insect damage from 2009 to 2014 for farms in the different tree age categories.

The farms in each of the tree age categories had a decrease in the average level of rejects due to insect damage from 2013 to 2014. The biggest decrease was amongst farms aged 8 to 9 years (0.45%), 10 to 14 years (0.47%), 15 to 19 years (0.46%) and 25+ years (0.46%). There was a smaller decrease amongst 5 to 7 year old (0.07%) and 20 to 24 year old farms (0.21%). The farms in these two categories had also a small decrease in average rejects due to insect damage from 2012 to 2013.

Farms aged 15 to 19 years had the highest average level of rejects due to insect damage in 2010, 2011, 2013 and 2014. Farms aged 5 to 7 years had the lowest average level of rejects due to insect damage in 2009, 2011, 2013 and 2014.



	2009	2010	2011	2012	2013	2014
5 to 7	0.38	0.74	0.39	0.49	0.44	0.37
8 to 9	1.00	0.78	0.73	0.43	0.87	0.42
10 to 14	1.03	0.88	1.16	1.14	1.13	0.66
15 to 19	0.71	0.99	1.28	1.07	1.54	1.08
20 to 24	0.62	0.94	0.92	1.10	0.92	0.71
25 +	0.72	0.46	0.84	0.78	1.12	0.66

Figure 6.5-14: Comparison of average insect damage reject levels by tree age category (2009 to 2014)

Table 6.1-8 shows that insect damage is positively correlated with mould, discolouration and germination and negatively correlated with brown centres.

Table 6.5-8 shows the statistical differences between average levels of rejects due to insect damage for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 15 to 19 years had a significantly higher insect damage reject than farms in all the other tree age categories apart from 10 to 14 years.
- Farms aged 10 to 14 years had a significantly higher insect damage reject than farms aged 5 to 7, 8 to 9 and 25+ years old.
- Farms aged 5 to 7 years had significantly lower average insect reject levels than farms in all other tree age groups.
- There was no significant difference in average insect reject levels between farms aged 8 to 9 years, 20 to 24 years and 25+ years of age.

Bearing farms	Least significant difference				
Dependent variable	Tree age (I)	Tree Age (J)	Mean difference (I-J)	Sig	Mean
Insect damage %	5 - 7	8 - 9	-0.27	0.07*	0.46
		10 - 14	-0.55	0.00***	
		15 - 19	-0.66	0.00***	
		20 - 24	-0.43	0.00***	
		25+	-0.32	0.01***	
	8 - 9	5 - 7	0.27	0.07*	0.73
		10 - 14	-0.29	0.03**	
		15 - 19	-0.39	0.00***	
		20 - 24	-0.16	0.20	
		25+	-0.06	0.67	
	10 - 14	5 - 7	0.55	0.00***	1.01
		8 - 9	0.29	0.03**	
		15 - 19	-0.10	0.26	
		20 - 24	0.13	0.17	
		25+	0.23	0.02**	
	15 - 19	5 - 7	0.66	0.00***	1.12
		8 - 9	0.39	0.00***	
		10 - 14	0.10	0.26	
		20 - 24	0.23	0.01***	
		25+	0.34	0.00***	
	20 - 24	5 - 7	0.43	0.00***	0.89
		8 - 9	0.16	0.20	
		10 - 14	-0.13	0.17	
		15 - 19	-0.23	0.01***	
		25+	0.11	0.25	
	25+	5 - 7	0.32	0.01***	0.78
		8 - 9	0.06	0.67	
		10 - 14	-0.23	0.02**	
		15 - 19	-0.34	0.00***	
		20 - 24	-0.11	0.25	

Table 6.5-8: Comparison of tree age average rejects due to insect damage for all seasons combined

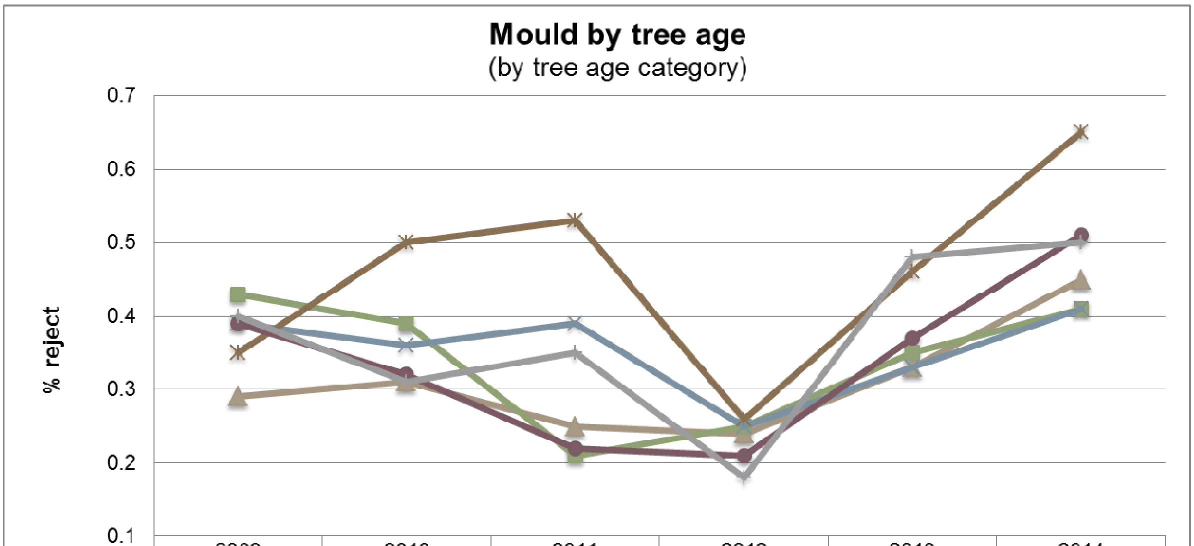
* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Mould by tree age

Figure 6.5-15 shows average consigned rejects due to mould from 2009 to 2014 for farms in the different tree age categories.

Farms in all tree age categories had increased average rejects due to mould from 2012 to 2013 and again in 2013 to 2014. The biggest increase from 2013 to 2014 was amongst farms aged 15 to 19 years (0.19%) and 20 to 24 years (0.14%). Farms aged 25+ years showed only a small increase from 2013 to 2014 (0.02%) following a more substantial increase from 2012 to 2013.

Farms aged 15 to 19 years had the highest average level of rejects due to mould in 2010, 2011, 2012 and 2014. 5 to 7 year old farms had the lowest mould rejects in 2009, 2010 and 2013.



	2009	2010	2011	2012	2013	2014
5 to 7	0.29	0.31	0.25	0.24	0.33	0.45
8 to 9	0.43	0.39	0.21	0.25	0.35	0.41
10 to 14	0.39	0.36	0.39	0.25	0.33	0.41
15 to 19	0.35	0.50	0.53	0.26	0.46	0.65
20 to 24	0.39	0.32	0.22	0.21	0.37	0.51
25 +	0.40	0.31	0.35	0.18	0.48	0.50

Figure 6.5-15: Comparison of average mould reject levels by tree age category (2009 to 2014)

Table 6.5-9 shows the statistical differences between average rejects due to mould for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms age 15 to 19 years had significantly higher average mould reject than farms in all the other tree age categories.
- There was no significant difference in the average mould reject levels between farms in all the other tree age categories.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Mould %	5 - 7	8 - 9	-0.04	0.62	0.31
		10 - 14	-0.04	0.47	
		15 - 19	-0.15	0.00***	
		20 - 24	-0.03	0.57	
		25+	-0.08	0.11	
	8 - 9	5 - 7	0.04	0.62	0.36
		10 - 14	0.01	0.92	
		15 - 19	-0.11	0.02**	
		20 - 24	0.02	0.94	
		25+	-0.04	0.37	
	10 - 14	5 - 7	0.04	0.47	0.35
		8 - 9	0.01	0.92	
		15 - 19	-0.12	0.00***	
		20 - 24	0.01	0.82	
		25+	-0.04	0.28	
	15 - 19	5 - 7	0.15	0.00***	0.47
		8 - 9	0.11	0.02**	
		10 - 14	0.12	0.00***	
		20 - 24	0.13	0.00***	
		25+	0.08	0.05**	
	20 - 24	5 - 7	0.03	0.57	0.34
		8 - 9	0.02	0.94	
		10 - 14	-0.01	0.82	
		15 - 19	-0.13	0.00***	
		25+	-0.05	0.18	
	25+	5 - 7	0.08	0.11	0.39
		8 - 9	0.04	0.37	
		10 - 14	0.04	0.28	
		15 - 19	-0.08	0.05**	
		20 - 24	0.05	0.18	

Table 6.5-9: Comparison of tree age average rejects due to mould for all seasons combined

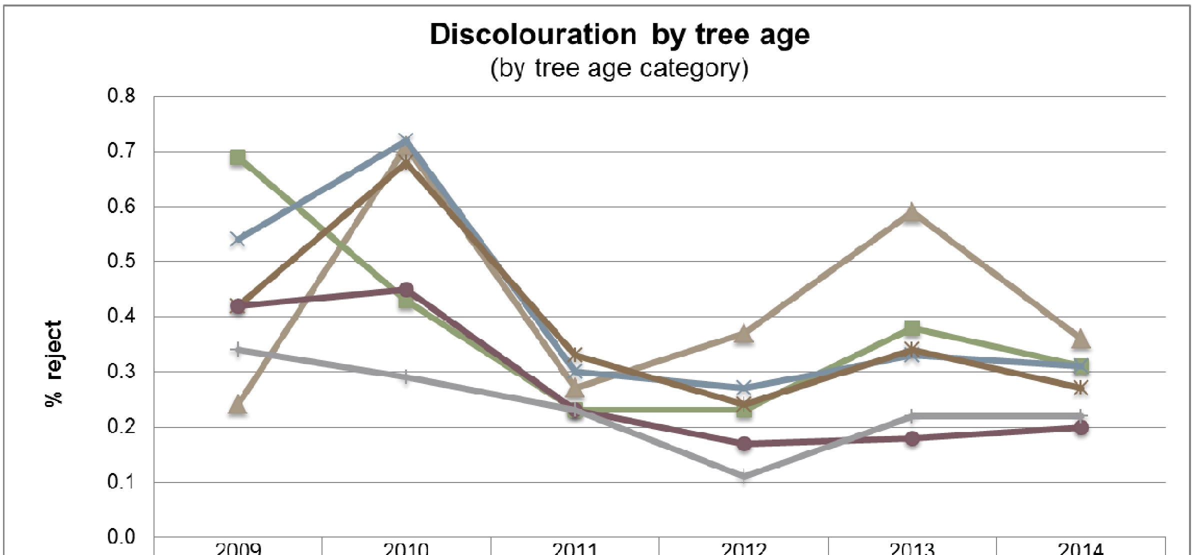
* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Discolouration by tree age

Figure 6.5-16 shows average consigned rejects due to discolouration from 2009 to 2014 for the farms in the different tree age categories.

Farms aged 5 to 7 years had the largest decrease in the average rejects due to discolouration from 2013 to 2014 (0.23%) after having the largest increase from 2012 to 2013 (0.22%). Farms aged 8 to 9 years and 15 to 19 years had a smaller decrease in discolouration reject from 2013 to 2014 after a small increase from 2012 to 2013.

Farms aged 5 to 7 years had the highest average rejects due to discolouration in 2012, 2013 and 2014. Farms aged 20 to 24 years and 25+ years had the lowest average level of rejects due to discolouration from 2010 to 2014.



	2009	2010	2011	2012	2013	2014
5 to 7	0.24	0.71	0.27	0.37	0.59	0.36
8 to 9	0.69	0.43	0.23	0.23	0.38	0.31
10 to 14	0.54	0.72	0.30	0.27	0.33	0.31
15 to 19	0.42	0.68	0.33	0.24	0.34	0.27
20 to 24	0.42	0.45	0.23	0.17	0.18	0.20
25 +	0.34	0.29	0.23	0.11	0.22	0.22

Figure 6.5-16: Comparison of average discolouration reject levels by tree age category (2009 to 2014)

Table 6.5-10 shows the statistical differences between average reject levels due to discolouration for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms older than 20 years had significantly lower average discolouration reject than the farms in all the other younger tree age categories.
- There was no significant difference in average rejects due to discolouration between farms younger than 20 years.

Bearing farms	Least significant difference				
Dependent variable	Tree age (I)	Tree Age (J)	Mean difference (I-J)	Sig	Mean
Discolouration %	5 - 7	8 - 9	0.03	0.63	0.43
		10 - 14	0.02	0.63	
		15 - 19	0.07	0.18	
		20 - 24	0.19	0.00***	
		25+	0.21	0.00***	
	8 - 9	5 - 7	-0.03	0.63	0.40
		10 - 14	-0.01	0.91	
		15 - 19	0.04	0.52	
		20 - 24	0.16	0.00***	
		25+	0.18	0.00***	
	10 - 14	5 - 7	-0.02	0.63	0.41
		8 - 9	0.01	0.91	
		15 - 19	0.04	0.29	
		20 - 24	0.16	0.00***	
		25+	0.19	0.00***	
	15 - 19	5 - 7	-0.07	0.18	0.37
		8 - 9	-0.04	0.52	
		10 - 14	-0.04	0.29	
		20 - 24	0.12	0.00***	
		25+	0.14	0.00***	
	20 - 24	5 - 7	-0.19	0.00***	0.25
		8 - 9	-0.16	0.00***	
		10 - 14	-0.16	0.00***	
		15 - 19	-0.12	0.00***	
		25+	0.02	0.56	
	25+	5 - 7	-0.21	0.00***	0.23
		8 - 9	-0.18	0.00***	
		10 - 14	-0.19	0.00***	
		15 - 19	-0.14	0.00***	
		20 - 24	-0.02	0.56	

Table 6.5-10: Comparison of tree age average rejects due to discolouration for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% leve

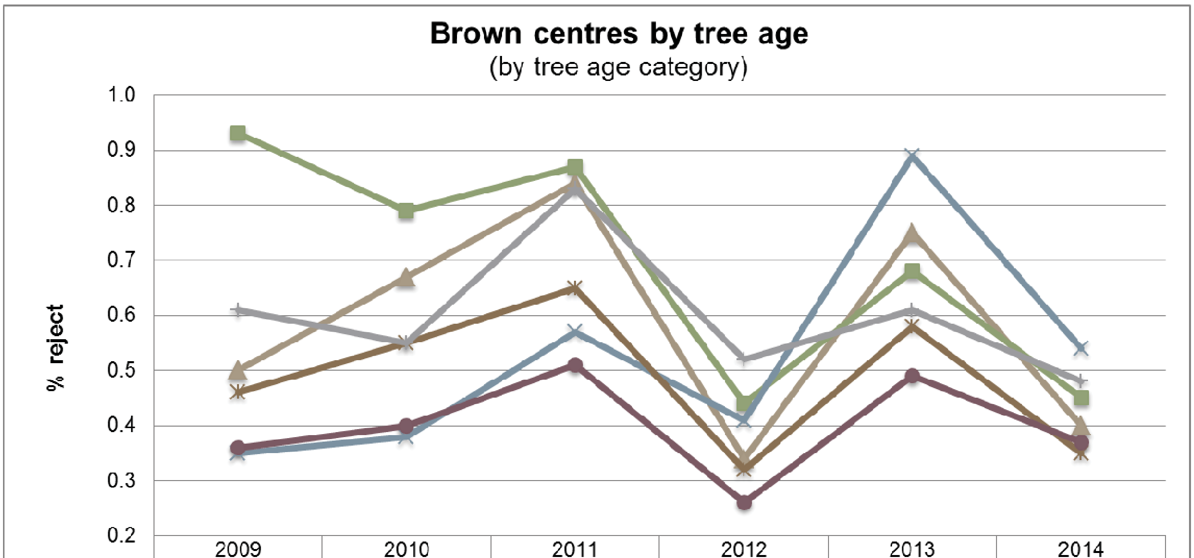
Brown centres by tree age

Figure 6.5-17 shows average consigned rejects due to brown centres from 2009 to 2014 for the farms in the different tree age categories.

There was a decrease in average rejects due to brown centres amongst farms in all tree age categories from 2013 to 2014, following an increase from 2012 to 2013. The most substantial decrease was amongst farms aged 5 to 7 years (0.35%) and 10 to 14 years (0.35%). Farms aged 25+ years had a smaller decrease from 2013 to 2014 following a smaller increase from 2012 to 2013.

Farms aged 8 to 9 years had the highest average level of rejects due to brown centres in 2009, 2010 and 2011. Farms aged 10 to 14 years had the highest average level of brown centres in 2013 and 2014. Farms aged 20 to 24 years had the lowest average level of brown centres from 2011 to 2013 and the second lowest average level in each of the other three years.

Younger farms are, on average, larger than the older farms. The grower surveys from the *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008) found that the average level of brown centres significantly increased with increasing farm size, maximum silo size and nut storage bed depth.



	2009	2010	2011	2012	2013	2014
5 to 7	0.50	0.67	0.84	0.34	0.75	0.40
8 to 9	0.93	0.79	0.87	0.44	0.68	0.45
10 to 14	0.35	0.38	0.57	0.41	0.89	0.54
15 to 19	0.46	0.55	0.65	0.32	0.58	0.35
20 to 24	0.36	0.40	0.51	0.26	0.49	0.37
25 +	0.61	0.55	0.83	0.52	0.61	0.48

Figure 6.5-17: Comparison of average brown centre reject levels by tree age category (2009 to 2014)

Table 6.5-11 shows the statistical differences between average rejects due to brown centres for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 8 to 9 years had significantly higher levels of brown centres than farms in all of the other tree age categories.
- Farms aged 20 to 24 years had significantly lower average rejects due to brown centres than farms in all the other tree age categories.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Brown centres %	5 - 7	8 - 9	-0.14	0.06*	0.57
		10 - 14	0.05	0.41	
		15 - 19	0.10	0.10*	
		20 - 24	0.17	0.00***	
		25+	-0.01	0.85	
	8 - 9	5 - 7	0.14	0.06*	0.71
		10 - 14	0.19	0.01***	
		15 - 19	0.23	0.00***	
		20 - 24	0.31	0.00***	
		25+	0.13	0.06*	
	10 - 14	5 - 7	-0.05	0.41	0.52
		8 - 9	-0.19	0.01***	
		15 - 19	0.05	0.31	
		20 - 24	0.13	0.01***	
		25+	-0.06	0.23	
	15 - 19	5 - 7	-0.10	0.10*	0.47
		8 - 9	-0.23	0.00***	
		10 - 14	-0.05	0.31	
		20 - 24	0.08	0.08*	
		25+	-0.11	0.03**	
	20 - 24	5 - 7	-0.17	0.00***	0.40
		8 - 9	-0.31	0.00***	
		10 - 14	-0.13	0.01***	
		15 - 19	-0.08	0.08*	
		25+	-0.19	0.00***	
	25+	5 - 7	0.01	0.85	0.58
		8 - 9	-0.13	0.06*	
		10 - 14	0.06	0.23	
		15 - 19	0.11	0.03**	
		20 - 24	0.19	0.00***	

Table 6.5-11: Comparison of tree age average rejects due to brown centres for all seasons combined

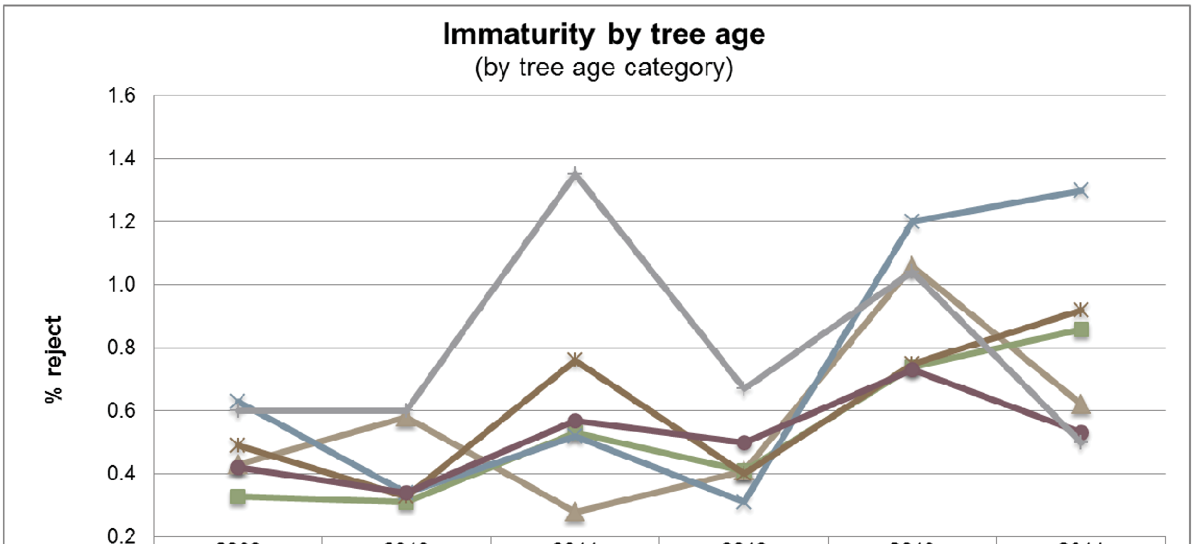
* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Immaturity by tree age

Figure 6.5-18 shows average consigned reject due to immaturity from 2009 to 2014 for farms in the different tree age categories.

There was an increase from 2013 to 2014 in average reject levels due to immaturity amongst farms aged 8 to 9 (0.12%), 10 to 14 (0.1%) and 15 to 19 (0.17%). There was a decrease from 2013 to 2014 in the average immaturity reject amongst farms in the other three tree age categories. Farms in all tree age categories had an increase in average immaturity rejects from 2012 to 2013.

Farms aged 10 to 14 years had the highest average level of rejects due to immaturity in 2009, 2013 and 2014. Farms aged 25+ years had the highest immaturity in 2010, 2011 and 2012, but the lowest in 2014.



	2009	2010	2011	2012	2013	2014
5 to 7	0.43	0.58	0.28	0.41	1.06	0.62
8 to 9	0.33	0.31	0.53	0.41	0.74	0.86
10 to 14	0.63	0.34	0.52	0.31	1.20	1.30
15 to 19	0.49	0.33	0.76	0.40	0.75	0.92
20 to 24	0.42	0.34	0.57	0.50	0.73	0.53
25 +	0.60	0.60	1.35	0.67	1.04	0.50

Figure 6.5-18: Comparison of average immaturity reject levels by tree age category (2009 to 2014)

Table 6.5-12 shows the statistical differences between average rejects due to immaturity for farms in the different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 25+ years had significantly higher immaturity than farms in all the other tree age categories apart from those aged 10 to 14 years.
- Farms aged 10 to 14 years had significantly higher average immaturity reject than farms aged 8 to 9 and 20 to 24 years.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Immaturity %	5 - 7	8 - 9	0.09	0.33	0.61
		10 - 14	-0.07	0.48	
		15 - 19	-0.02	0.92	
		20 - 24	.07	0.39	
		25+	-0.17	0.09*	
	8 - 9	5 - 7	-0.09	0.33	0.52
		10 - 14	-0.16	0.08	
		15 - 19	-0.11	0.23	
		20 - 24	-0.01	0.72	
		25+	-0.26	0.01***	
	10 - 14	5 - 7	0.07	0.48	0.69
		8 - 9	0.16	0.08*	
		15 - 19	0.05	0.45	
		20 - 24	0.15	0.05**	
		25+	-0.10	0.23	
	15 - 19	5 - 7	0.02	0.92	0.63
		8 - 9	0.11	0.23	
		10 - 14	-0.05	0.45	
		20 - 24	0.10	0.22	
		25+	-0.15	0.05**	
	20 - 24	5 - 7	-0.07	0.39	0.54
		8 - 9	0.01	0.72	
		10 - 14	-0.15	0.05**	
		15 - 19	-0.10	0.22	
		25+	-0.24	0.00***	
	25+	5 - 7	0.17	0.09*	0.78
		8 - 9	0.26	0.01***	
		10 - 14	0.10	0.23	
		15 - 19	0.15	0.05**	
		20 - 24	0.24	0.00***	

Table 6.5-12: Comparison of tree age average rejects due to immaturity for all seasons combined

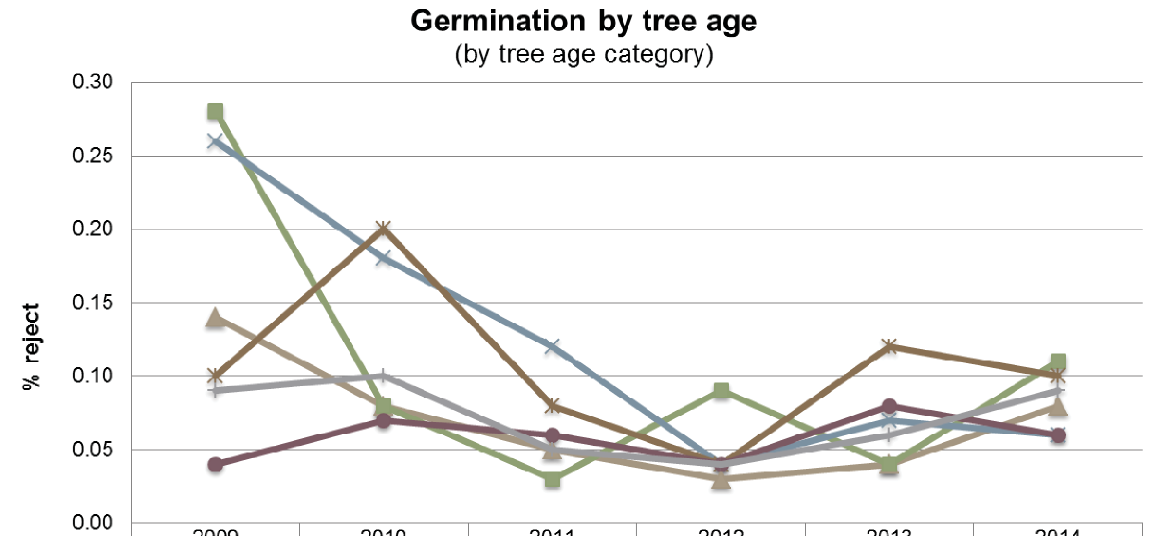
* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Germination by tree age

Figure 6.5-19 shows average consigned rejects due to germination from 2009 to 2014 for farms in the different tree age categories. The average level of rejects due to germination was the lowest of all the reject categories in each year of the benchmarking.

There was an increase from 2013 to 2014 in average rejects due to germination amongst farms aged 5 to 7 (0.04%), 8 to 9 (0.07%) and 25+ years (0.03%). There was a slight decrease from 2013 to 2014 amongst farms in the other tree age categories.

Farms aged 8 to 9 had the highest average germination levels in 2009, 2012 and 2014 but the lowest in 2011 and 2013. Farms aged 15 to 19 had the highest average germination levels in 2010 and 2013.



	2009	2010	2011	2012	2013	2014
5 to 7	0.14	0.08	0.05	0.03	0.04	0.08
8 to 9	0.28	0.08	0.03	0.09	0.04	0.11
10 to 14	0.26	0.18	0.12	0.04	0.07	0.06
15 to 19	0.10	0.20	0.08	0.04	0.12	0.10
20 to 24	0.04	0.07	0.06	0.04	0.08	0.06
25 +	0.09	0.10	0.05	0.04	0.06	0.09

Figure 6.5-19: Comparison of average germination reject levels by tree age category (2009 to 2014)

Table 6.5-13 shows the statistical differences between rejects due to germination for farms in different tree age categories for all seasons from 2009 to 2014. Farms aged 8 to 9, 10 to 14 and 15 to 19 years had significantly higher average germination than farms aged 5 to 7, 20 to 24 and 25+ years.

Bearing farms	Least significant difference				
Dependent variable	Tree age (I)	Tree Age (J)	Mean difference (I-J)	Sig	Mean
Germination %	5 - 7	8 - 9	-0.06	0.02**	0.06
		10 - 14	-0.06	0.00***	
		15 - 19	-0.05	0.03**	
		20 - 24	0.00	0.99	
		25+	-0.01	0.57	
	8 - 9	5 - 7	0.06	0.02**	0.12
		10 - 14	0.00	0.98	
		15 - 19	0.02	0.51	
		20 - 24	0.06	0.01***	
		25+	0.05	0.05**	
	10 - 14	5 - 7	0.06	0.00***	0.12
		8 - 9	0.00	0.98	
		15 - 19	0.02	0.34	
		20 - 24	0.06	0.00***	
		25+	0.05	0.01***	
	15 - 19	5 - 7	0.05	0.03**	0.11
		8 - 9	-0.02	0.51	
		10 - 14	-0.02	0.34	
		20 - 24	0.05	0.01***	
		25+	0.03	0.06**	
	20 - 24	5 - 7	0.00	0.99	0.06
		8 - 9	-0.06	0.01***	
		10 - 14	-0.06	0.00***	
		15 - 19	-0.05	0.01***	
		25+	-0.01	0.49	
	25+	5 - 7	0.01	0.57	0.07
		8 - 9	-0.05	0.05**	
		10 - 14	-0.05	0.01***	
		15 - 19	-0.03	0.06*	
		20 - 24	0.01	0.49	

Table 6.5-13: Comparison of tree age average rejects due to germination for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Nut-in-shell moisture content (NIS MC) by tree age

Table 6.5-14 shows the statistical differences in NIS MC for farms in different tree age categories for all seasons from 2009 to 2014. The major differences are:

- Farms aged 5 to 7 years had significantly lower average NIS MC than farms in all other tree age categories. Most of the farms aged 5 to 7 years in the benchmarking are located in the Central Queensland region where conditions are typically drier during the harvest season than other regions.
- Farms age 25+ years had significantly higher average NIS MC than farms in all other tree age categories other than 10 to 14 years. A high proportion of 25+ year old trees are located in the Northern Rivers region of New South Wales.
- Farms aged 8 to 9 years had significantly lower average NIS MC than farms aged 10 to 14 and 20 to 24. Many of the 8 to 9 year old farms are also located in the Central Queensland region

Bearing farms	Least significant difference				
Dependent variable	Tree age (I)	Tree Age (J)	Mean difference (I-J)	Sig	Mean
Moisture content %	5 - 7	8 - 9	-1.81	0.00***	12.21
		10 - 14	-3.52	0.00***	
		15 - 19	-2.33	0.00***	
		20 - 24	-2.80	0.00***	
		25+	-3.93	0.00***	
	8 - 9	5 - 7	1.81	0.00***	14.01
		10 - 14	-1.72	0.00***	
		15 - 19	-0.53	0.28	
		20 - 24	-0.99	0.04**	
		25+	-2.12	0.00***	
	10 - 14	5 - 7	3.52	0.00***	15.73
		8 - 9	1.72	0.00***	
		15 - 19	1.19	0.00***	
		20 - 24	0.73	0.04**	
		25+	-0.40	0.29	
	15 - 19	5 - 7	2.33	0.00***	14.54
		8 - 9	0.53	0.28	
		10 - 14	-1.19	0.00***	
		20 - 24	-0.46	0.18	
		25+	-1.59	0.00***	
	20 - 24	5 - 7	2.80	0.00***	15.00
		8 - 9	0.99	0.04**	
		10 - 14	-0.73	0.04**	
		15 - 19	0.46	0.18	
		25+	-1.13	0.00***	
	25+	5 - 7	3.93	0.00***	16.13
		8 - 9	2.12	0.00***	
		10 - 14	0.40	0.29	
		15 - 19	1.59	0.00***	
		20 - 24	1.13	0.00***	

Table 6.5-14: Comparison of tree age consigned NIS moisture content (%) for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

Whole kernel percentage by tree age

Table 6.5-15 shows the statistical differences between the percentages of whole kernels for farms in different tree age categories for all seasons from 2009 to 2014. Cultivars have a strong influence on the percentage of whole kernels achieved. The major differences are:

- Farms aged 8 to 9 and 10 to 14 years had significantly higher average whole kernels than farms in all the other tree age categories.
- Farms age 20 to 24 and 25+ years had significantly lower average whole kernels than farms in all the other tree age categories.

Bearing farms	Least significant difference				
Dependent variable	**Tree age (I)**	**Tree Age (J)**	**Mean difference (I-J)**	**Sig**	**Mean**
Whole kernel %	5 - 7	8 - 9	-2.67	0.09*	53.82
		10 - 14	-2.39	0.04**	
		15 - 19	1.66	0.14	
		20 - 24	4.66	0.00***	
		25+	4.00	0.00***	
	8 - 9	5 - 7	2.67	0.09*	56.50
		10 - 14	0.29	0.84	
		15 - 19	4.34	0.00***	
		20 - 24	7.33	0.00***	
		25+	6.67	0.00***	
	10 - 14	5 - 7	2.39	0.04**	56.21
		8 - 9	-0.29	0.84	
		15 - 19	4.05	0.00***	
		20 - 24	7.04	0.00***	
		25+	6.38	0.00***	
	15 - 19	5 - 7	-1.66	0.14	52.16
		8 - 9	-4.34	0.00***	
		10 - 14	-4.05	0.00***	
		20 - 24	3.00	0.00***	
		25+	2.34	0.02**	
	20 - 24	5 - 7	-4.66	0.00***	49.17
		8 - 9	-7.33	0.00***	
		10 - 14	-7.04	0.00***	
		15 - 19	-3.00	0.00***	
		25+	-0.66	0.50	
	25+	5 - 7	-4.00	0.00***	49.82
		8 - 9	-6.67	0.00***	
		10 - 14	-6.38	0.00***	
		15 - 19	-2.34	0.02**	
		20 - 24	0.66	0.50	

Table 6.5-15: Comparison of tree age average whole kernel (%) for all seasons combined

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

6.6 Results by farm size

Yield by farm size

The bearing farms were divided into categories of approximately equal numbers based on the hectares of planted macadamia trees. Table 6.6-1 provides a summary of averages of yield parameters for different farm size categories in the benchmarking survey for 2014 and for all years from 2009 to 2014. The farm size categories are:

- Less than 10 hectares,
- Between 10 and 20 hectares,
- Between 20 and 30 hectares,
- Between 30 and 50 hectares,
- Between 50 and 100 hectares,
- More than 100 hectares.

All the farm size categories less than 50 hectares had a greater average NIS, saleable kernel and total kernel tonnes per hectare in 2014 compared to the average over the six years from 2009 to 2014. The farms between 50 and 100 hectares and the farms larger than 100 hectares had similar average yields per hectare in 2014 compared to the average from 2009 to 2014. Most of the farms larger than 100 hectares are in the Central Queensland region.

Farm size averages	2014						2009-2014					
	<10 ha	10 - <20 ha	20 - <30 ha	30 - <50 ha	50 - <100 ha	100+ ha	<10 ha	10 - <20 ha	20 - <30 ha	30 - <50 ha	50 - <100 ha	100+ ha
NIS (tonnes/ha)	2.47	2.57	2.69	2.77	2.13	2.12	2.40	2.35	2.64	2.39	2.11	2.18
Saleable kernel (tonnes/ha)	0.84	0.85	0.86	0.90	0.68	0.66	0.77	0.75	0.82	0.75	0.65	0.67
Total kernel (tonnes/ha)	0.89	0.90	0.92	0.96	0.73	0.73	0.83	0.80	0.88	0.80	0.71	0.74

Table 6.6-1: Farm size yield averages for 2014 and for all years from 2009 - 2014

Figure 6.6-1 shows ranking trends for farms in the different size categories for tonnes of saleable kernel per bearing hectare for 2009 to 2014. Each bar represents the average yield per hectare for an individual farm from 2009 to 2014.

The farms are grouped by size with the largest farms (larger than 100 bearing hectares) represented by the dark blue bars on the left of the chart and the smallest farms (less than 10 bearing hectares) represented by the pale blue bars on the right. Statistical analysis shows that the larger farms are more concentrated amongst the middle 50% of farm years for yield of NIS and saleable kernel per hectare. By comparison, the smaller farms are more concentrated amongst the top 25% and bottom 25% of farm years.

The red trend line represents the smoothed moving average of the 20 previous bars on the chart. The red line shows that farms less than 50 bearing hectares yielded higher average saleable kernel tonnes per bearing hectare than the farms larger than 50 bearing hectares.

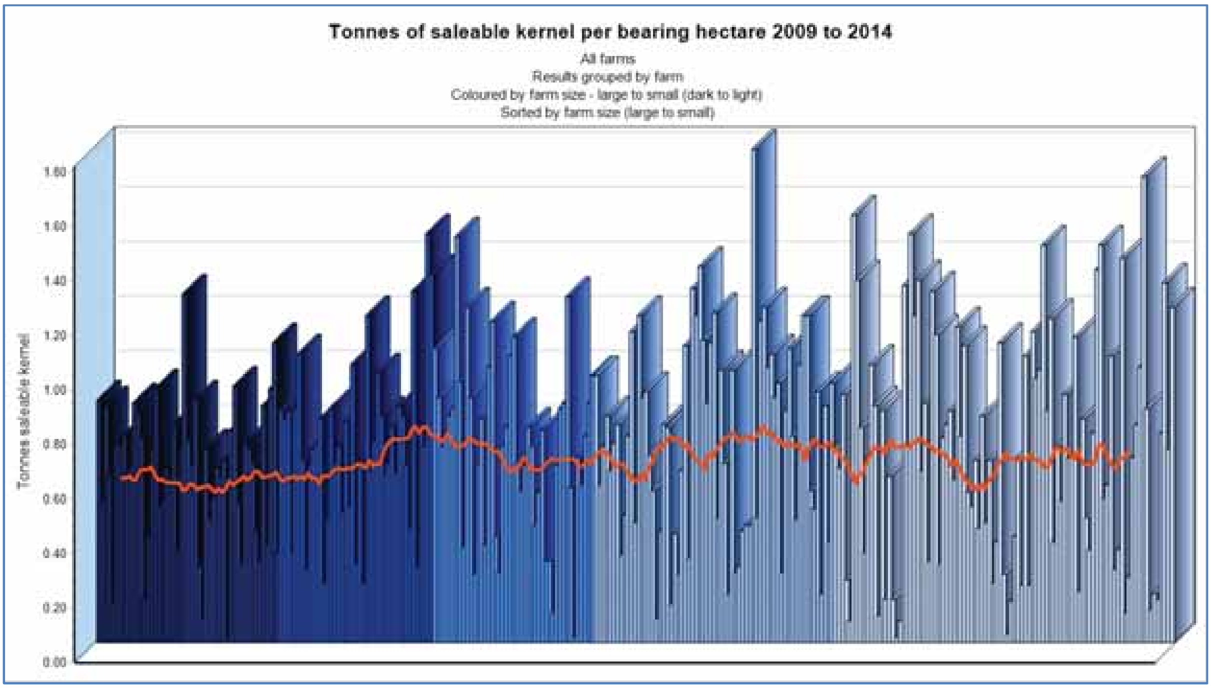


Figure 6.6-1: 20 point moving average for saleable kernel per bearing hectare for different farm size categories for 2009 to 2014

Nut-in-shell tonnes per hectare by farm size

Table 6.6-2 shows a total of 1324 farm years from 2009 to 2014. A farm year describes the records for an individual farm for a given year. The farm size categories with less than 20 hectares of bearing macadamias had a higher relative representation in both the top and bottom 25% of farm years for NIS tonnes per hectare. For example, farms with less than 10 hectares of bearing trees represented 29.3% of the total sample but represented 36.1% of the top 25% and 34.6% of the bottom 25% of farm years.

All farm size categories greater than 30 hectares had higher relative representation in the middle 50% and a lower relative representation in the top 25% of farm years for NIS tonnes per hectare. For example, farms larger than 100 hectares of bearing trees represented 9.5% of the total sample but represented 12.9% of the middle 50% and only 4.8% of the top 25% of farm years. The farm size category between 20 and 30 hectares had a higher relative representation in the top 25% and middle 50% of farm categories.

The relationship between tonnes of NIS per hectare and farm size is statistically significant.

NIS tonnes per hectare	Total farm years =1324	Top 25% (>=3.16)	Middle 50% (>=1.46 to< 3.16)	Bottom 25% (<1.46)	Total
<10 ha	Farm year	120	153	115	388
	% within percentile	36.1%	23.2%	34.6%	29.3%
	% of total	9.1%	11.6%	8.7%	29.3%
10 ha to <20 ha	Farm year	93	143	93	329
	% within percentile	28.0%	21.7%	28.0%	24.8%
	% of total	7.0%	10.8%	7.0%	24.8%
20 ha to <30 ha	Farm year	48	95	25	168
	% within percentile	14.5%	14.4%	7.5%	12.7%
	% of total	3.6%	7.2%	1.9%	12.7%
30 ha to <50 ha	Farm year	37	110	38	185
	% within percentile	11.1%	16.7%	11.4%	14.0%
	% of total	2.8%	8.3%	2.9%	14.0%
50 ha to <100 ha	Farm year	18	74	36	128
	% within percentile	5.4%	11.2%	10.8%	9.7%
	% of total	1.4%	5.6%	2.7%	9.7%
>100 ha	Farm year	16	85	25	126
	% within percentile	4.8%	12.9%	7.5%	9.5%
	% of total	1.2%	6.4%	1.9%	9.5%
Total	Farm year	332	660	332	1324
	% of total	25.1%	49.8%	25.1%	100.0%

Table 6.6-2: Cross tabulation nut-in-shell tonnes per hectare by percentile and farm size

Table 6.6-3 shows the statistical differences between the average tonnes of NIS per bearing hectare for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 20 and 30 hectares had a significantly higher average NIS tonnes per bearing hectare than farms in all the other farm size categories.
- Farms between 50 and 100 hectares had a significantly lower average NIS tonnes per bearing hectare than farms smaller than 50 hectares.
- Farms larger than 100 hectares had a significantly lower average NIS tonnes per bearing hectare than farms less than 10 hectares.

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
NIS tonnes per hectare	<10 ha	Between 10 and 20	0.05	0.58	<10 ha	2.40
		Between 20 and 30	-0.24	0.04**		
		Between 30 and 50	0.01	0.91		
		Between 50 and 100	0.29	0.02**		
		Above 100	0.22	0.08*		
	10 ha to <20 ha	Less than 10	-0.05	0.58	10 ha to <20 ha	2.35
		Between 20 and 30	-0.29	0.01***		
		Between 30 and 50	-0.04	0.73		
		Between 50 and 100	0.24	0.06*		
		Above 100	0.17	0.19		
	20 ha to <30 ha	Less than 10	0.24	0.04**	20 ha to <30 ha	2.64
		Between 10 and 20	0.29	0.01***		
		Between 30 and 50	0.25	0.06*		
		Between 50 and 100	0.53	0.00***		
		Above 100	0.46	0.00***		
	30 ha to <50 ha	Less than 10	-0.01	0.91	30 ha to <50 ha	2.39
		Between 10 and 20	0.04	0.73		
		Between 20 and 30	-0.25	0.06*		
		Between 50 and 100	0.28	0.05*		
		Above 100	0.21	0.14		
	50 ha to <100 ha	Less than 10	-0.29	0.02**	50 ha to <100 ha	2.11
		Between 10 and 20	-0.24	0.06*		
		Between 20 and 30	-0.53	0.00***		
		Between 30 and 50	-0.28	0.05*		
		Above 100	-0.07	0.66		
	>=100 ha	Less than 10	-0.22	0.08*	>=100 ha	2.18
		Between 10 and 20	-0.17	0.19		
		Between 20 and 30	-0.46	0.00***		
		Between 30 and 50	-0.21	0.14		
		Between 50 and 100	0.07	0.66		

Table 6.6-3: Comparison of farm size average NIS tonnes per hectare for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Saleable kernel tonnes per hectare by farm size

Farms with less than 20 hectares of bearing macadamias had higher relative proportions in both the top 25% and bottom 25% of farm years and lower relative proportions in the middle 50% for saleable kernel tonnes per hectare. For example, farms with less than 10 hectares had 36.9% in the top 25% and 35.0% in the bottom 25% but only 22.6% in the middle 50% of farm years.

By comparison, farms larger than 30 hectares accounted for higher relative proportions in the middle 50% and lower relative proportions in the top 25% of farm years for tonnes of saleable kernel per hectare. For example, farms larger than 100 hectares had 12.0% in the middle 50% but only 4.9% in the top 25% of farm years.

This relationship between tonnes of saleable kernel per hectare and farm size is statistically significant

Saleable kernel tonnes per hectare	Total farm years =1324	Top 25% (>=1.01)	Middle 50% (>=0.44 to <1.01)	Bottom 25% (<0.44)	Total
<10 ha	Farm year	121	149	118	388
	% within percentile	36.9%	22.6%	35.0%	29.3%
	% of total	9.1%	11.3%	8.9%	29.3%
10 ha to <20 ha	Farm year	92	152	85	329
	% within percentile	28.0%	23.1%	25.2%	24.8%
	% of total	6.9%	11.5%	6.4%	24.8%
20 ha to <30 ha	Farm year	46	93	29	168
	% within percentile	14.0%	14.1%	8.6%	12.7%
	% of total	3.5%	7.0%	2.2%	12.7%
30 ha to <50 ha	Farm year	37	109	39	185
	% within percentile	11.3%	16.5%	11.6%	14.0%
	% of total	2.8%	8.2%	2.9%	14.0%
50 ha to <100 ha	Farm year	16	77	35	128
	% within percentile	4.9%	11.7%	10.4%	9.7%
	% of total	1.2%	5.8%	2.6%	9.7%
>100 ha	Farm year	16	79	31	126
	% within percentile	4.9%	12.0%	9.2%	9.5%
	% of total	1.2%	6.0%	2.3%	9.5%
Total	Farm year	328	659	337	1324
	% of total	24.8%	49.8%	25.5%	100.0%

Table 6.6-4: Cross tabulation saleable kernel tonnes per hectare by percentile and farm size

Table 6.6-5 shows the statistical differences between the average tonnes of saleable kernel per bearing hectare for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 20 and 30 hectares had a significantly higher average saleable kernel tonnes per bearing hectare than farms between 10 and 20 hectares and larger than 50 hectares.
- Farms between 50 and 100 hectares and larger than 100 hectares had a significantly lower average saleable kernel tonnes per bearing hectare than farms in all the other farm size categories.

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Saleable kernel tonnes per hectare	<10 ha	Between 10 and 20	0.02	0.56	<10 ha	0.77
		Between 20 and 30	-0.05	0.18		
		Between 30 and 50	0.02	0.60		
		Between 50 and 100	0.12	0.00***		
		Above 100	0.10	0.02**		
	10 ha to <20 ha	Less than 10	-0.02	0.56	10 ha to <20 ha	0.75
		Between 20 and 30	-0.07	0.08*		
		Between 30 and 50	0.00	0.97		
		Between 50 and 100	0.10	0.02**		
		Above 100	0.08	0.05**		
	20 ha to <30 ha	Less than 10	0.05	0.18	20 ha to <30 ha	0.82
		Between 10 and 20	0.07	0.08*		
		Between 30 and 50	0.07	0.11		
		Between 50 and 100	0.17	0.00***		
		Above 100	0.15	0.00***		
	30 ha to <50 ha	Less than 10	-0.02	0.60	30 ha to <50 ha	0.75
		Between 10 and 20	0.00	0.97		
		Between 20 and 30	-0.07	0.11		
		Between 50 and 100	0.10	0.03**		
		Above 100	0.08	0.09*		
	50 ha to <100 ha	Less than 10	-0.12	0.00***	50 ha to <100 ha	0.65
		Between 10 and 20	-0.10	0.02**		
		Between 20 and 30	-0.17	0.00***		
		Between 30 and 50	-0.10	0.03**		
		Above 100	-0.02	0.70		
	>=100 ha	Less than 10	-0.10	0.02**	>=100 ha	0.67
		Between 10 and 20	-0.08	0.05**		
		Between 20 and 30	-0.15	0.00***		
		Between 30 and 50	-0.08	0.09*		
		Between 50 and 100	0.02	0.70		

Table 6.6-5: Comparison of farm size average saleable kernel tonnes per hectare for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Total kernel tonnes per hectare by farm size

Table 6.6-6 shows the statistical differences between the average tonnes of total kernel per bearing hectare for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 20 and 30 hectares had a significantly higher average total kernel tonnes per bearing hectare than farms between 10 and 20 hectares, and larger than 30 hectares.
- Farms between 50 and 100 hectares had a significantly lower average total kernel tonnes per bearing hectare than farms smaller than 50 hectares.
- Farms larger than 100 hectares had a significantly lower average total kernel tonnes per bearing hectare than farms smaller than 10 hectares

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Total kernel tonnes per hectare	<10 ha	Between 10 and 20	0.03	0.44	<10 ha	0.83
		Between 20 and 30	-0.06	0.17		
		Between 30 and 50	0.02	0.54		
		Between 50 and 100	0.12	0.01***		
		Above 100	0.09	0.04**		
	10 ha to <20 ha	Less than 10	-0.03	0.44	10 ha to <20 ha	0.80
		Between 20 and 30	-0.08	0.05**		
		Between 30 and 50	0.00	0.97		
		Between 50 and 100	0.09	0.04**		
		Above 100	0.07	0.15		
	20 ha to <30 ha	Less than 10	0.06	0.17	20 ha to <30 ha	0.88
		Between 10 and 20	0.08	0.05**		
		Between 30 and 50	0.08	0.09*		
		Between 50 and 100	0.17	0.00***		
		Above 100	0.15	0.00***		
	30 ha to <50 ha	Less than 10	-0.02	0.54	30 ha to <50 ha	0.80
		Between 10 and 20	0.00	0.97		
		Between 20 and 30	-0.08	0.09		
		Between 50 and 100	0.09	0.06		
		Above 100	0.07	0.18		
	50 ha to <100 ha	Less than 10	-0.12	0.01***	50 ha to <100 ha	0.71
		Between 10 and 20	-0.09	0.04**		
		Between 20 and 30	-0.17	0.00***		
		Between 30 and 50	-0.09	0.06*		
		Above 100	-0.03	0.65		
	>=100 ha	Less than 10	-0.09	0.04**	>=100 ha	0.74
		Between 10 and 20	-0.07	0.15		
		Between 20 and 30	-0.15	0.00***		
		Between 30 and 50	-0.07	0.18		
		Between 50 and 100	0.03	0.65		

Table 6.6-6: Comparison of farm size average total kernel tonnes per hectare for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Quality by farm size

Table 6.6-7 provides a summary of quality parameters for different farm size categories in the benchmarking survey for 2014 and for all years from 2009 to 2014.

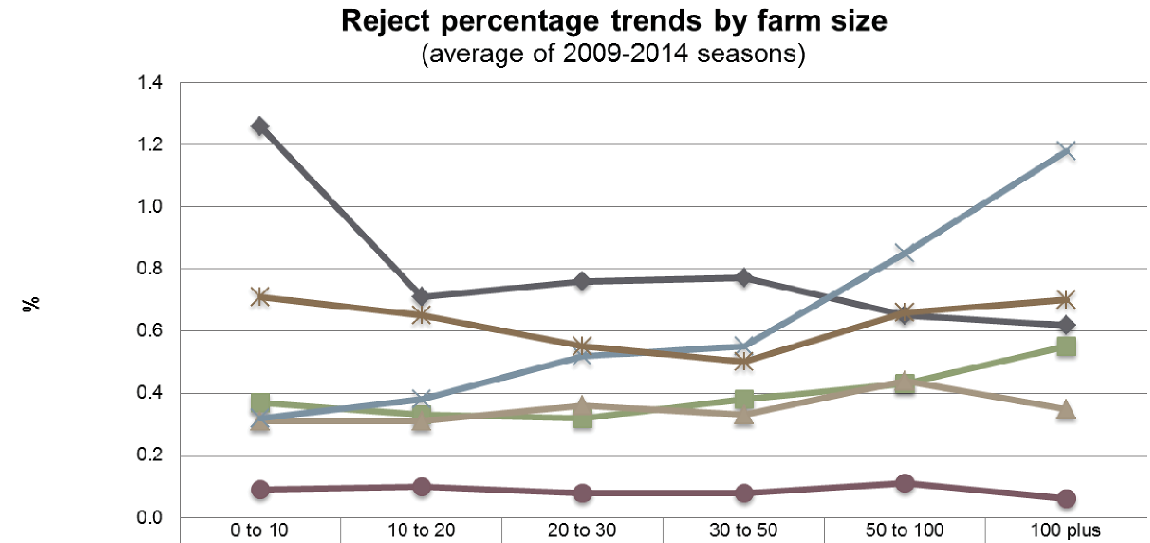
There were major differences in 2014 in average results for the different farm size categories compared to the averages from 2009 to 2014:

- All the farm size categories had a greater average SKR and PKR in 2014 than the averages from 2009 to 2014.
- The farms less than 100 hectares had a greater average CKR and the farms larger than 100 hectares had a slightly smaller CKR in 2014 than the averages from 2009 to 2014.
- The farms less than 10 hectares and between 20 and 30 hectares had a greater average RKR and the farms between 10 and 20 hectares, 30 and 50 hectares and 50 and 100 hectares a smaller average RKR in 2014 than the averages from 2009 to 2014.
- The farms between 20 and 30 hectares and more than 100 hectares had a greater average NIS MC and the farms less than 20 hectares and between 30 and 100 hectares had a smaller average NIS MC in 2014 than the averages from 2009 to 2014.
- All the farm size categories less than 50 hectares had a higher average percentage of whole kernels and the farm size categories larger than 50 hectares had a lower average percentage in 2014 than the averages from 2009 to 2014.
- All the farm size categories less than 100 hectares had a lower average level of rejects and the farms larger than 100 hectares had a greater average level of rejects due to insect damage in 2014 than the averages from 2009 to 2014.
- All the farm size categories had a greater average level of rejects due to mould in 2014 than the averages from 2009 to 2014.
- All the farm size categories had a smaller average level of rejects due to discolouration in 2014 than the averages from 2009 to 2014.
- All the farm size categories more than 10 hectares had a smaller average level of rejects and the farms less than 10 hectares had a greater average level of rejects due to brown centres in 2014 than the averages from 2009 to 2014.
- The farms between 30 and 100 hectares had a lower average level of rejects and the farms less than 30 hectares and the farms greater than 100 hectares had a higher average level of rejects due to immaturity in 2014 than the averages from 2009 to 2014.
- The farms between 10 and 30 hectares had a lower average level of rejects and the farms greater than 50 hectares had a greater average level of rejects due to germination than the averages from 2009 to 2014.

Farm size averages	2014						2009-2014					
	<10 ha	10 - <20 ha	20 - <30 ha	30 - <50 ha	50 - <100 ha	100+ ha	<10 ha	10 - <20 ha	20 - <30 ha	30 - <50 ha	50 - <100 ha	100+ ha
Saleable KR %	34.71	35.12	34.37	35.26	34.74	33.16	33.57	33.97	33.17	33.71	33.25	32.62
Premium KR %	30.57	31.58	30.78	31.70	31.34	30.57	30.55	30.86	30.28	30.66	30.42	30.00
Commercial KR %	4.13	3.54	3.58	3.56	3.41	2.59	3.02	3.11	2.90	3.05	2.83	2.62
Reject KR %	3.13	2.41	2.60	2.28	2.81	3.37	2.99	2.57	2.57	2.52	3.22	3.37
Moisture %	15.28	15.66	15.16	13.77	11.80	13.16	15.54	15.70	14.93	14.49	12.63	13.02
Whole kernel %	54.78	55.85	53.64	52.39	48.34	49.47	53.46	53.98	51.11	50.20	49.05	51.86
Insect damage %	0.99	0.59	0.60	0.61	0.61	0.77	1.29	0.75	0.69	0.80	0.72	0.59
Mould %	0.55	0.46	0.51	0.43	0.58	0.59	0.37	0.34	0.32	0.35	0.45	0.53
Discolouration %	0.22	0.23	0.32	0.25	0.35	0.26	0.27	0.32	0.37	0.30	0.53	0.35
Brown centres %	0.32	0.31	0.42	0.40	0.59	0.88	0.29	0.38	0.54	0.51	0.84	1.14
Immaturity %	0.94	0.75	0.64	0.48	0.54	0.88	0.70	0.66	0.57	0.51	0.63	0.67
Germination %	0.08	0.06	0.07	0.09	0.13	0.09	0.08	0.11	0.08	0.09	0.09	0.07

Table 6.6-7: Farm size quality averages for 2014 and for all years from 2009 - 2014

Significant differences between the farm size categories are evident in the breakdowns of the reject analyses. Figure 6.6-2 shows the average consignment reject analysis for bearing farms of different sizes. The chart shows the averages of the reject categories within the reject kernel recovery for all seasons from 2009 to 2014.



	0 to 10	10 to 20	20 to 30	30 to 50	50 to 100	100 plus
Insect	1.26	0.71	0.76	0.77	0.65	0.62
Mould	0.37	0.33	0.32	0.38	0.43	0.55
Discoloured	0.31	0.31	0.36	0.33	0.44	0.35
Brown centres	0.32	0.38	0.52	0.55	0.85	1.18
Immature	0.71	0.65	0.55	0.50	0.66	0.70
Germinated	0.09	0.10	0.08	0.08	0.11	0.06

Figure 6.6-2: Comparison of consignment reject analysis for farms of different sizes (average of the 2009 to 2014 seasons)

The level of rejects due to brown centres (or internal discolouration) increased with increasing average farm size. Farms less than 10 hectares had an average reject level due to brown centres of 0.32% compared to farms greater than 100 hectares with an average reject level of 1.18%.

This is consistent with the findings of the grower surveys from *the "Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project (MC07008). These surveys found that the average level of brown centres significantly increased with increasing farm size, maximum silo size and nut storage bed depth.

The level of rejects due to mould was also greater with larger average farm sizes. Farms less than 50 hectares had an average reject level due to mould less than 0.4% compared to farms greater than 100 hectares with an average reject level of 0.55%. Kernel quality surveys also indicated a significant positive correlation between the levels of brown centres and mould.

The level of rejects due to insect damage was highest for smaller average farm sizes. Farms less than 10 hectares had an average reject level due to insect damage of 1.26% compared to farms greater than 100 hectares with an average reject level of 0.62%.

The level of rejects due to immaturity, discolouration and germination did not vary as much as the level of rejects due to insect damage, brown centres and mould with farm size.

Further analysis of pest management in macadamias is necessary to examine the causes of higher levels of insect damage on smaller farms.

Saleable kernel recovery (SKR) by farm size

Farms less than 20 hectares had a higher relative proportion of farm years in the top 25% and a lower relative proportion in the bottom 25% for SKR. For example, farms between 10 and 20 hectares had 26.4% of farm years in the top 25% but only 19.9% of farm years in the bottom 25%. Farms larger than 50 hectares had a higher relative proportion in the middle 50% and bottom 25% of farm years and a lower relative proportion in the top 25% for SKR. For example, farms larger than 100 hectares had 10.3% of farm years in the middle 50%, 10.5% in the bottom 25% and only 3.7% in the top 25% for SKR.

This relationship between SKR and farm size is statistically significant.

Saleable kernel recovery %	Total farms years = 1316	Top 25% (=>35.99)	Middle 50% (>=31.01 to < 35.99)	Bottom 25% (<31.01)	Total
<10 ha	Farm year	114	197	102	413
	% within percentile	35.0%	29.9%	30.7%	31.4%
	% of total	8.7%	15.0%	7.8%	31.4%
10 ha to < 20 ha	Farm year	86	154	66	306
	% within percentile	26.4%	23.4%	19.9%	23.3%
	% of total	6.5%	11.7%	5.0%	23.3%
20 ha to < 30 ha	Farm year	44	84	55	183
	% within percentile	13.5%	12.8%	16.6%	13.9%
	% of total	3.3%	6.4%	4.2%	13.9%
30 ha to < 50 ha	Farm year	53	96	42	191
	% within percentile	16.3%	14.6%	12.7%	14.5%
	% of total	4.0%	7.3%	3.2%	14.5%
50 ha to < 100 ha	Farm year	17	59	32	108
	% within percentile	5.2%	9.0%	9.6%	8.2%
	% of total	1.3%	4.5%	2.4%	8.2%
>100 ha	Farm year	12	68	35	115
	% within percentile	3.7%	10.3%	10.5%	8.7%
	% of total	0.9%	5.2%	2.7%	8.7%
Total	Farm years	326	658	332	1316
	% of total	24.8%	50.0%	25.2%	100.0%

Table 6.6-8: Cross tabulation saleable kernel recovery by percentile and farm size

Table 6.6-9 shows the statistical differences between the average SKR's for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 10 and 20 hectares had a significantly higher average SKR than farms between 20 and 30 hectares and farms larger than 50 hectares.
- Farms larger than 100 hectares had a significantly lower average SKR than farms between 30 and 50 hectares and farms smaller than 20 hectares.

Bearing farms	Least significant difference					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig**	**Mean**	
Saleable kernel recovery %	<10 ha	Between 10 and 20	-0.40	0.15	<10 ha	33.57
		Between 20 and 30	0.40	0.24		
		Between 30 and 50	-0.15	0.65		
		Between 50 and 100	0.32	0.39		
		Above 100	0.95	0.01***		
	10 ha to <20 ha	Less than 10	0.40	0.15	10 ha to <20 ha	33.97
		Between 20 and 30	0.80	0.02**		
		Between 30 and 50	0.25	0.45		
		Between 50 and 100	0.72	0.06*		
		Above 100	1.35	0.00***		
	20 ha to <30 ha	Less than 10	-0.40	0.24	20 ha to <30 ha	33.17
		Between 10 and 20	-0.80	0.02**		
		Between 30 and 50	-0.54	0.16		
		Between 50 and 100	-0.08	0.86		
		Above 100	0.55	0.20		
	30 ha to <50 ha	Less than 10	0.15	0.65	30 ha to <50 ha	33.71
		Between 10 and 20	-0.25	0.45		
		Between 20 and 30	0.54	0.16		
		Between 50 and 100	0.47	0.27		
		Above 100	1.10	0.01**		
	50 ha to <100 ha	Less than 10	-0.32	0.39	50 ha to <100 ha	32.25
		Between 10 and 20	-0.72	0.06*		
		Between 20 and 30	0.08	0.86		
		Between 30 and 50	-0.47	0.27		
		Above 100	0.63	0.17		
	>=100 ha	Less than 10	-0.95	0.01***	>=100 ha	32.62
		Between 10 and 20	-1.35	0.00***		
		Between 20 and 30	-0.55	0.20		
		Between 30 and 50	-1.10	0.01***		
		Between 50 and 100	-0.63	0.17		

Table 6.6-9: Comparison of farm size average saleable kernel recovery for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Premium kernel recovery (PKR) by farm size

Farms less than 10 hectares had a higher relative proportion of farm years in the top 25% (38.3%) and a lower relative proportion in the middle 50% (28.5%) and bottom 25% (30.1%) for PKR. By comparison, farms larger than 50 hectares had a lower relative proportion in the top 25% and a higher relative proportion in the bottom 25% of farm years for PKR. For example, farms larger than 100 hectares had only 4.8% of farm years in the top 25% but 9.4% in the bottom 25%.

This relationship between PKR and farm size is not statistically significant.

Premium kernel recovery %	Total farms years = 1316	Top 25% (>=33.20	Middle 50% (>=28.05 to <33.20)	Bottom 25% (<28.05)	Total
<10 ha	Farm year	127	187	99	413
	% within percentile	38.3%	28.5%	30.1%	31.4%
	% of total	9.7%	14.2%	7.5%	31.4%
10 ha to < 20 ha	Farm year	78	161	67	306
	% within percentile	23.5%	24.6%	20.4%	23.3%
	% of total	5.9%	12.2%	5.1%	23.3%
20 ha to < 30 ha	Farm year	40	95	48	183
	% within percentile	12.0%	14.5%	14.6%	13.9%
	% of total	3.0%	7.2%	3.6%	13.9%
30 ha to < 50 ha	Farm year	50	91	50	191
	% within percentile	15.1%	13.9%	15.2%	14.5%
	% of total	3.8%	6.9%	3.8%	14.5%
50 ha to < 100 ha	Farm year	21	53	34	108
	% within percentile	6.3%	8.1%	10.3%	8.2%
	% of total	1.6%	4.0%	2.6%	8.2%
>100 ha	Farm year	16	68	31	115
	% within percentile	4.8%	10.4%	9.4%	8.7%
	% of total	1.2%	5.2%	2.4%	8.7%
Total	Farm year	332	655	329	1316
	% of total	25.2%	49.8%	25.0%	100.0%

Table 6.6-10: Cross tabulation premium kernel recovery by percentile and farm size

Table 6.6-11 shows the statistical differences in average PKR for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 10 and 20 hectares had a significantly higher average PKR than farms larger than 100 hectares.
- There is no significant difference between any of the average PKR in the other farm size categories

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Premium kernel recovery %	<10 ha	Between 10 and 20	-0.30	0.28	<10 ha	30.55
		Between 20 and 30	0.27	0.43		
		Between 30 and 50	-0.11	0.74		
		Between 50 and 100	0.13	0.73		
		Above 100	0.55	0.15		
	10 ha to <20 ha	Less than 10	0.30	0.28	10 ha to <20 ha	30.86
		Between 20 and 30	0.58	0.11		
		Between 30 and 50	0.19	0.58		
		Between 50 and 100	0.44	0.27		
		Above 100	0.86	0.03**		
	20 ha to <30 ha	Less than 10	-0.27	0.43	20 ha to <30 ha	30.28
		Between 10 and 20	-0.58	0.11		
		Between 30 and 50	-0.39	0.33		
		Between 50 and 100	-0.14	0.75		
		Above 100	0.28	0.53		
	30 ha to <50 ha	Less than 10	0.11	0.74	30 ha to <50 ha	30.66
		Between 10 and 20	-0.19	0.58		
		Between 20 and 30	0.39	0.33		
		Between 50 and 100	0.25	0.57		
		Above 100	0.66	0.13		
	50 ha to <100 ha	Less than 10	-0.13	0.73	50 ha to <100 ha	30.42
		Between 10 and 20	-0.44	0.27		
		Between 20 and 30	0.14	0.75		
		Between 30 and 50	-0.25	0.57		
		Above 100	0.42	0.38		
	>=100 ha	Less than 10	-0.55	0.15	>=100 ha	30.00
		Between 10 and 20	-0.86	0.03**		
		Between 20 and 30	-0.28	0.53		
		Between 30 and 50	-0.66	0.13		
		Between 50 and 100	-0.42	0.38		

Table 6.6-11: Comparison of farm size average premium kernel recovery for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Commercial kernel recovery (CKR) by farm size

Farms less than 10 hectares had a higher relative proportion of farm years in the bottom 25% (39.4%) and top 25% (36.1%) and a lower relative proportion in the middle 50% (25.2%) for CKR. By comparison, farms larger than 50 hectares had a higher relative proportion in the middle 50% and a lower relative proportion in the top and bottom 25% of farm years for CKR. For example, farms larger than 100 hectares had 13.1% of farm years in the middle 50% but only 2.4% in the top 25% and 6.2% in the bottom 25% of farm years for CKR.

This relationship between CKR and farm size is statistically significant.

Commercial kernel recovery %	Total farm years = 1316	Top 25% (>=4.1)	Middle 50% (>=1.60 to <4.1)	Bottom 25% (<1.60)	Total
<10 ha	Farm year	119	167	127	413
	% within percentile	36.1%	25.2%	39.4%	31.4%
	% of total	9.0%	12.7%	9.7%	31.4%
10 ha to < 20 ha	Farm year	81	154	71	306
	% within percentile	24.5%	23.2%	22.0%	23.3%
	% of total	6.2%	11.7%	5.4%	23.3%
20 ha to < 30 ha	Farm year	43	95	45	183
	% within percentile	13.0%	14.3%	14.0%	13.9%
	% of total	3.3%	7.2%	3.4%	13.9%
30 ha to < 50 ha	Farm year	54	98	39	191
	% within percentile	16.4%	14.8%	12.1%	14.5%
	% of total	4.1%	7.4%	3.0%	14.5%
50 ha to < 100 ha	Farm year	25	63	20	108
	% within percentile	7.6%	9.5%	6.2%	8.2%
	% of total	1.9%	4.8%	1.5%	8.2%
>100 ha	Farm year	8	87	20	115
	% within percentile	2.4%	13.1%	6.2%	8.7%
	% of total	0.6%	6.6%	1.5%	8.7%
Total	Farm year	330	664	322	1316
	% of total	25.1%	50.5%	24.5%	100.0%

Table 6.6-12: Cross tabulation commercial kernel recovery by percentile and farm size

Table 6.6-13 shows the statistical differences in average CKR for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms larger than 100 hectares had a significantly lower average CKR than farms smaller than 20 hectares and between 30 and 50 hectares.
- There is no significant difference between any of the average CKR's in the other farm size categories

Bearing farms	Least significant difference					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig**	**Mean**	
Commercial kernel recovery %	<10 ha	Between 10 and 20	-0.10	0.53	<10 ha	3.02
		Between 20 and 30	0.12	0.51		
		Between 30 and 50	-0.03	0.85		
		Between 50 and 100	0.19	0.36		
		Above 100	0.40	0.05*		
	10 ha to <20 ha	Less than 10	0.10	0.53	10 ha to <20 ha	3.11
		Between 20 and 30	0.22	0.25		
		Between 30 and 50	0.06	0.73		
		Between 50 and 100	0.28	0.17		
		Above 100	0.50	0.02**		
	20 ha to <30 ha	Less than 10	-0.12	0.51	20 ha to <30 ha	2.90
		Between 10 and 20	-0.22	0.25		
		Between 30 and 50	-0.16	0.47		
		Between 50 and 100	0.07	0.78		
		Above 100	0.28	0.24		
	30 ha to <50 ha	Less than 10	0.03	0.85	30 ha to <50 ha	3.05
		Between 10 and 20	-0.06	0.73		
		Between 20 and 30	0.16	0.47		
		Between 50 and 100	0.22	0.34		
		Above 100	0.43	0.06*		
	50 ha to <100 ha	Less than 10	-0.19	0.36	50 ha to <100 ha	2.83
		Between 10 and 20	-0.28	0.17		
		Between 20 and 30	-0.07	0.78		
		Between 30 and 50	-0.22	0.34		
		Above 100	0.21	0.40		
	>=100 ha	Less than 10	-0.40	0.05*	>=100 ha	2.62
		Between 10 and 20	-0.50	0.02**		
		Between 20 and 30	-0.28	0.24		
		Between 30 and 50	-0.43	0.06*		
		Between 50 and 100	-0.21	0.40		

Table 6.6-13: Comparison of farm size average commercial kernel recovery for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Reject kernel recovery (RKR) by farm size

Note: When comparing levels of RKR in cross tabulations, the figures are inverted (i.e. the lower levels are in the top 25%) as a low RKR represents better quality. The percentiles are not exactly split into the top 25%, middle 50% and bottom 25% as the low RKR percentages, particularly amongst the better quality results, require slightly different percentile groupings to effectively split the benchmark sample results.

Farms with less than 20 bearing hectares have a higher relative proportion in the top 25% of farm years for RKR. For example, farms less than 10 hectares had 36.2% of farm years in the top 25%. Farms less than 10 hectares also had a higher relative proportion in the bottom 25% (37.6%) of farm years for RKR. Farms larger than 20 hectares tended to have a higher relative proportion of farm years in the middle 50% for RKR. Farms larger than 50 hectares also had a higher relative proportion of farm years in the bottom 25% of farm years. For example, farms larger than 100 hectares had 8.6% in the middle 50% and 13.1% in the bottom 25% but only 4.6% in the top 25% of farm years for RKR.

This relationship between RKR and farm size is statistically significant.

Reject kernel recovery %	Total farm years = 1316	Top 25% (<=1.69)	Middle 50% (> 1.69 to <=3.39)	Bottom 25% (> 3.39)	Total
<10 ha	Farm year	119	168	126	413
	% within percentile	36.2%	25.8%	37.6%	31.4%
	% of total	9.0%	12.8%	9.6%	31.4%
10 ha to < 20 ha	Farm year	105	141	60	306
	% within percentile	31.9%	21.6%	17.9%	23.3%
	% of total	8.0%	10.7%	4.6%	23.3%
20 ha to < 30 ha	Farm year	38	108	37	183
	% within percentile	11.6%	16.6%	11.0%	13.9%
	% of total	2.9%	8.2%	2.8%	13.9%
30 ha to < 50 ha	Farm year	41	117	33	191
	% within percentile	12.5%	17.9%	9.9%	14.5%
	% of total	3.1%	8.9%	2.5%	14.5%
50 ha to < 100 ha	Farm year	11	62	35	108
	% within percentile	3.3%	9.5%	10.4%	8.2%
	% of total	0.8%	4.7%	2.7%	8.2%
>100 ha	Farm year	15	56	44	115
	% within percentile	4.6%	8.6%	13.1%	8.7%
	% of total	1.1%	4.3%	3.3%	8.7%
Total	Farm years	329	652	335	1316
	% of total	25.0%	49.5%	25.5%	100.0%

Table 6.6-14: Cross tabulation reject kernel recovery by percentile and farm size

Table 6.6-15 shows the statistical differences in average RKR for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- The farms larger than 100 hectares had a significantly higher average RKR than farms smaller than 50 hectares.
- The farms between 50 and 100 hectares had a significantly higher average RKR than farms between 10 and 50 hectares.
- The farms smaller than 10 hectares had a significantly higher average RKR than farms between 10 and 50 hectares.

Bearing farms	Least significant difference				
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig**	**Mean**	
Reject kernel recovery %	<10 ha	Between 10 and 20	0.43	0.00***	<10 ha	2.99
		Between 20 and 30	0.43	0.01***		
		Between 30 and 50	0.48	0.00***		
		Between 50 and 100	-0.23	0.21		
		Above 100	-0.38	0.03**		
	10 ha to <20 ha	Less than 10	-0.43	0.00***	10 ha to <20 ha	2.57
		Between 20 and 30	0.00	1.00		
		Between 30 and 50	0.05	0.76		
		Between 50 and 100	-0.65	0.00***		
		Above 100	-0.81	0.00***		
	20 ha to <30 ha	Less than 10	-0.43	0.01***	20 ha to <30 ha	2.57
		Between 10 and 20	0.00	1.00		
		Between 30 and 50	0.05	0.79		
		Between 50 and 100	-0.65	0.00***		
		Above 100	-0.81	0.00***		
	30 ha to <50 ha	Less than 10	-0.48	0.00***	30 ha to <50 ha	2.52
		Between 10 and 20	-0.05	0.76		
		Between 20 and 30	-0.05	0.79		
		Between 50 and 100	-0.70	0.00***		
		Above 100	-0.86	0.00***		
	50 ha to <100 ha	Less than 10	0.23	0.21	50 ha to <100 ha	3.22
		Between 10 and 20	0.65	0.00***		
		Between 20 and 30	0.65	0.00***		
		Between 30 and 50	0.70	0.00***		
		Above 100	-0.15	0.48		
	>=100 ha	Less than 10	0.38	0.03**	>=100 ha	3.37
		Between 10 and 20	0.81	0.00***		
		Between 20 and 30	0.81	0.00***		
		Between 30 and 50	0.86	0.00***		
		Between 50 and 100	0.15	0.48		

Table 6.6-15: Comparison of farm size average reject kernel recovery for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Insect damage by farm size

Table 6.6-16 shows the statistical differences in average levels of rejects due to insect damage for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms smaller than 10 hectares had a significantly higher average level of rejects due to insect damage than farms in each of the other size categories.
- Farms between 30 and 50 hectares had a significantly higher average level of rejects due to insect damage than farms larger than 100 hectares.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Insect damage %	<10 ha	Between 10 and 20	0.53	0.00***	<10 ha	1.29
		Between 20 and 30	0.59	0.00***		
		Between 30 and 50	0.49	0.00***		
		Between 50 and 100	0.57	0.00***		
		Above 100	0.70	0.00***		
	10 ha to <20 ha	Less than 10	-0.53	0.00***	10 ha to <20 ha	0.75
		Between 20 and 30	0.06	0.55		
		Between 30 and 50	-0.05	0.64		
		Between 50 and 100	0.04	0.74		
		Above 100	0.17	0.14		
	20 ha to <30 ha	Less than 10	-0.59	0.00***	20 ha to <30 ha	0.69
		Between 10 and 20	-0.06	0.55		
		Between 30 and 50	-0.11	0.35		
		Between 50 and 100	-0.02	0.86		
		Above 100	0.11	0.40		
	30 ha to <50 ha	Less than 10	-0.49	0.00***	30 ha to <50 ha	0.80
		Between 10 and 20	0.05	0.64		
		Between 20 and 30	0.11	0.35		
		Between 50 and 100	0.08	0.50		
		Above 100	0.21	0.09*		
	50 ha to <100 ha	Less than 10	-0.57	0.00***	50 ha to <100 ha	0.72
		Between 10 and 20	-0.04	0.74		
		Between 20 and 30	0.02	0.86		
		Between 30 and 50	-0.08	0.50		
		Above 100	0.13	0.34		
	>=100 ha	Less than 10	-0.70	0.00***	>=100 ha	0.59
		Between 10 and 20	-0.17	0.14		
		Between 20 and 30	-0.11	0.40		
		Between 30 and 50	-0.21	0.09*		
		Between 50 and 100	-0.13	0.34		

Table 6.6-16: Comparison of farm size average rejects due to insect damage for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Mould by farm size

Table 6.6-17 shows the statistical differences in average levels of rejects due to mould for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms larger than 100 hectares had a significantly higher average level of rejects due to mould than farms in each of the other size categories.
- Farms between 50 and 100 hectares had a significantly higher average level of rejects due to mould than farms between 10 and 50 hectares.

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Mould %	<10 ha	Between 10 and 20	0.03	0.27	<10 ha	0.37
		Between 20 and 30	0.05	0.16		
		Between 30 and 50	0.01	0.73		
		Between 50 and 100	-0.08	0.13		
		Above 100	-0.16	0.00***		
	10 ha to <20 ha	Less than 10	-0.03	0.27	10 ha to <20 ha	0.34
		Between 20 and 30	0.02	0.63		
		Between 30 and 50	-0.02	0.56		
		Between 50 and 100	-0.11	0.02**		
		Above 100	-0.19	0.00***		
	20 ha to <30 ha	Less than 10	-0.05	0.16	20 ha to <30 ha	0.32
		Between 10 and 20	-0.02	0.63		
		Between 30 and 50	-0.04	0.35		
		Between 50 and 100	-0.13	0.02**		
		Above 100	-0.21	0.00***		
	30 ha to <50 ha	Less than 10	-0.01	0.73	30 ha to <50 ha	0.35
		Between 10 and 20	0.02	0.56		
		Between 20 and 30	0.04	0.35		
		Between 50 and 100	-0.09	0.10*		
		Above 100	-0.18	0.00***		
	50 ha to <100 ha	Less than 10	0.08	0.13	50 ha to <100 ha	0.45
		Between 10 and 20	0.11	0.02**		
		Between 20 and 30	0.13	0.02**		
		Between 30 and 50	0.09	0.10*		
		Above 100	-0.08	0.09*		
	>=100 ha	Less than 10	0.16	0.00***	>=100 ha	0.53
		Between 10 and 20	0.19	0.00***		
		Between 20 and 30	0.21	0.00***		
		Between 30 and 50	0.18	0.00***		
		Between 50 and 100	0.08	0.09*		

Table 6.6-17: Comparison of farm size average rejects due to mould for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Discolouration by farm size

Table 6.6-18 shows the statistical differences in average levels of rejects due to discolouration for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 50 and 100 hectares had a significantly higher average level of rejects due to discolouration than farms in each of the other size categories.
- Farms less than 10 hectares had a significantly lower average level of rejects due to discolouration than farms between 20 and 30 hectares and farms more than 50 hectares.

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Discoloured %	<10 ha	Between 10 and 20	-0.05	0.18	<10 ha	0.27
		Between 20 and 30	-0.10	0.02**		
		Between 30 and 50	-0.03	0.51		
		Between 50 and 100	-0.26	0.00***		
		Above 100	-0.08	0.09*		
	10 ha to <20 ha	Less than 10	0.05	0.18	10 ha to <20 ha	0.32
		Between 20 and 30	-0.05	0.23		
		Between 30 and 50	0.02	0.64		
		Between 50 and 100	-0.21	0.00***		
		Above 100	-0.03	0.48		
	20 ha to <30 ha	Less than 10	0.10	0.02**	20 ha to <30 ha	0.37
		Between 10 and 20	0.05	0.23		
		Between 30 and 50	0.07	0.14		
		Between 50 and 100	-0.15	0.01***		
		Above 100	0.02	0.73		
	30 ha to <50 ha	Less than 10	0.03	0.51	30 ha to <50 ha	0.30
		Between 10 and 20	-0.02	0.64		
		Between 20 and 30	-0.07	0.14		
		Between 50 and 100	-0.23	0.00***		
		Above 100	-0.05	0.31		
	50 ha to <100 ha	Less than 10	0.26	0.00***	50 ha to <100 ha	0.53
		Between 10 and 20	0.21	0.00***		
		Between 20 and 30	0.15	0.01***		
		Between 30 and 50	0.23	0.00***		
		Above 100	0.17	0.00***		
	>=100 ha	Less than 10	0.08	0.09*	>=100 ha	0.35
		Between 10 and 20	0.03	0.48		
		Between 20 and 30	-0.02	0.73		
		Between 30 and 50	0.05	0.31		
		Between 50 and 100	-0.17	0.00***		

Table 6.6-18: Comparison of farm size average rejects due to discolouration for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Brown centres by farm size

Table 6.6-19 shows the statistical differences in average levels of rejects due to brown centres for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms larger than 100 hectares had a significantly higher average level of rejects due to brown centres than farms in each of the other farm size categories.
- Farms between 50 and 100 hectares had a significantly higher average level of rejects due to brown centres than farms smaller than 50 hectares.
- Farms less than 10 hectares had a significantly lower average level of rejects due to brown centres than farms in each of the other farm size categories.
- Farms between 10 and 20 hectares had a significantly lower average level of rejects due to brown centres than farms in each of the other farm size categories more than 20 hectares.

Bearing farms	Least significant difference					
Dependent variable	**Farm (I)**	**Farm (J)**	**Mean difference (I-J)**	**Sig**	**Mean**	
Brown centres %	<10 ha	Between 10 and 20	-0.09	0.01***	<10 ha	0.29
		Between 20 and 30	-0.25	0.00***		
		Between 30 and 50	-0.22	0.00***		
		Between 50 and 100	-0.55	0.00***		
		Above 100	-0.85	0.00***		
	10 ha to <20 ha	Less than 10	0.09	0.01***	10 ha to <20 ha	0.38
		Between 20 and 30	-0.16	0.00***		
		Between 30 and 50	-0.12	0.01***		
		Between 50 and 100	-0.46	0.00***		
		Above 100	-0.76	0.00***		
	20 ha to <30 ha	Less than 10	0.25	0.00***	20 ha to <30 ha	0.54
		Between 10 and 20	0.16	0.00***		
		Between 30 and 50	0.04	0.49		
		Between 50 and 100	-0.30	0.00***		
		Above 100	-0.60	0.00***		
	30 ha to <50 ha	Less than 10	0.22	0.00***	30 ha to <50 ha	0.51
		Between 10 and 20	0.12	0.01***		
		Between 20 and 30	-0.04	0.49		
		Between 50 and 100	-0.34	0.00***		
		Above 100	-0.64	0.00***		
	50 ha to <100 ha	Less than 10	0.55	0.00***	50 ha to <100 ha	0.84
		Between 10 and 20	0.46	0.00***		
		Between 20 and 30	0.30	0.00***		
		Between 30 and 50	0.34	0.00***		
		Above 100	-0.30	0.00***		
	>=100 ha	Less than 10	0.85	0.00***	>=100 ha	1.14
		Between 10 and 20	0.76	0.00***		
		Between 20 and 30	0.60	0.00***		
		Between 30 and 50	0.64	0.00***		
		Between 50 and 100	0.30	0.00***		

Table 6.6-19: Comparison of farm size average rejects due to brown centres for all seasons combined

** The mean difference is significant at the 10% level*
*** The mean difference is significant at the 5% level*
**** The mean difference is significant at the 1% level*

Immaturity by farm size

Table 6.6-20 shows the statistical differences in average levels of rejects due to immaturity for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms less than 10 hectares had a significantly higher average level of rejects due to immaturity than farms between 20 and 30 hectares and between 30 and 50 hectares.
- Farms between 10 and 20 hectares had a significantly higher average level of rejects due to immaturity than farms between 30 and 50 hectares.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Immaturity %	<10 ha	Between 10 and 20	0.05	0.42	<10 ha	0.70
		Between 20 and 30	0.14	0.07*		
		Between 30 and 50	0.19	0.01***		
		Between 50 and 100	0.07	0.28		
		Above 100	0.04	0.58		
	10 ha to <20 ha	Less than 10	-0.05	0.42	10 ha to <20 ha	0.66
		Between 20 and 30	0.09	0.26		
		Between 30 and 50	0.15	0.08*		
		Between 50 and 100	0.03	0.63		
		Above 100	0.01	0.97		
	20 ha to <30 ha	Less than 10	-0.14	0.07*	20 ha to <30 ha	0.57
		Between 10 and 20	-0.09	0.26		
		Between 30 and 50	0.06	0.60		
		Between 50 and 100	-0.06	0.63		
		Above 100	-0.10	0.35		
	30 ha to <50 ha	Less than 10	-0.19	0.01***	30 ha to <50 ha	0.51
		Between 10 and 20	-0.15	0.08*		
		Between 20 and 30	-0.06	0.60		
		Between 50 and 100	-0.12	0.33		
		Above 100	-0.16	0.15		
	50 ha to <100 ha	Less than 10	-0.07	0.28	50 ha to <100 ha	0.63
		Between 10 and 20	-0.03	0.63		
		Between 20 and 30	0.06	0.63		
		Between 30 and 50	0.12	0.33		
		Above 100	-0.04	0.67		
	>=100 ha	Less than 10	-0.04	0.58	>=100 ha	0.67
		Between 10 and 20	0.01	0.97		
		Between 20 and 30	0.109	0.35		
		Between 30 and 50	0.16	0.15		
		Between 50 and 100	0.04	0.67		

Table 6.6-20: Comparison of farm size average rejects due to immaturity for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Germination by farm size

Table 6.6-21 shows the statistical differences in average levels of rejects due to germination for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms less than 10 hectares had a significantly lower average level of rejects due to germination than farms between 10 and 20 hectares.
- There was no significant difference in the level of rejects due to germination amongst the other farm size categories.

Bearing farms	Least significant difference					
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Germination %	<10 ha	Between 10 and 20	-0.03	0.10*	<10 ha	0.08
		Between 20 and 30	0.00	0.86		
		Between 30 and 50	-0.01	0.78		
		Between 50 and 100	-0.01	0.51		
		Above 100	0.01	0.70		
	10 ha to <20 ha	Less than 10	0.03	0.10*	10 ha to <20 ha	0.11
		Between 20 and 30	0.03	0.14		
		Between 30 and 50	0.02	0.28		
		Between 50 and 100	0.01	0.59		
		Above 100	0.03	0.12		
	20 ha to <30 ha	Less than 10	0.00	0.86	20 ha to <30 ha	0.08
		Between 10 and 20	-0.03	0.14		
		Between 30 and 50	-0.01	0.69		
		Between 50 and 100	-0.02	0.47		
		Above 100	0.00	0.85		
	30 ha to <50 ha	Less than 10	0.01	0.78	30 ha to <50 ha	0.09
		Between 10 and 20	-0.02	0.28		
		Between 20 and 30	0.01	0.69		
		Between 50 and 100	-0.01	0.71		
		Above 100	0.01	0.58		
	50 ha to <100 ha	Less than 10	0.01	0.51	50 ha to <100 ha	0.09
		Between 10 and 20	-0.01	0.59		
		Between 20 and 30	0.02	0.47		
		Between 30 and 50	0.01	0.71		
		Above 100	0.02	0.40		
	>=100 ha	Less than 10	-0.01	0.70	>=100 ha	0.07
		Between 10 and 20	-0.03	0.12		
		Between 20 and 30	0.00	0.85		
		Between 30 and 50	-0.01	0.58		
		Between 50 and 100	-0.02	0.40		

Table 6.6-21: Comparison of farm size average rejects due to germination for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Nut-in-shell moisture content (NIS MC) by farm size

Table 6.6-22 shows the statistical differences in average NIS MC for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms larger than 50 hectares had a significantly lower average NIS MC than farms smaller than 50 hectares.
- Farms between 30 and 50 hectares had a significantly lower average NIS MC than farms in all farm size categories less than 20 hectares.
- Farms between 20 and 30 hectares had a significantly lower average NIS MC than farms between 10 and 20 hectares.

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Moisture Content %	<10 ha	Between 10 and 20	-0.16	0.61	<10 ha	15.54
		Between 20 and 30	0.61	0.11		
		Between 30 and 50	1.05	0.01***		
		Between 50 and 100	2.90	0.00***		
		Above 100	2.52	0.00***		
	10 ha to <20 ha	Less than 10	0.16	0.61	10 ha to <20 ha	15.70
		Between 20 and 30	0.77	0.06*		
		Between 30 and 50	1.21	0.00***		
		Between 50 and 100	3.07	0.00***		
		Above 100	2.68	0.00***		
	20 ha to <30 ha	Less than 10	-0.61	0.11	20 ha to <30 ha	14.93
		Between 10 and 20	-0.77	0.06*		
		Between 30 and 50	0.44	0.32		
		Between 50 and 100	2.30	0.00***		
		Above 100	1.91	0.00***		
	30 ha to <50 ha	Less than 10	-1.05	0.01***	30 ha to <50 ha	14.49
		Between 10 and 20	-1.21	0.00***		
		Between 20 and 30	-0.44	0.32		
		Between 50 and 100	1.86	0.00***		
		Above 100	1.47	0.00***		
	50 ha to <100 ha	Less than 10	-2.90	0.00***	50 ha to <100 ha	12.63
		Between 10 and 20	-3.07	0.00***		
		Between 20 and 30	-2.30	0.00***		
		Between 30 and 50	-1.86	0.00***		
		Above 100	-0.39	0.47		
	>=100 ha	Less than 10	-2.52	0.00***	>=100 ha	13.02
		Between 10 and 20	-2.68	0.00***		
		Between 20 and 30	-1.91	0.00***		
		Between 30 and 50	-1.47	0.00***		
		Between 50 and 100	0.39	0.47		

Table 6.6-22: Comparison of farm size consigned NIS moisture content (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

Whole kernel percentage by farm size

Table 6.6-23 shows the statistical differences in average percentages of whole kernels for farms in the different farm size categories for all seasons from 2009 to 2014. The major differences are:

- Farms between 10 and 20 hectares had a significantly higher average percentage of whole kernels than farms in all farm size categories larger than 20 hectares.
- Farms less than 10 hectares had a significantly higher average percentage of whole kernels than farms between 20 and 100 hectares.
- Farms larger than 100 hectares had a significantly higher average percentage of whole kernels than farms between 50 and 100 hectares

Bearing farms	Least significant difference				
Dependent variable	Farm (I)	Farm (J)	Mean difference (I-J)	Sig	Mean	
Whole kernel %	<10 ha	Between 10 and 20	-0.53	0.54	<10 ha	53.46
		Between 20 and 30	2.35	0.02**		
		Between 30 and 50	3.26	0.00***		
		Between 50 and 100	4.41	0.00***		
		Above 100	1.60	0.21		
	10 ha to <20 ha	Less than 10	0.53	0.54	10 ha to <20 ha	53.98
		Between 20 and 30	2.88	0.00***		
		Between 30 and 50	3.79	0.00***		
		Between 50 and 100	4.93	0.00***		
		Above 100	2.13	0.10*		
	20 ha to <30 ha	Less than 10	-2.35	0.02**	20 ha to <30 ha	51.11
		Between 10 and 20	-2.88	0.00***		
		Between 30 and 50	0.91	0.42		
		Between 50 and 100	2.06	0.12		
		Above 100	-0.75	0.59		
	30 ha to <50 ha	Less than 10	-3.26	0.00***	30 ha to <50 ha	50.20
		Between 10 and 20	-3.79	0.00***		
		Between 20 and 30	-0.91	0.42		
		Between 50 and 100	1.15	0.39		
		Above 100	-1.66	0.23		
	50 ha to <100 ha	Less than 10	-4.41	0.00***	50 ha to <100 ha	49.05
		Between 10 and 20	-4.93	0.00***		
		Between 20 and 30	-2.06	0.12		
		Between 30 and 50	-1.15	0.39		
		Above 100	-2.81	0.07*		
	>=100 ha	Less than 10	-1.60	0.21	>=100 ha	51.86
		Between 10 and 20	-2.13	0.10*		
		Between 20 and 30	0.75	0.59		
		Between 30 and 50	1.66	0.23		
		Between 50 and 100	2.81	0.07*		

Table 6.6-23: Comparison of farm size whole kernel (%) for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

6.7 Results by planting density

Planting density is measured as the number of trees per hectare and is calculated by dividing 10000 (the amount of square metres in a hectare) by the row spacing (in metres) and the tree spacing (in metres) within the row.

Yield by planting density

Figure 6.7-1 shows the average annual **kilograms** of saleable kernel per bearing **tree** for all the farms in the benchmarking for the six years from 2009 to 2014. Figure 6.7-2 shows the average annual **tonnes** of saleable kernel per bearing **hectare** for all the farms from 2009 to 2014. This includes the bearing farms of all average tree ages. The farms are sorted by their average planting density with low density plantings at the left and high density plantings at the right. The red trend line represents the smoothed moving average of the 20 previous points and has been centred on the chart.

The moving average line in figure 6.7-1 shows that the average yield of saleable kernel per tree decreased from just over three kilograms for the farms at the lowest planting densities to just under two kilograms for the farms at the highest planting densities.

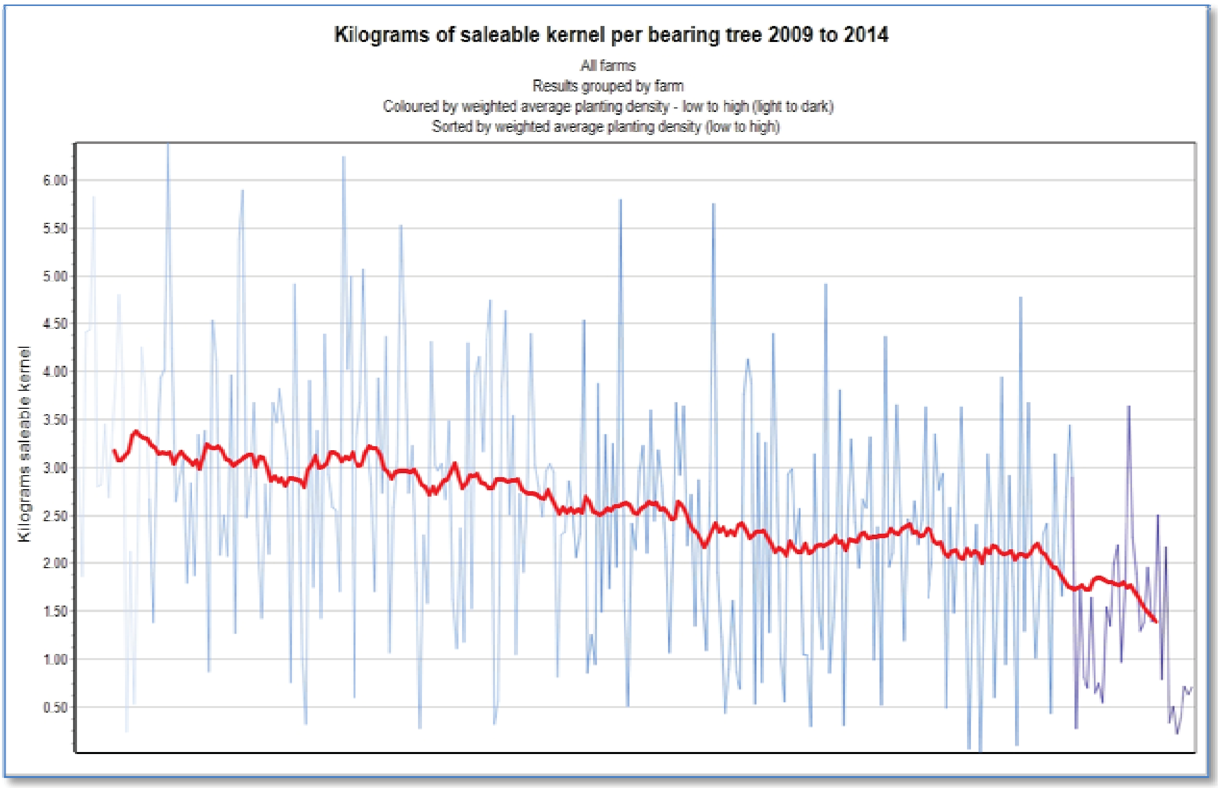


Figure 6.7-1: Saleable kernel per bearing tree by weighted average planting density for 2009 to 2014

By comparison, the red line in figure 6.7-2 shows that the average yield per hectare for the farms at the lowest planting densities and at the highest planting densities was similar at approximately 0.6 tonnes of saleable kernel per hectare. The average yields per hectare for the farms at many of the medium planting densities were higher at approximately 0.8 tonnes of saleable kernel per bearing hectare.

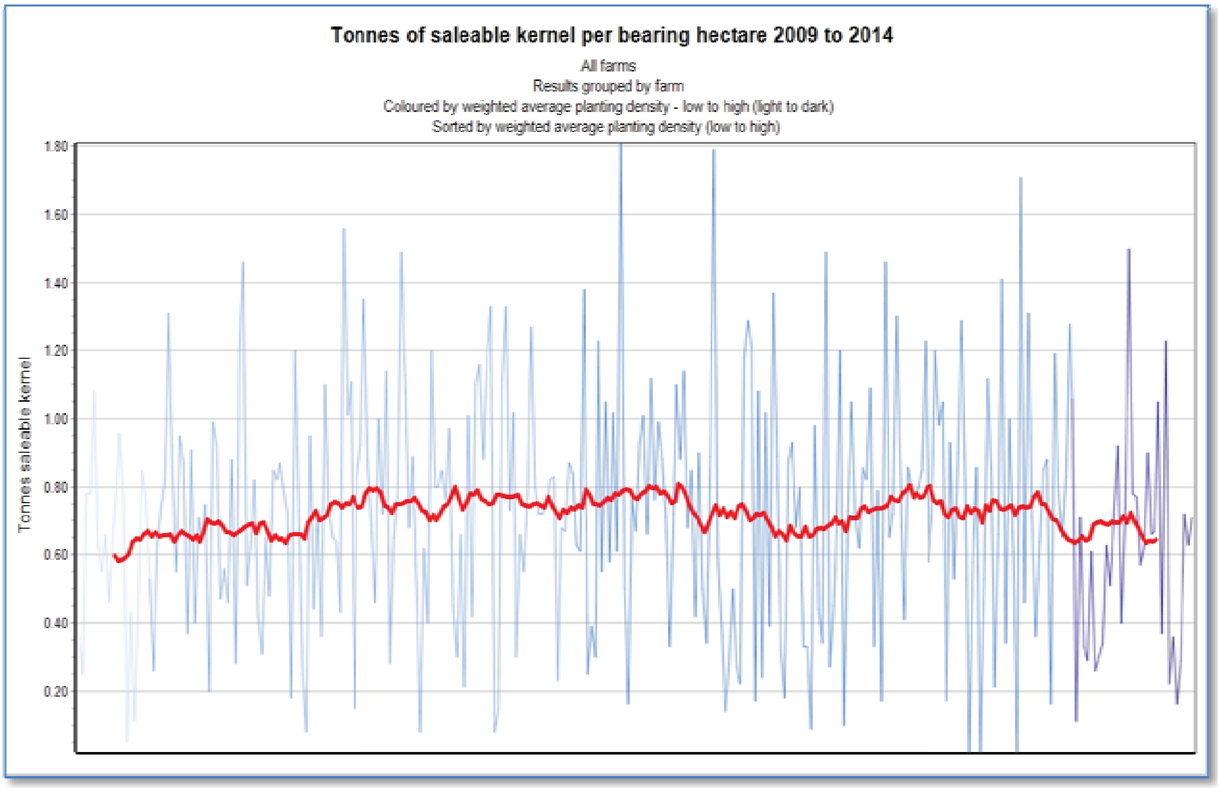


Figure 6.7-2: Saleable kernel per bearing hectare by weighted average planting density for 2009 to 2014

Figure 6.7-3 shows the average annual **kilograms** of saleable kernel per bearing **tree** from 2009 to 2014 for the farms where the average tree age is between 20 and 24 years. Figure 6.7-4 shows the average annual **tonnes** of saleable kernel per bearing **hectare** from 2009 to 2014 for the farms of the same age category.

The farms in the average tree age category from 20 to 24 years in the benchmarking sample achieved significantly higher average yields of NIS and saleable kernel per bearing hectare from 2009 to 2014 than farms in all the other average tree age categories. At most Australian macadamia industry standard medium to high planting densities, the plantings have achieved close to mature light interception and canopy coverage of the orchard floor by 20 to 24 years.

As with the trend in figure 6.7-1 showing the yields per tree for farms of all bearing ages, the average yield per tree for the farms from 20 to 24 tears in figure 6.7-3 decreased from just over 3.5 kilograms for the farms at the lowest planting densities to approximately 2.5 kilograms for the farms at the highest planting densities. The average yields per hectare for the farms in figure 6.7-4 at the lowest planting densities were approximately 0.7 tonnes of saleable kernel per bearing hectare. This gradually rose to about 0.9 tonnes per hectare as the planting density increased and then plateaued at about this level.

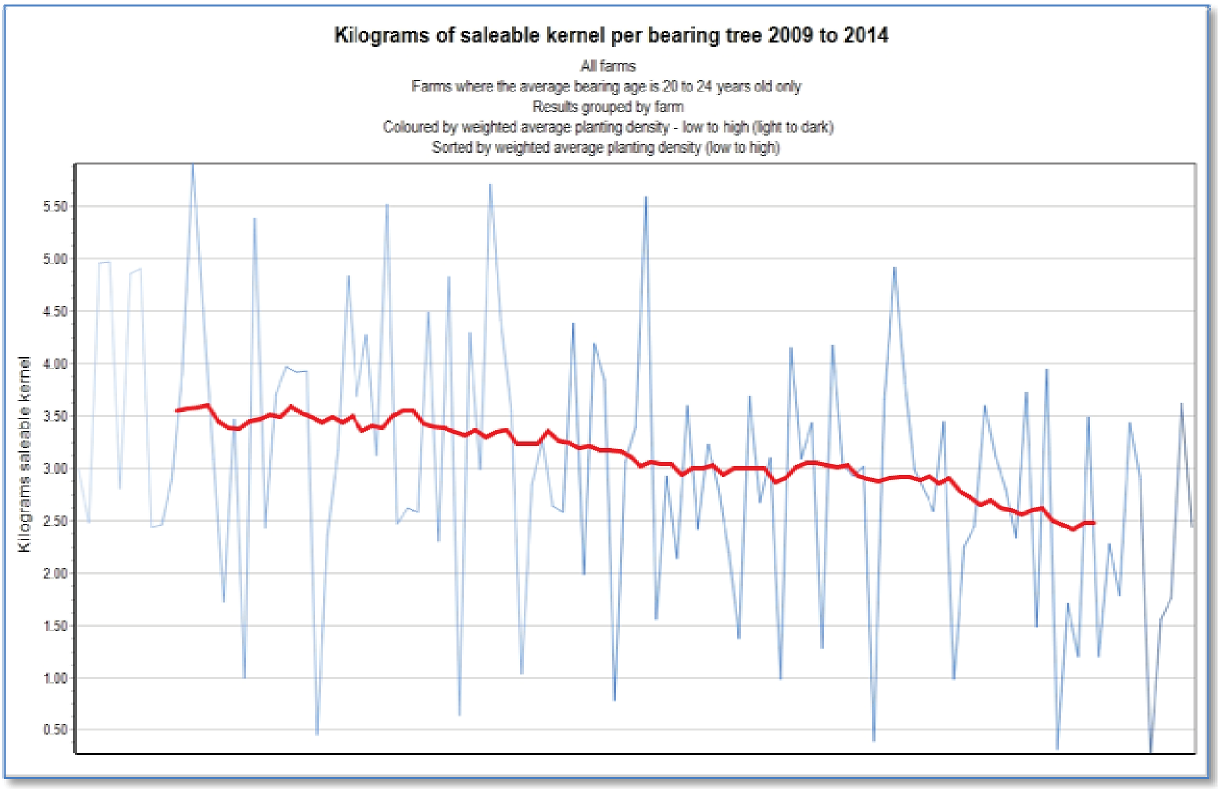


Figure 6.7-3: Saleable kernel per bearing tree for average tree age of 20 to 24 years by weighted average planting density for 2009 to 2014

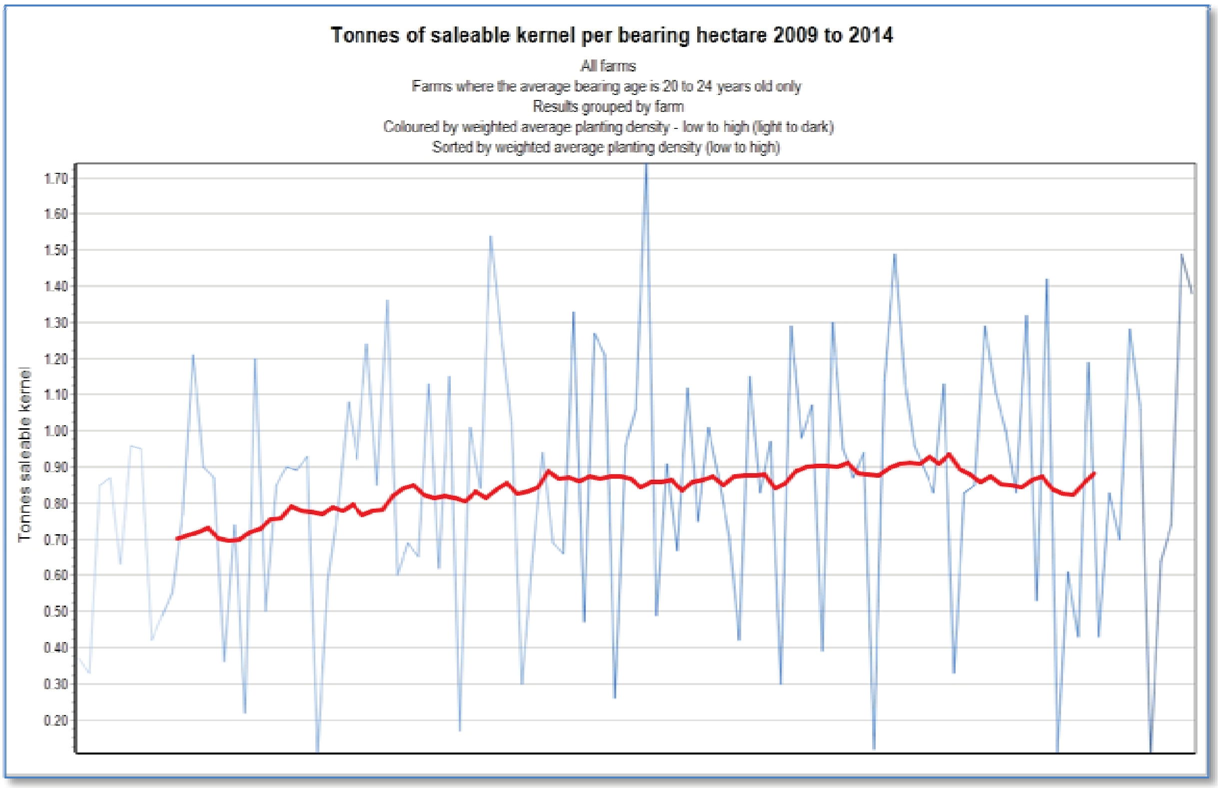


Figure 6.7-4: Saleable kernel per bearing hectare for average tree age of 20 to 24 years by weighted average planting density for 2009 to 2014

6.8 Results by irrigation status

Yield by irrigation status

Bearing farms are divided into irrigated and non-irrigated farms for statistical analysis. Table 6.8-1 provides a summary of average yield per bearing hectare for farms represented by the two approaches for 2014 and for all years from 2009 to 2014.

The non-irrigated farms had a higher average yield per hectare of NIS, saleable kernel and total kernel in 2014 than the irrigated farms. The non-irrigated farms also had a higher average yield per hectare of NIS, saleable kernel and total kernel in 2014 than the averages for non-irrigated farms from 2009 to 2014. By comparison, the irrigated farms had a lower average yield per hectare of NIS, saleable kernel and total kernel in 2014 than the averages for irrigated farms from 2009 to 2014.

Irrigation status averages	2014			2009-2014		
	Irrigated	Non-irrigated	All	Irrigated	Non-irrigated	All
NIS tonnes/ha	2.06	2.65	2.49	2.27	2.41	2.37
Saleable kernel tonnes/ha	0.66	0.88	0.82	0.71	0.76	0.75
Total kernel tonnes/ha	0.71	0.93	0.88	0.77	0.82	0.81

Table 6.8-1: Irrigation status yield averages for 2014 and for all years from 2009 to 2014

Figure 6.8-1 shows ranking trends for irrigated and non-irrigated farms for tonnes of saleable kernel per bearing hectare for 2009 to 2014. Each bar in the ranking chart in figure 6.8-1 represents the average yield per hectare from an individual farm from 2009 to 2014.

The farms are grouped by irrigation status with the irrigated farms represented by the light blue bars on the left of the chart and the non-irrigated farms represented by the dark blue bars on the right. As with farm size, statistical analysis shows that the irrigated farms are more concentrated amongst the middle 50% of farms for saleable kernel yield per hectare. By comparison, the non-irrigated farms are more concentrated amongst the top 25% and bottom 25% of farms for yield per hectare. Most of the irrigated farms in the benchmarking sample are in the Central Queensland region where the average farm size is much larger than in the other three regions.

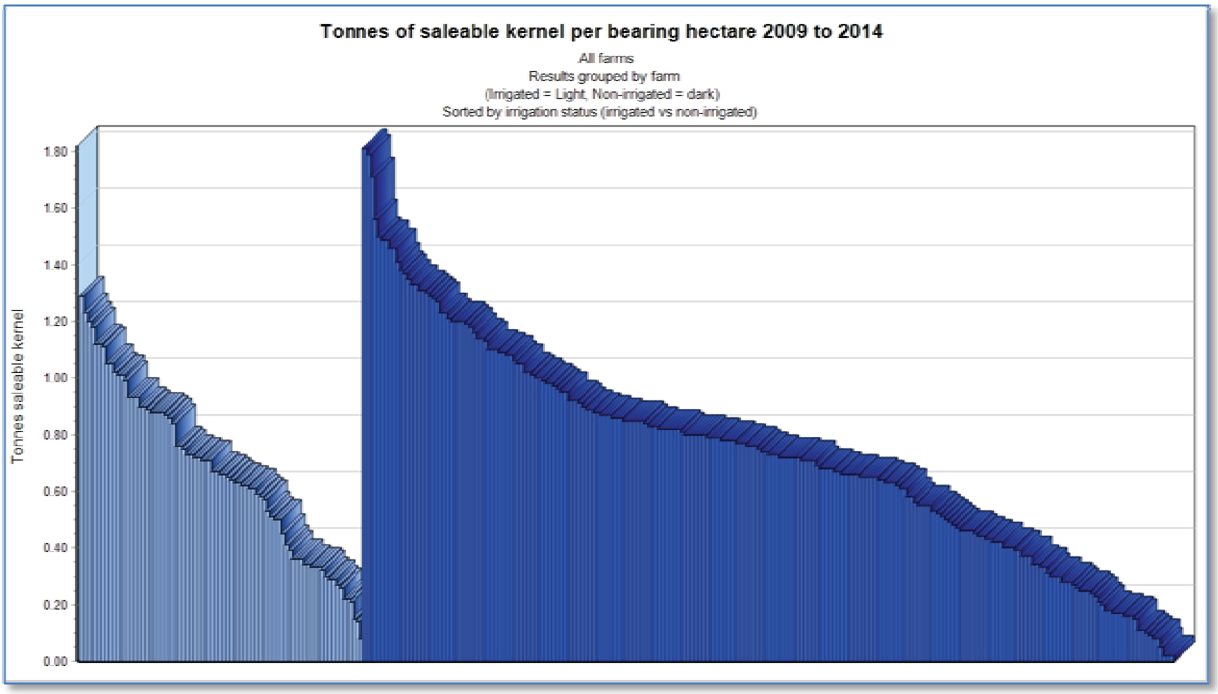


Figure 6.8-1: Saleable kernel per bearing hectare yield trends for irrigated and non-irrigated farms for 2009 to 2014

Nut-in-shell (NIS) tonnes per hectare by irrigation status

Table 6.8-2 shows that of the total of 1324 farm years from 2009 to 2014, 26.7% were irrigated and 73.3% were not irrigated.

Statistical analysis of the cross tabulations shows that the yield of NIS per bearing hectare from 2009 to 2014 was significantly correlated with the irrigation status of the farms (i.e. the percentile group a farm belongs to depends on whether it was irrigated). There is a larger proportion of irrigated farm years in the middle 50% (30.2%) than in the top 25% (21.4%) and the bottom 25% (25.0%) and a larger relative proportion of the non-irrigated farms in the top and bottom 25% of farm years for tonnes of NIS per bearing hectare.

This relationship between NIS tonnes per hectare and irrigation status is statistically significant.

NIS tonnes per hectare	Total farm years = 1324	Top 25% (>=3.16)	Middle 50% (>=1.46 to <3.16)	Bottom 25% (<1.46)	Total
Non-Irrigated	Farm year	261	461	249	971
	% within percentile	78.6%	69.8%	75.0%	73.3%
	% of total	19.7%	34.8%	18.8%	73.3%
Irrigated	Farm year	71	199	83	353
	% within percentile	21.4%	30.2%	25.0%	26.7%
	% of total	5.4%	15.0%	6.3%	26.7%
Total	Farm year	332	660	332	1324
	% of total	25.1%	49.8%	25.1%	100%

Table 6.8-2: Cross tabulation nut-in-shell tonnes per hectare by percentile and irrigation status

Saleable kernel tonnes per hectare by irrigation status

Irrigated farms have a higher relative proportion in the middle 50% (30.8%) and a lower relative proportion in the top 25% (21.0%) and bottom 25% (24.0%) of farm years for saleable kernel tonnes per hectare from 2009 to 2014. The non-irrigated farms have a higher relative proportion in the top 25% (79.0%) and bottom 25% (76.0%) of farm years and a lower relative proportion in the middle 50% (69.2%) of farm years for saleable kernel tonnes per hectare.

This relationship between saleable kernel yield per hectare and irrigation status is statistically significant.

Saleable kernel tonnes per hectare	Total farm years = 1324	Top 25% (>=1.01)	Middle 50% (>=0.44 to <1.01)	Bottom 25% (<0.44)	Total
Non-Irrigated	Farm year	259	456	256	971
	% within percentiles	79.0%	69.2%	76.0%	73.3%
	% of total	19.6%	34.4%	19.3%	73.3%
Irrigated	Farm year	69	203	81	353
	% within percentiles	21.0%	30.8%	24.0%	26.7%
	% of total	5.2%	15.3%	6.1%	26.7%
Total	Farm year	328	659	337	1324
	% of total	24.8%	49.8%	25.5%	100%

Table 6.8-3: Cross tabulation saleable kernel tonnes per hectare by percentile and irrigation status

Quality by irrigation status

Table 6.8-4 provides a summary of quality parameter averages for both irrigated and non-irrigated farms in the benchmarking survey for 2014 compared to the averages for all years from 2009 to 2014. The irrigated farms in 2014 and from 2009 to 2014 were on average more than three times larger than the non-irrigated farms.

There were major differences in the quality parameter results for 2014 compared with all years from 2009 to 2014 for irrigated and non-irrigated farms:

- Both irrigated and non-irrigated farms had a higher average SKR, PKR and CKR in 2014 compared to the averages from 2009 to 2014.
- Non-irrigated farms had a lower average RKR and irrigated farms had a similar RKR in 2014 compared to the averages from 2009 to 2014.
- Both irrigated and non-irrigated farms had a lower average NIS MC in 2014 compared to the averages from 2009 to 2014.
- Irrigated farms had a lower average whole kernel percentage and non-irrigated farms had a higher average percentage in 2014 compared to the averages from 2009 to 2014.
- Non-irrigated farms had a substantially lower average level of rejects due to insect damage and irrigated farms a slightly higher average level in 2014 than the averages from 2009 to 2014.
- Both irrigated and non-irrigated farms had a higher average level of rejects due to mould and immaturity and a lower average level of rejects due to discolouration and brown centres in 2014 than the averages from 2009 to 2014.
- Irrigated farms had a slightly higher average level of rejects due to germination and non-irrigated farms had a slightly lower average level in 2014 compared to the averages from 2009 to 2014.

Irrigation status averages	2014			2009-2014		
	Irrigated	Non-irrigated	All	Irrigated	Non-irrigated	All
Saleable KR %	34.33	34.84	34.70	33.78	33.42	33.52
Premium KR %	31.85	30.80	31.09	31.61	30.15	30.54
Commercial KR %	2.48	4.04	3.61	2.17	3.27	2.97
Reject KR %	2.77	2.76	2.76	2.77	2.84	2.82
Moisture %	11.51	15.84	14.63	12.07	15.94	14.83
Whole kernel %	50.00	54.97	53.76	51.07	52.74	52.25
Insect damage %	0.70	0.74	0.73	0.68	0.96	0.89
Mould %	0.46	0.53	0.51	0.39	0.37	0.38
Discolouration %	0.26	0.26	0.26	0.43	0.30	0.33
Brown centres %	0.52	0.39	0.42	0.75	0.42	0.51
Immaturity %	0.77	0.74	0.75	0.55	0.67	0.64
Germination %	0.07	0.08	0.08	0.05	0.10	0.09
Farm size (ha)	75.07	22.90	37.08	70.95	22.47	35.39

Table 6.8-4: Irrigation status quality averages for 2014 and for all years from 2009 to 2014

Saleable kernel recovery (SKR) by irrigation status

The non-irrigated farms had a higher relative proportion in the bottom 25% (81.3%) and a lower relative proportion in the middle 50% (68.5%) of farm years for SKR from 2009 to 2014. By comparison, the irrigated farms had a higher relative proportion in the middle 50% (31.5%) and a lower relative proportion in the bottom 25% (18.7%) of farm years for SKR.

This relationship between SKR and irrigation status is statistically significant.

Saleable kernel recovery %	Total farm years = 1316	Top 25% (=>35.99)	Middle 50% (>=31.01 to< 35.99)	Bottom 25% (< 31.01)	Total
Non-Irrigated	Farm year	243	451	270	964
	% within percentile	74.5%	68.5%	81.3%	73.3%
	% of total	18.5%	34.3%	20.5%	73.3%
Irrigated	Farm year	83	207	62	352
	% within percentile	25.5%	31.5%	18.7%	26.7%
	% of total	6.3%	15.7%	4.7%	26.7%
Total	Farm year	326	658	332	1316
	% of total	24.8%	50.0%	25.2%	100%

Table 6.8-5: Cross tabulation saleable kernel recovery by percentile and irrigation status

Premium kernel recovery (PKR) by irrigation status

The non-irrigated farms had a higher relative proportion in the bottom 25% (86.0%) and a lower relative proportion in the top 25% (64.8%) of farm years for PKR from 2009 to 2014. By comparison, the irrigated farms had a higher relative proportion in the top 25% (35.2%) and a lower relative proportion in the bottom 25% (14.0%) of farm years for PKR.

This relationship between PKR and irrigation status is statistically significant.

Premium kernel recovery %	Total farm years = 1316	Top 25% (>=33.20	Middle 50% (>=28.05 to <33.20)	Bottom 25% (<28.05)	Total
Non-Irrigated	Farm year	215	466	283	964
	% within percentile	64.8%	71.1%	86.0%	73.3%
	% of total	16.3%	35.4%	21.5%	73.3%
Irrigated	Farm year	117	189	46	352
	% within percentile	35.2%	28.9%	14.0%	26.7%
	% of total	8.9%	14.4%	3.5%	26.7%
Total	Farm year	332	655	329	1316
	% of total	25.2%	49.8%	25.0%	100%

Table 6.8-6: Cross tabulation premium kernel recovery by percentile and irrigation status

Commercial kernel recovery (CKR) by irrigation status

The non-irrigated farms had a higher relative proportion in the top 25% (91.5%) and a lower relative proportion in the bottom 25% (59.0%) of farm years for CKR from 2009 to 2014. The irrigated farms had a higher relative proportion in the bottom 25% (41.0%) and a lower relative proportion in the top 25% (8.5%) of farm years for CKR.

This relationship between CKR and irrigation status is statistically significant.

Commercial kernel recovery %	Total farm years = 1316	Top 25% (>=4.1)	Middle 50% (>=1.60 to <4.1)	Bottom 25% (<1.60)	Total
Non-Irrigated	Farm year	302	472	190	964
	% within percentile	91.5%	71.1%	59.0%	73.3%
	% of total	22.9%	35.9%	14.4%	73.3%
Irrigated	Farm year	28	192	132	352
	% within percentile	8.5%	28.9%	41.0%	26.7%
	% of total	2.1%	14.6%	10.0%	26.7%
Total	Farm year	330	664	322	1316
	% of total	25.1%	50.5%	24.5%	100%

Table 6.8-7: Cross tabulation commercial kernel recovery by percentile and irrigation status

Reject kernel recovery (RKR) by irrigation status

Note: When comparing levels of reject kernel recovery in the cross tabulations, the figures are inverted (i.e. the lower levels are in the top %) as a low RKR% represents better quality. The percentiles are not split exactly into the top 25%, middle 50% and bottom 25% as the low RKR percentages, particularly amongst the better quality results, require slightly different percentile groupings to be able to split the benchmark sample results.

There are 329 farm years in the top 25% of farms for RKR from 2009 to 2014 of which 235 (71.4%) are non–irrigated and 94 (28.6%) are irrigated. In the middle 50%, 73.2% are non-irrigated and 26.8% are irrigated. In the bottom 25% of farm years, 75.2% are non-irrigated and 24.8% are irrigated. There is a higher relative proportion of irrigated farms in the top 25% and a higher relative proportion of non-irrigated farms in the bottom 25% of farm years for RKR.

This relationship between RKR and irrigation status is not statistically significant.

Reject kernel recovery %	Total farm years = 1316	Top 25% (<=1.69)	Middle 50% (> 1.69 to <=3.39)	Bottom 25% (> 3.39)	Total
Non-irrigated	Farm year	235	477	252	964
	% within percentile	71.4%	73.2%	75.2%	73.3%
	% of total	17.9%	36.2%	19.1%	73.3%
Irrigated	Farm year	94	175	83	352
	% within percentile	28.6%	26.8%	24.8%	26.7%
	% of total	7.1%	13.3%	6.3%	26.7%
Total	Farm year	329	652	335	1316
	% of total	25.0%	49.5%	25.5%	100%

Table 6.8-8: Cross tabulation reject kernel recovery by percentile and irrigation status

Irrigation status by farm ownership

A much higher proportion of irrigated farm years were from non-owner managed farms than owner managed farms. Of the 391 non-owner managed farm years, 45.0% were irrigated and 55.0% not irrigated from 2009 to 2014. Only 19.0% of the 933 owner managed farm years were irrigated. Most of the irrigated farms are in the Central Queensland region where there is also a higher proportion of non-owner managed farms.

This relationship between irrigation status and farm ownership is statistically significant.

	Total farm years = 1324	Non-owner managed	Owner managed	Total
Non-irrigated	Farm year	215	756	971
	% within percentile	55.0%	81.0%	73.3%
	% of total	16.2%	57.1%	73.3%
Irrigated	Farm year	176	177	353
	% within percentile	45.0%	19.0%	26.7%
	% of total	13.3%	13.4%	26.7%
Total	Farm year	391	933	1324
	% within percentile	100.0%	100.0%	100.0%
	% of total	29.5%	70.5%	100.0%

Table 6.8-9: Cross tabulation of irrigation status by ownership of farms

Irrigation status comparisons

Table 6.8-10 shows the statistical yield and quality differences between irrigated and non-irrigated farms from 2009 to 2014.

If the mean difference for sample 1 minus sample 2 for a particular variable is negative and the difference is significant, then the average value of that variable for sample 1 is significantly lower than the average value of that variable for sample 2. For example, in table 6.8-10, we can see a mean difference of 1.46% for average PKR for irrigated farms minus the average PKR for non-irrigated farms in the survey sample. This is significant at the 0.00 level (less than 0.01). This means that the average PKR for non-irrigated farms was significantly less than for irrigated farms.

The comparison of yield and quality results between irrigated and non-irrigated farms for the six seasons from 2009 to 2014 showed that:

- Non-irrigated farms had a significantly higher average yield of NIS, saleable kernel and total kernel per hectare than irrigated farms.
- There were no significant differences in the average SKR or RKR between the irrigated and non-irrigated farms.
- Irrigated farms had a significantly higher average PKR than non-irrigated farms.
- Non-irrigated farms had a significantly higher average CKR than irrigated farms.
- Non-irrigated farms had a significantly higher average NIS MC than irrigated farms.
- Non-irrigated farms had a significantly higher average percentage of whole kernels than irrigated farms.
- Non-irrigated farms had a significantly higher average level of rejects due to insect damage, immaturity and germination than irrigated farms.
- Irrigated farms had a significantly higher average level of rejects due to discolouration and brown centres than non-irrigated farms.

Irrigated farms in the benchmark sample are, on average, larger than non-irrigated farms and are mainly located in the Central Queensland region. The climate is drier in Central Queensland than the other regions during the harvest season which has a major bearing on the consigned NIS moisture content. The *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project surveys also found a strong correlation between the level of brown centres and farm size, maximum silo size and nut storage bed depth.

Variables	Non-irrigated (1) Irrigated (2)	Sample size	Means	Mean difference (1-2)	Significance
Nut-in-shell tonnes per hectare	Irrigated	353	2.27	-0.13	0.09*
	Non-irrigated	971	2.41		
Saleable kernel tonnes per hectare	Irrigated	353	0.71	-0.05	0.07*
	Non-irrigated	971	0.76		
Total kernel tonnes per hectare	Irrigated	353	0.77	-0.05	0.08*
	Non-irrigated	971	0.82		
Saleable kernel recovery %	Irrigated	352	33.78	0.36	0.12
	Non-irrigated	964	33.42		
Premium kernel recovery %	Irrigated	352	31.61	1.46	0.00***
	Non-irrigated	964	30.15		
Commercial kernel recovery %	Irrigated	352	2.17	-1.10	0.00***
	Non-irrigated	964	3.27		
Reject kernel recovery %	Irrigated	352	2.77	-0.07	0.50
	Non-irrigated	964	2.84		
Moisture content %	Irrigated	297	12.07	-3.87	0.00***
	Non-irrigated	741	15.94		
Whole kernel %	Irrigated	200	51.07	-1.67	0.02**
	Non-irrigated	483	52.74		
Insect damage %	Irrigated	348	0.68	-0.28	0.00***
	Non-irrigated	950	0.96		
Mould %	Irrigated	348	0.39	0.01	0.58
	Non-irrigated	951	0.37		
Discolouration %	Irrigated	348	0.43	0.13	0.00***
	Non-irrigated	948	0.30		
Brown centres %	Irrigated	348	0.75	0.33	0.00***
	Non-irrigated	946	0.42		
Immaturity %	Irrigated	348	0.55	-0.12	0.02**
	Non-irrigated	949	0.67		
Germination %	Irrigated	348	0.05	-0.05	0.00***
	Non-irrigated	946	0.10		

Table 6.8-10: Comparison of yield and quality results for irrigated and non-irrigated farms for all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

6.9 Results by management structure

Yield by management structure

Bearing farms were divided into owner managed and non-owner managed (managed on behalf of the owner). Table 6.9-1 provides a summary of averages of yield and quality parameters for farms represented by the two management structures for 2014 and for all years from 2009 to 2014. The yield and quality differences are discussed in detail in the section on statistical analysis.

The owner managed farms and the non-owner managed farms had a higher average yield of NIS, saleable kernel and total kernel per bearing hectare in 2014 compared to the average over the six years from 2009 to 2014. The owner managed farms also had slightly higher yields per hectare than the non-owner managed farms in 2014.

Management structure	2014			2009-2014		
	Owner managed	Non-owner managed	All	Owner managed	Non-owner managed	All
NIS tonnes/ha	2.51	2.44	2.49	2.35	2.42	2.37
Saleable kernel tonnes/ha	0.83	0.78	0.82	0.75	0.75	0.75
Total kernel tonnes/ha	0.88	0.85	0.87	0.80	0.82	0.81

Table 6.9-1: Management structure yield averages for 2014 and for all years from 2009 - 2014

Figure 6.9-1 shows ranking trends for owner managed farms and non-owner managed farms for tonnes of saleable kernel per bearing hectare for 2009 to 2014. Each bar in the ranking chart represents the average yield per hectare from an individual farm from 2009 to 2014.

The farms are grouped by management system with the owner managed farms represented by the light blue bars on the left of the chart and the non-owner managed farms represented by the dark blue bars on the right. As with farm size and irrigation status, statistical analysis shows that the non-owner managed farms are more concentrated amongst the middle 50% of farms for saleable kernel yield per hectare. By comparison, the owner managed farms are more concentrated amongst the top 25% and bottom 25% of farms. There is also a higher proportion of irrigated farms in the benchmarking survey amongst non-owner managed farms than amongst the owner managed farms.

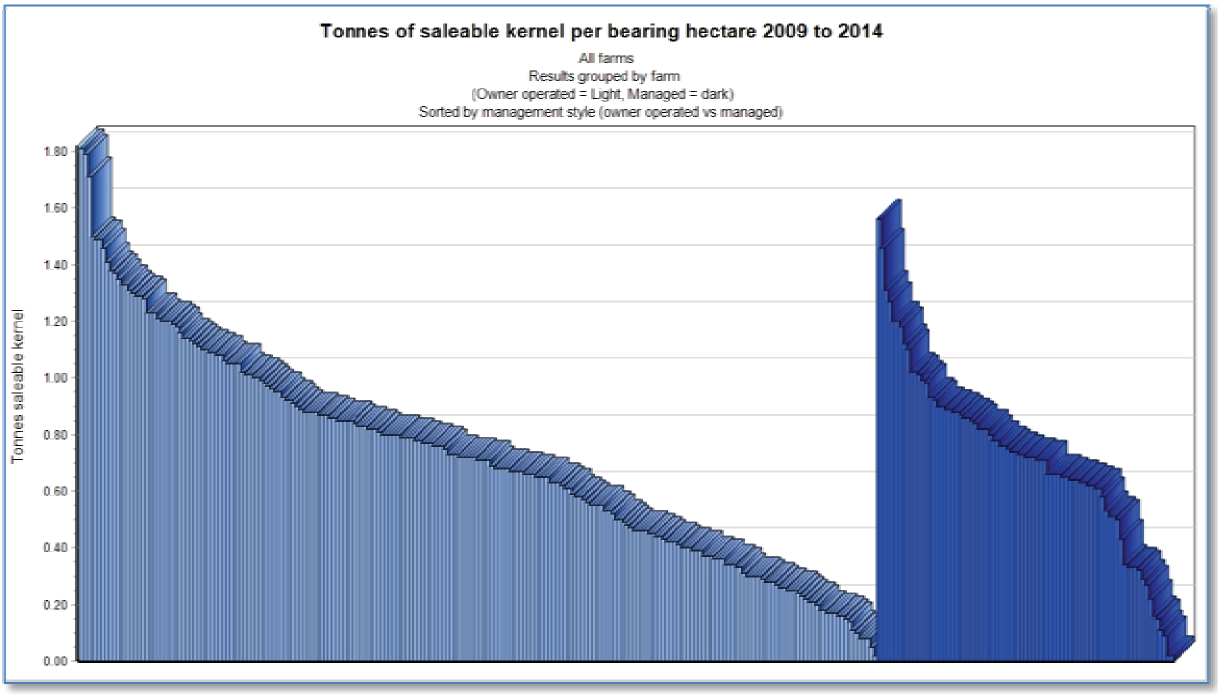


Figure 6.9-1: Saleable kernel per bearing hectare yield trends for managed vs owner- operated farms for 2009-2014

Nut-in-shell (NIS) tonnes per hectare by management structure

There were 933 (70.5% of the total) owner managed and 391 (29.5% of the total) non-owner managed farm years in the benchmarking sample from 2009 to 2014. The non-owner managed farms were proportionally more highly represented in the middle 50% of farm years (34.1%) and the owner managed farms more highly represented in the top 25% (72.9%) and bottom 25% (77.1%) of farm years for NIS tonnes per bearing hectare.

This relationship between management structure and NIS tonnes per bearing hectare is statistically significant.

NIS tonnes per hectare	Total farm years = 1324	Top 25% (>=3.16)	Middle 50% (>=1.46 to <3.16)	Bottom 25% (<1.46)	Total
Non-owner managed	Farm year	90	225	76	391
	% within percentile	27.1%	34.1%	22.9%	29.5%
	% of total	6.8%	17.0%	5.7%	29.5%
Owner managed	Farm year	242	435	256	933
	% within percentile	72.9%	65.9%	77.1%	70.5%
	% of total	18.3%	32.9%	19.3%	70.5%
Total	Farm year	332	660	332	1324
	% of total	25.1%	49.8%	25.1%	100%

Table 6.9-2: Cross tabulation nut-in-shell tonnes per hectare by percentile and management style

Saleable kernel tonnes per hectare by management structure

The owner-managed farms had a higher relative proportion of farm years in both the top 25% (74.7%) and bottom 25% (75.7%) for tonnes of saleable kernel per bearing hectare and a lower relative proportion of farm years in the middle 50% (65.7%) from 2009 to 2014. By comparison, the non-owner managed farms represented 34.3% of the farm years in the middle 50%, but only 25.3% in the top 25% and 24.3% in the bottom 25% of the total farm years for tonnes of saleable kernel per bearing hectare.

This relationship between management structure and saleable kernel tonnes per bearing hectare is statistically significant.

Saleable kernel tonnes per hectare	Total farm years =1324	Top 25% (>=1.01)	Middle 50% (>=0.44 to <1.01)	Bottom 25% (<=0.44)	Total
Non-owner managed	Farm year	83	226	82	391
	% within percentile	25.3%	34.3%	24.3%	29.5%
	% of total	6.3%	17.1%	6.2%	29.5%
Owner managed	Farm year	245	433	255	933
	% within percentile	74.7%	65.7%	75.7%	70.5%
	% of total	18.5%	32.7%	19.3%	70.5%
Total	Farm year	328	659	337	1324
	% of total	24.8%	49.8%	25.5%	100%

Table 6.9-3: Cross tabulation saleable kernel tonnes per hectare by percentile and management style

Quality by management structure

Table 6.9-4 provides a summary of averages of quality parameters for both owner-managed and non-owner managed farms in the benchmarking survey for 2014 compared to the averages for all years from 2009 to 2014. Non-owner managed farms in 2014 and from 2009 to 2014 were, on average, approximately three times larger than the owner managed farms.

There were major differences in the quality parameter results for 2014 compared with all years from 2009 to 2014 for the owner managed and non-owner managed farms:

- Both the owner managed and non-owner managed farms had a higher average SKR, PKR and CKR and a lower average RKR in 2014 compared to the averages for all years from 2009 to 2014.
- Both the owner managed and non-owner managed farms had a lower average NIS MC compared to the averages for all years from 2009 to 2014.
- Both the owner managed and non-owner managed farms had a higher average percentage of whole kernels compared to the averages for all years from 2009 to 2014.
- The owner managed farms had a lower average level of rejects due to insect damage and germination and the non-owner managed farms had a higher average level compared to the averages for all years from 2009 to 2014.
- Both the owner managed and non-owner managed farms had a higher average level of rejects due to mould compared to the averages for all years from 2009 to 2014.
- Both the owner managed and non-owner managed farms had a lower average level of rejects due to discolouration and brown centres compared to the averages for all years from 2009 to 2014.
- The owner managed farms had a higher average level of rejects due to immaturity and the non-owner managed farms had a lower average level compared to the averages for all years from 2009 to 2014.

Management structure averages	2014			2009-2014		
	Owner managed	Non-owner managed	All	Owner managed	Non-owner managed	All
Saleable KR %	34.69	34.73	34.70	33.58	33.36	33.52
Premium KR %	31.27	30.62	31.09	30.75	30.04	30.54
Commercial KR %	3.41	4.11	3.61	2.83	3.32	2.97
Reject KR %	2.74	2.82	2.76	2.77	2.95	2.82
Moisture %	15.26	12.87	14.63	15.49	13.30	14.83
Whole kernel %	53.41	54.89	53.76	52.18	52.42	52.25
Insect damage %	0.72	0.75	0.73	0.96	0.72	0.89
Mould %	0.54	0.46	0.51	0.36	0.40	0.38
Discolouration %	0.25	0.29	0.26	0.31	0.38	0.33
Brown centres %	0.32	0.69	0.42	0.36	0.86	0.51
Immaturity %	0.83	0.54	0.75	0.67	0.55	0.64
Germination %	0.08	0.08	0.08	0.10	0.07	0.09
Farm size (ha)	23.86	70.56	37.08	21.80	67.84	35.39

Table 6.9-4: Management structure yield and quality averages for 2014 and for all years from 2009 - 2014

Saleable kernel recovery (SKR) by management structure

The owner managed farms had a higher relative proportion in the top 25% (71.5%) and middle 50% (71.9%) and a lower relative proportion in the bottom 25% (66.8%) of farm years for SKR from 2009 to 2014. By comparison, non-owner managed farms had a higher relative proportion in the bottom 25% (33.2%) and a lower relative proportion in the middle 50% (28.1%) and top 25% (28.5%) of farm years for SKR.

This relationship between SKR and management structure is not statistically significant.

Saleable kernel recovery %	Total farm years = 1316	Top 25% (=>35.99)	Middle 50% (>=31.01 to< 35.99)	Bottom 25% (<31.01)	Total
Non-owner managed	Farm year	93	185	112	390
	% within percentile	28.5%	28.1%	33.2%	29.5%
	% of total	7.0%	14.0%	8.5%	29.5%
Owner managed	Farm year	233	473	220	926
	% within percentile	71.5%	71.9%	66.8%	70.5%
	% of total	17.6%	35.7%	17.1%	70.5%
Total	Farm year	326	658	332	1316
	% of total	24.6%	49.7%	25.7%	100%

Table 6.9-5: Cross tabulation saleable kernel recovery by percentile and management style

Premium kernel recovery (PKR) by management structure

The owner managed farms had a higher relative proportion in the top 25% (79.8%) and a lower relative proportion in the middle 50% (67.2%) and bottom 25% (67.2%) of farm years for PKR from 2009 to 2014. By comparison, non-owner managed farms had a higher relative proportion in the middle 50% (32.8%) and bottom 25% (32.8%) and a lower relative proportion in the top 25% (20.2%) of farm years for PKR.

This relationship between PKR and management structure is statistically significant.

Premium kernel recovery %	Total farm years = 1316	Top 25% (>=33.20	Middle 50% (>=28.05 to <33.20)	Bottom 25% (<28.05)	Total
Non-owner managed	Farm year	67	215	108	390
	% within percentile	20.2%	32.8%	32.8%	29.6%
	% of total	5.1%	16.3%	8.2%	29.6%
Owner managed	Farm year	265	440	221	926
	% within percentile	79.8%	67.2%	67.2%	70.4%
	% of total	20.1%	33.4%	16.8%	70.4%
Total	Farm year	332	655	329	1316
	% of total	25.2%	49.8%	25.0%	100%

Table 6.5-6: Cross tabulation premium kernel recovery by percentile and management style

Commercial kernel recovery (CKR) by management structure

The owner managed farms had a lower relative proportion in the top 25% (65.2%) and a higher relative proportion in the bottom 25% (79.5%) of farm years for CKR from 2009 to 2014. The non-owner managed farms had a higher relative proportion in the top 25% (34.8%) and a lower relative proportion in the bottom 25% (20.5%) of farm years for CKR.

This relationship between CKR and management structure is statistically significant.

Commercial kernel recovery %	Total farm years = 1316	Top 25% (>=4.1)	Middle 50% (>=1.60 to <4.1)	Bottom 25% (<1.60)	Total
Non-owner managed	Farm year	115	209	66	390
	% within percentile	34.8%	31.5%	20.5%	29.6%
	% of total	8.7%	15.9%	5.0%	29.6%
Owner managed	Farm year	215	455	256	926
	% within percentile	65.2%	68.5%	79.5%	70.4%
	% of total	16.3%	34.6%	19.5%	70.4%
Total	Farm year	330	664	322	1316
	% of total	25.1%	50.5%	24.5%	100%

Table 6.9-7: Cross tabulation commercial kernel recovery by percentile and management style

Reject kernel recovery (RKR) by management structure

There is a higher relative proportion of owner managed farms in the top 25% (82.7%) and a lower relative proportion in the middle 50% (64.1%) of farm years for RKR from 2009 to 2014. There is a higher relative proportion of non-owner managed farms in the middle 50% (35.9%) and a lower relative proportion in the top 25% (17.3%) of farm years for RKR.

This relationship between RKR and management structure is statistically significant.

Reject kernel recovery %	Total farm years = 1316	Top 25% (<=1.69)	Middle 50% (> 1.69 to <=3.39)	Bottom 25% (> 3.39)	Total
Non-owner managed	Farm year	57	234	99	390
	% within percentile	17.3%	35.9%	29.6%	29.6%
	% of total	4.3%	17.8%	7.5%	29.6%
Owner managed	Farm year	272	418	236	926
	% within percentile	82.7%	64.1%	70.4%	70.4%
	% of total	20.7%	31.8%	17.9%	70.4%
Total	Farm year	329	652	335	1316
	% of total	25.0%	49.5%	25.5%	100%

Table 6.9-8: Cross tabulation reject kernel recovery by percentile and management style

Management structure comparisons

Table 6.9-9 shows the statistically significant yield and quality differences between owner managed and non-owner managed farms from 2009 to 2014.

The comparison of yield and quality results showed that:

- There were no significant differences in the average yield of NIS or saleable or total kernel per hectare between non-owner managed and owner managed farms.
- There were no significant differences in the average SKR or RKR between non-owner managed and owner managed farms.
- Owner managed farms had a significantly higher average PKR than non-owner managed farms.
- Owner managed farms had a significantly lower CKR than non-owner managed farms.
- Owner managed farms had a significantly higher average NIS MC than non-owner managed farms.
- Owner managed farms had a significantly higher average level of rejects due to insect damage, immaturity and germination than non-owner managed farms. Non-owner managed farms had a significantly higher average level of rejects due to brown centres and discolouration than owner managed farms.

Owner managed farms in the benchmark sample are on average smaller than the non-owner managed farms. The *"Macadamia kernel quality: understanding brown centres and other kernel quality defects"* project surveys found a strong correlation between level of brown centres and farm size, maximum silo size and nut storage bed depth.

Variables	Non-owner Managed (1) Owner managed (2)	Sample size	Means	Mean difference (1-2)	Significance
Nut-in-shell tonnes per hectare	Non-owner managed	391	2.42	0.07	0.36
	Owner managed	933	2.35		
Saleable kernel tonnes per hectare	Non-owner managed	391	0.75	0.01	0.83
	Owner managed	933	0.75		
Total kernel tonnes per hectare	Non-owner managed	391	0.82	0.02	0.53
	Owner managed	933	0.80		
Saleable kernel recovery %	Non-owner managed	390	33.36	-0.22	0.32
	Owner managed	926	33.58		
Premium kernel recovery %	Non-owner managed	390	30.04	-0.71	0.01***
	Owner managed	926	30.75		
Commercial kernel recovery %	Non-owner managed	390	3.32	0.49	0.00***
	Owner managed	926	2.83		
Reject kernel recovery %	Non-owner managed	390	2.95	0.17	0.11
	Owner managed	926	2.77		
Moisture content %	Non-owner managed	311	13.30	-2.19	0.00***
	Owner managed	727	15.49		
Whole kernel %	Non-owner managed	204	52.42	0.24	0.73
	Owner managed	479	52.18		
Insect damage %	Non-owner managed	387	0.72	-0.24	0.00***
	Owner managed	911	0.96		
Mould %	Non-owner managed	387	0.40	0.04	0.14
	Owner managed	912	0.36		
Discolouration %	Non-owner managed	387	0.38	0.06	0.03**
	Owner managed	909	0.31		
Brown centres %	Non-owner managed	386	0.86	0.05	0.00***
	Owner managed	908	0.36		
Immaturity %	Non-owner managed	386	0.55	-0.13	0.02**
	Owner managed	911	0.67		
Germination %	Non-owner managed	386	0.07	-0.03	0.04**
	Owner managed	908	0.10		

Table 6.9-9: Comparison of yield and quality results for owner-operated and non-owner operated farms all seasons combined

* The mean difference is significant at the 10% level
** The mean difference is significant at the 5% level
*** The mean difference is significant at the 1% level

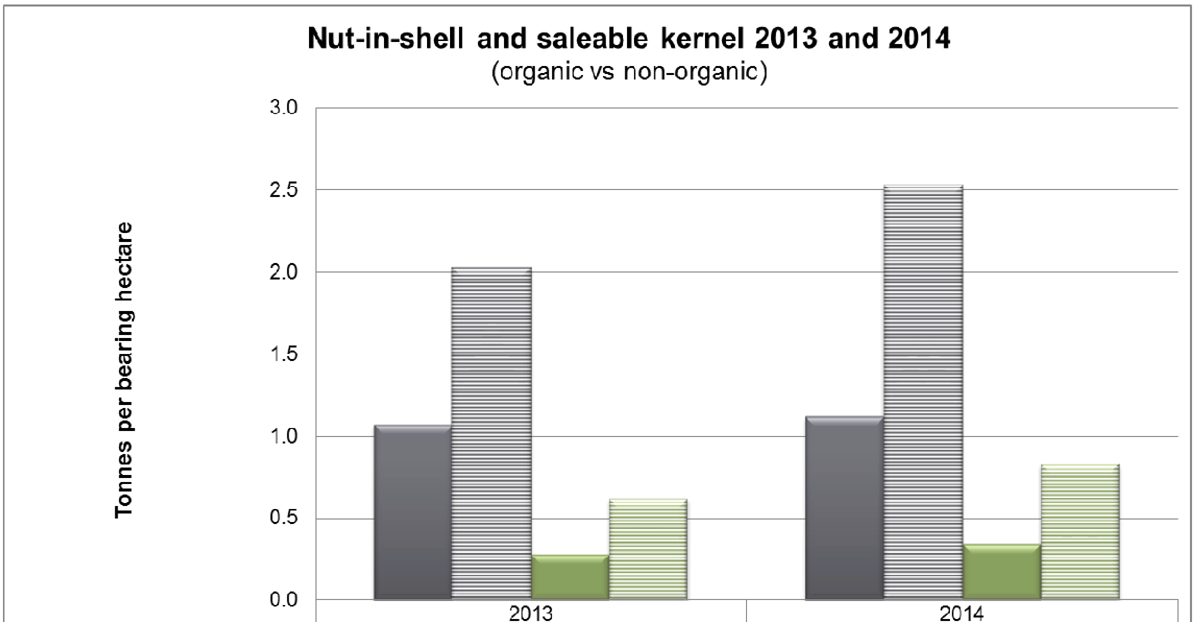
6.10 *Results by organic status*

Organic macadamia farms were identified during the benchmarking data collection following the 2013 and 2014 harvest seasons. This enabled a comparison of the yield and quality results between the organic farms and non-organic farms (those farms using conventional farming methods). It is important to note that there was great variation in the results amongst both the organic farms and non-organic farms.

Organic farms were defined as those farms that were certified as organic or as in transition to certification. There were only six farms identified as organic in the benchmarking sample in 2013 and eight farms in 2014.

Yield by organic status

Figure 6.10-1 shows the average yield of NIS and saleable kernel per bearing hectare in 2013 and 2014 for organic and non-organic farms. The non-organic farms had higher average yields of NIS and saleable kernel per bearing hectare than the organic farms in both 2013 and 2014.



	2013	2014
Nut-in-shell (organic)	1.07	1.12
Nut-in-shell (non-organic)	2.03	2.53
Saleable kernel (organic)	0.28	0.34
Saleable kernel (non-organic)	0.62	0.83

Figure 6.10-1: Average production figures of organic farms vs non-organic farms (2013 and 2014 seasons)

Quality by organic status

Figure 6.10-2 shows the average saleable kernel recovery (SKR) in 2013 and 2014 for organic and non-organic farms. The non-organic farms had a 3.9% higher average SKR than the organic farms in 2013 and a 3.55% higher average SKR in 2014.

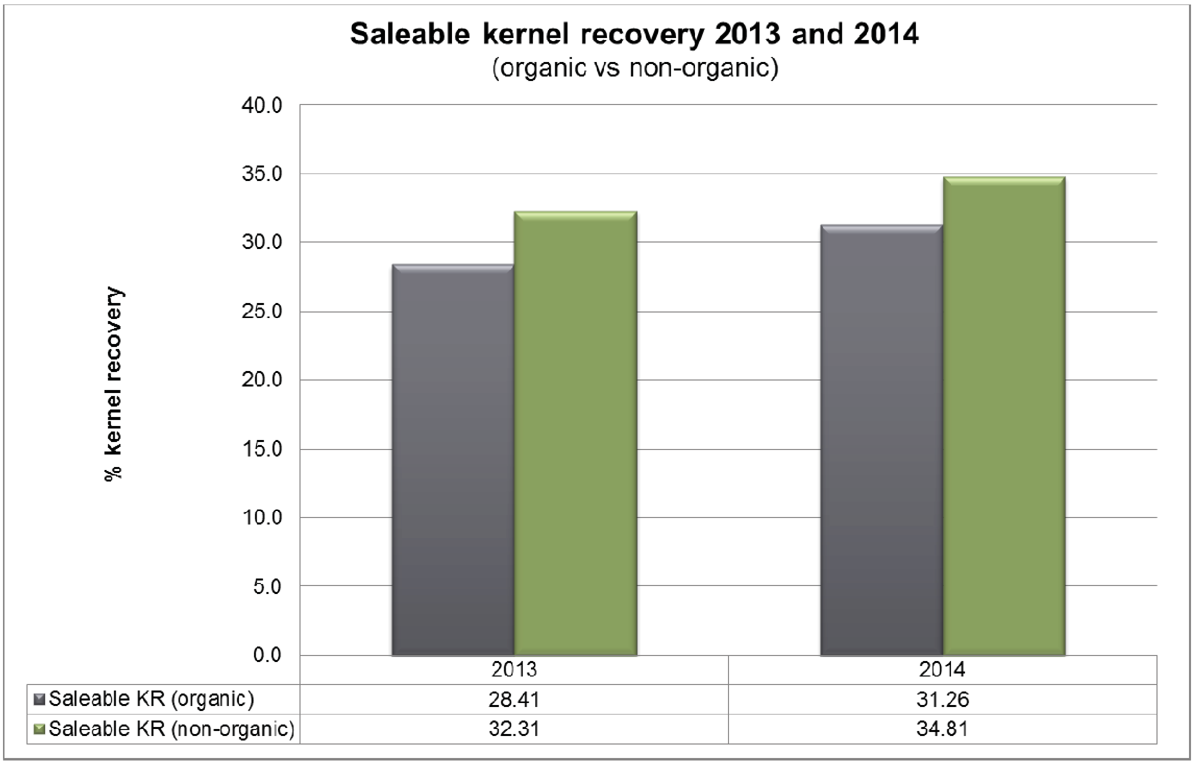


Figure 6.10-2: Average saleable kernel recovery (%) of organic farms vs non-organic farms (2013 and 2014 seasons)

Figure 6.10-3 shows the average reject kernel recovery (RKR) in 2013 and 2014 for organic and non-organic farms. The organic farms and non-organic farms had an equivalent average RKR in 2013. The non-organic farms had a 0.09% lower average RKR than the organic farms in 2014.

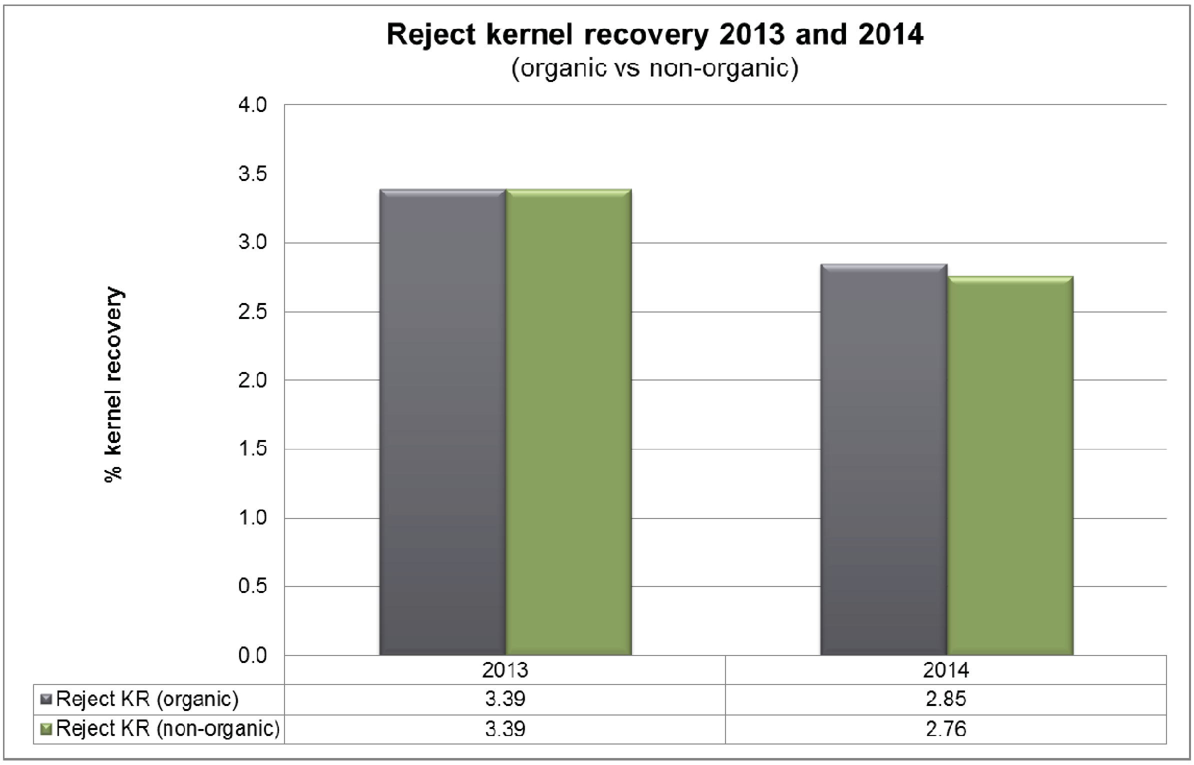
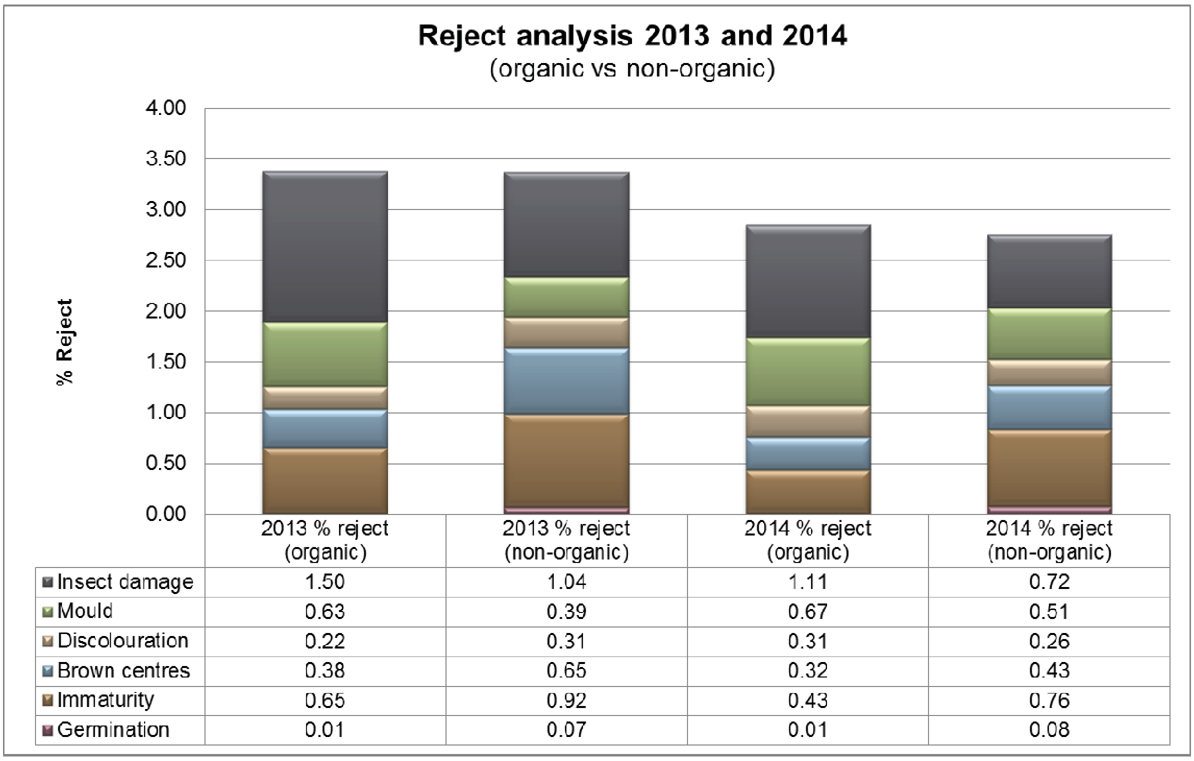


Figure 6.10-3: Average reject kernel recovery (%) of organic farms vs non-organic farms (2013 and 2014 seasons)

Figure 6.10-4 shows the average reject analysis in 2013 and 2014 for organic and non-organic farms. Organic farms had a higher average level of rejects due to insect damage and mould than non-organic farms in 2013 and 2014. Organic farms had a lower average level of rejects due to brown centres, immaturity and germination than non-organic farms in 2013 and 2014. Organic farms had a lower average level of rejects due to discolouration in 2013 but a higher average level than non-organic farms in 2014.

The organic farms were on average much smaller (11.23 hectares in 2014) than the non-organic farms (37.88 hectares in 2014). All the organic farms in the benchmarking survey were from the Mid North Coast of New South Wales and the Northern Rivers of New South Wales regions. Further investigation is required to understand whether the differences between the yield and quality results for the organic and non-organic farms are due to the farming methods used or due to other factors such as farm size or regional effects.



	2013 % reject (organic)	2013 % reject (non-organic)	2014 % reject (organic)	2014 % reject (non-organic)
Insect damage	1.50	1.04	1.11	0.72
Mould	0.63	0.39	0.67	0.51
Discolouration	0.22	0.31	0.31	0.26
Brown centres	0.38	0.65	0.32	0.43
Immaturity	0.65	0.92	0.43	0.76
Germination	0.01	0.07	0.01	0.08

Figure 6.10-4: Reject analysis of organic farms vs non-organic farms (2013 and 2014 seasons)

Appendix 3

Macadamia industry farm financial information report 2013

Macadamia Industry Farm Financial Information Report

February 2013

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Disclaimer

The example profile of a new 30 hectare macadamia farm in this document is based on historical agronomic and financial data but it is important to note that individual circumstances will vary from the example profile due to variations in management, yield, price and costs from year-to-year for individual farms.

Executive summary

This analysis provides a generalised summary of indicative cash flows involved in establishing a new macadamia orchard. Initial investment is required in the example provided to purchase land, trees, machinery and a farm shed and to prepare the ground and plant the trees. Cash flow is negative during the initial years when there is little or no yield but expenses are still being incurred. The first harvestable crop is expected in year 5 of the orchard but it is not until year 10 that sufficient yield is achieved to generate sufficient revenue to cover costs. It is assumed that working capital from either equity (owner contributions) or debt (borrowings) will be required to maintain sufficient cash inflows to cover these costs until this time.

From year 11 onwards in the example profile, net cash inflows exceed cash outflows and continue to increase in line with the increase in yield per hectare up to the point where maximum production is reached.

Introduction

The following information is provided by the authors to the Australian Macadamia Society (AMS) to assist with their discussions with the Australian Taxation Office (ATO) in order to provide a greater understanding of the economics of Australian macadamia farming.

An indicative cash flow analysis of an example new 30 hectare macadamia farm is included in this paper. The information on which this analysis is based is drawn from a number of sources including:

- The final report of the project *On-farm economic analysis in the Australian macadamia industry (2003-2006)*.
- The *Financial Planner for Macadamia* software *(2009)*.
- The project report *Macadamia farm cash flow analysis 2003 to 2006, including estimates for 2008 and 2009*
- The project report *Benchmarking report for the Australian macadamia industry for the 2009, 2010 and 2011 seasons*
- The paper published in the Agricultural Systems journal *Annual forecasting of the Australian macadamia crop – integrating tree census data with statistical climate-adjustment models by Mayer, D.G et al (2006)*

The economic analysis project collected and analysed both financial and production data from 41 farms, representing a cross-section of the industry for farm size, tree age, region and management structure. The data was collected using a standard chart of accounts, developed in conjunction with Rutherfords, accountants and financial advisers in Lismore. This was to ensure consistency in the recording of costs.

The data collected in this project was used to develop example farm financial profiles in the *Financial Planner for Macadamia* software. These profiles can then be modified to suit individual circumstances. The analyses (e.g. discounted cash flow analysis) in the financial planner provide a complete picture of the economics of macadamia growing over the life of a specified period for a farm. The cash flow situation will differ for each farm depending on individual circumstances. The financial planning software enables macadamia growers and their advisers to examine the effect on profitability over the life of an orchard by varying yields, prices and costs. It also enables current growers to examine the effect on profitability of changes to their business.

The financial planner includes four analysis components to meet the needs of the Australian macadamia industry:

- Investment analysis to evaluate the viability of investment alternatives over time.
- Cash budgeting analysis to measure projected cash balance of potential investments and examine the impacts of changes to management and financial plans on financial indicators.
- Sensitivity analysis to model variation in annual costs, kernel recovery, nut in shell price and yield and compare their relative impact on key financial indicators over time.

- Profile comparison analysis to compare and rank individual profiles according to key financial indicatorsThe *macadamia farm cash flow analysis* work provided an analysis of cash flows for a cross section of Australian macadamia farms. The report focused on two periods:
- The four calendar years from 2003 to 2006 where the financial and production data was collected from 41 farms as part of the economic analysis project.
- The two calendar years of 2008 and 2009 where production data was collected and analysed during this period as part of the national best practice group network. Revenues were calculated based on industry standard nut prices and the kernel recoveries and tonnages of individual growers. Costs were derived from the data collected from 2003 to 2006 and incorporating changes to individual cost categories since the original data was collected.

The benchmarking report summarised the findings of the on-farm benchmarking in the Australian macadamia industry. The focus of the benchmarking was on comparing, analysing and reporting farm yield and quality results. Farm details and production data for 2009, 2010 and 2011 were collected from 212 farms. Most farms provided data for all three years. These farms represent approximately 50% of the Australian macadamia industry by planted area and production. They also represent a cross section of farms in the Australian macadamia industry for location, farm size, tree age, irrigation status and management structures.

The *annual forecasting of the Australian macadamia crop* paper discusses the crop prediction methods used in the forecasting. This includes using a statistical model developed using tree census data and growers' historical yields from the Australian Macadamia Society database. The model accounts for the effects of tree age, variety, year, region and tree spacing.

Financial information

The following financial details explain the information used to calculate indicative cash flows within an example new, non-irrigated 30 hectare macadamia orchard in coastal northern New South Wales or south-east Queensland macadamia growing regions. It is important to note that individual circumstances will vary from the example profile due to variations in management, yield, price and costs from year-to-year for individual farms.

Land costs

In the *Financial Planner for Macadamia*, an average land cost of $30,000 per hectare is used in the example profile to develop a new, non-irrigated 30 hectare macadamia orchard. This will vary depending on factors such as the topography and location of the land. In the example profile, it is assumed that 40 hectares are purchased of which 75% is planted. The other 25% of the land is used for roads and watercourses or is unsuitable for macadamia production.

Asset values

Asset values for the farms involved in the economic analysis project sample related to equipment used in the on-farm production of macadamias. This excluded buildings such as houses and other assets and land improvements that are not employed in macadamia production activities. These asset values were based on insured values. As a consequence these figures need to be treated with caution as they were only a proxy for market value.

Table 1 shows that the mean asset value for the 132 farm years of data collected was $159,428. A farm year equates to an individual farm for a single year. A farm that participated for the entire project and provided financial and production data for four years will therefore have records for four farm years. There were significant variations within the survey sample.

Table 1: Average asset values all farms

	Number	**Minimum**	**Maximum**	**Mean**
Total assets	132	$8,961	$331,000	$159,428
Assets per hectare	132	$1,071	$38,333	$8,907

Tree costs

The authors have been advised by the managers of the two largest nurseries supplying macadamia trees within the Australian macadamia industry that the current price for purchasing macadamia trees is $14 per tree plus GST.

Initial costs to establish a farm

The following initial establishment costs are used to develop the new, non-irrigated 30 hectare macadamia orchard in the example profile:

- Land costs – $1,200,000 (40 hectares @ $30,000 per hectare)
- Land preparation - $18,000 (30 hectares @ $600 per hectare)
- Machinery - $100,000
- Shed - $60,000
- Trees – $130,000 (30 hectares @ approx 313 trees per hectare @ $14 per tree)

These costs will vary depending upon individual circumstances. For example, the number of trees per hectare varies depending upon the spacing of the trees within and between the rows. The most common planting density in the Australian macadamia industry is 313 trees per hectare based on plant spacings of 8 metres between rows and 4 metres between trees within rows.

Minimum size orchard for viable production

This will vary considerably and is dependent on factors such as orchard productivity (defined as the yield of saleable kernel per hectare), price received per tonne of saleable kernel and costs of production. All of these variables can change significantly over time.

The economic analysis project found significant differences in the mean tonnes of nut-in-shell per hectare, revenue per hectare and profit per hectare between farms of different sizes with an average tree age older than 10 years (table 5.11 in the *On-farm economic analysis in the Australian macadamia industry* project final report).

Farms with an average of more than 35 hectares of macadamias had significantly higher mean tonnes of nut-in-shell (NIS) per hectare, revenue per hectare and profit per hectare than farms with an average of less than 15 hectares of macadamias. Farms with an average of between 15 hectares and 35 hectares of macadamias had a significantly higher mean tonnes of NIS per hectare than farms with an average of less than 15 hectares of macadamias. There were no significant differences in yield, revenue or profit per hectare between farms with an average of between 15 hectares and 35 hectares and farms with an average of more than 35 hectares of macadamias. There were no significant differences in costs per hectare between the different farm size categories.

By comparison, the benchmarking report did not find a significant difference in average yield of NIS tonnes per hectare, saleable kernel tonnes per hectare or total kernel tonnes per hectare between the farm size categories for the combined 2009, 2010 and 2011 seasons (tables 68, 69 and 70 in the *Benchmarking report for the Australian macadamia industry for the 2009, 2010 and 2011 seasons*). However, it was evident that there was high variability of production for many farms when comparing their production over the three years. There was also considerable variability of production between farms of similar sizes. Given this variability, it is important to note that there are factors other than farm size (e.g. farm management) that are very important for farm productivity and profitability.

Annual costs

Annual costs are provided for both non-bearing and bearing trees in profiles in the *Financial Planner for Macadamia* software. The cost structure is based on the standard chart of accounts developed in the *on-farm economic analysis* work. The costs in the example profile are based upon data collected in the economic analysis and then updated following input from a range of professionals and stakeholders associated with the macadamia industry (including growers, processors, consultants, accountants and bankers).

The annual costs are divided into fixed costs ($/year) and variable costs ($/hectare/year or $/tonne NIS/year). Fixed costs and variable costs for non-bearing and bearing trees in the example profile mentioned above are shown in tables 2, 3 and 4.

Once again, it is important to note that these costs will vary with individual circumstances.

An inflation rate of 3% per annum is included in the analysis.

Table 2: Fixed costs ($/year) for the example profile

	Non-bearing trees	Bearing trees
Administration	$6,000	$12,000
Government charges	$3,000	$3,000
Recurring leases	$6,000	$7,500
Management costs	$11,500	$21,000
Total fixed costs	**$26,500**	**$43,500**

Table 3: Variable costs ($/hectare/year) for the example profile

	Non-bearing trees	Bearing trees
Consultants	$20	$70
Contractors	$125	$430
Crop nutrition	$250	$840
Crop protection	$120	$300
Employment	$585	$1,400
Freight	$0	$40
Fuel and oil	$75	$290
Hire	$20	$80
Irrigation	$0	$0
Utilities	$40	$120
R&M Improvements	$100	$200
R&M Plant	$200	$570
Total costs per hectare	**$1535**	**$4,340**

Table 4: Variable costs ($/tonne NIS/year) for the example profile

	Non-bearing trees	Bearing trees
Post harvest handling	$0	$80

Projected yields of nut-in-shell

The projected yields for the different tree ages in the example profile are based upon a planting density of 313 trees per hectare (the most common planting density in the Australian macadamia industry) and a yield at orchard maturity of 4 tonnes per hectare of nut-in-shell. The yield of 4 tonnes of NIS per hectare is the expected peak yield at maturity for a well managed orchard.

In the cash flow analysis, the top 25% of farms with an average tree age older than 10 years for all regions in 2003 to 2006 and in 2008 and 2009 achieved yields greater than 4 tonnes of NIS per hectare (tables 17, 24 and 28 in *Macadamia farm cash flow analysis 2003 to 2006, including estimates for 2008 and 2009* report)

In the benchmarking report, average yields per hectare were less than this for bearing orchards, particularly in 2010 and 2011 (figure 37 in the *Benchmarking report for the Australian macadamia industry for the 2009, 2010 and 2011 seasons*). This was largely due to adverse conditions such as very hot, dry weather or very wet weather during key periods such as flowering in 2009 and 2010.

The projected yields at different tree ages and planting densities are based on yield data that has been collected from growers over many years via the AMS tree census data in the macadamia crop forecasting project. Figure 3 in the crop forecasting paper shows the average yield patterns in tonnes NIS per hectare by age and planting density for commercial varieties in the Bundaberg and northern New South Wales regions. The yield figures in the example profile are based on these patterns.

Figure 1 shows the yield in tonnes per hectare in the example profile up to year 20. No yield is expected during the first three years. Only a very small yield is expected in year 4. Yield per hectare increases rapidly up until about year 11 and then continues to increase more slowly until about year 19 when yields per hectare begin to plateau.

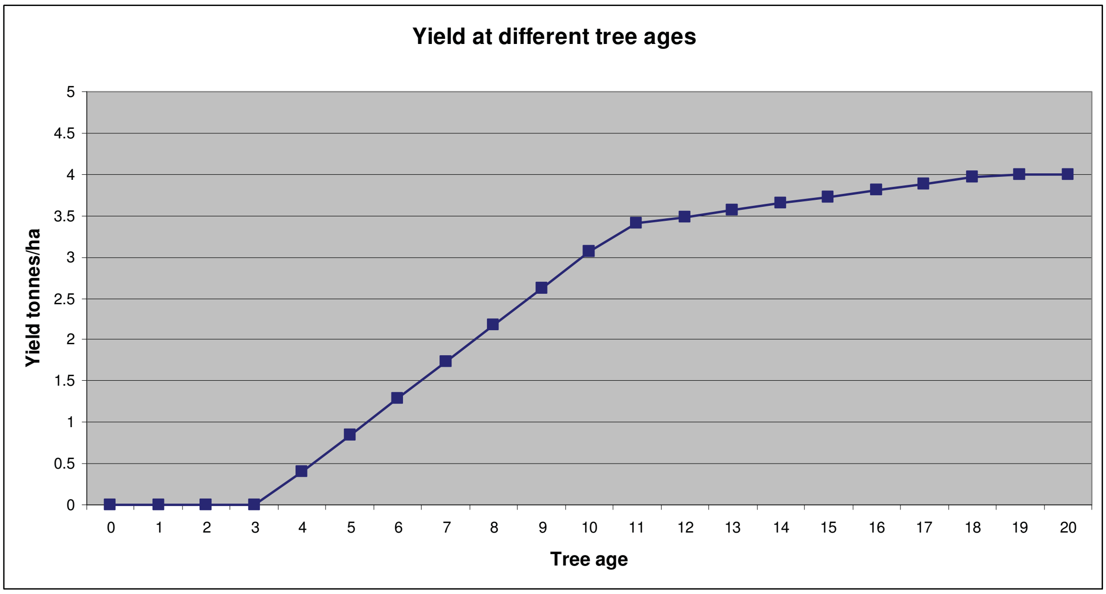

Figure 1: Yield at different tree ages (tonnes NIS/ha) for the example profile

Price

Table 5 below (from the AMS website) shows the standard price from 1987 to 2012 of NIS at a moisture content of 10% based on an industry standard 33% sound (or premium) kernel recovery.

Kernel recovery is used as the basis for adjusting the price paid for nut-in-shell. Kernel recovery is the percentage of kernel recovered from NIS after the NIS has been adjusted to a standard 10% moisture content. Different processors have differing pay scales but generally the price of NIS is adjusted upwards or downwards as the sound kernel recovery is above or below the industry standard. Similarly, the price of NIS is adjusted upwards or downwards with a decreasing or increasing level of unsound (or reject) kernel recovery.

Table 5: Australian macadamia nut-in-shell prices (1987 to 2012)

Calendar year	NIS prices - $/kg @ 10%mc
1987	$3.10
1988	$3.95
1989	$3.65
1990	$2.50
1991	$1.60
1992	$2.03
1993	$2.75
1994	$2.80
1995	$3.00
1996	$3.05
1997	$2.70
1998	$2.45
1999	$2.25
2000	$2.12
2001	$2.45
2002	$2.75
2003	$3.20
2004	$3.45
2005	$3.60
2006	$2.60
2007	$1.50
2008	$1.65
2009	$1.90
2010	$2.65
2011	$3.10
2012	$3.20

Source: Australian Macadamia Society website (www.macadamias.org)

A nut-in-shell price of $2.65 per kg for the industry standard of 33% sound kernel recovery is used in the example profile. A saleable kernel recovery of 36% also is used. Saleable kernel includes both sound (or premium) kernel and commercial grade kernel. The higher than standard saleable kernel recovery used reflects the higher kernel recoveries achieved with cultivars currently being planted.

The price is modelled in the analysis to increase by $0.02 per annum. This is less than the inflation rate of 3% used in the analysis.

Cash flow analysis

The following information relates to the analysis of cash flows within the example profile of a 30 hectare new farm in the *Financial Planner for Macadamia* software using the information described in the previous sections.

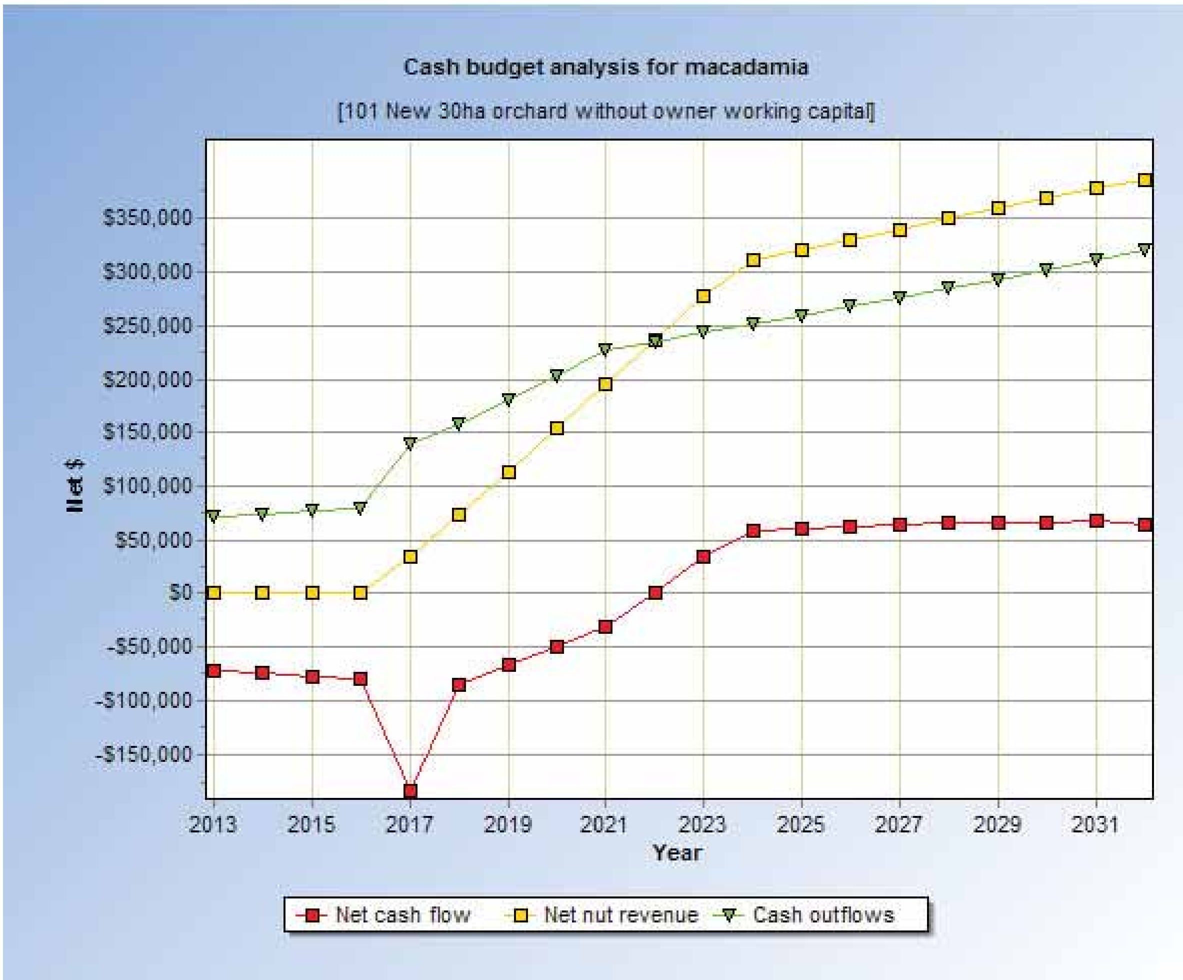

Figure 2: Net cash flow, net nut revenue and cash outflows for the example 30 hectare new farm

Figure 2 shows the net cash flow from year one to year 20 for the example profile with 2013 being the first year of the analysis. The cash flow is negative for the initial years where there is little or no yield but expenses are still being incurred. The substantial negative cash flow in year five (2017) corresponds to the first year where a nut crop is able to be harvested and additional cash outflows are incurred for managing and harvesting the crop and for the purchase of shed machinery for dehusking, sorting and handling the crop.

While some income is generated when the orchard begins to produce small nut yields from year five, it takes until year 10 (2022) to reach yields that generate sufficient revenue to cover costs. Until that point, the business is operating with negative annual net cash flows. As such, it is assumed that working capital from either equity (owner contributions) or debt (borrowings) will be used to maintain sufficient cash balances to cover cash outflows for operating costs until the point where production generates sufficient cash inflows to cover these costs in year 10 (2022)

From year 11 (2023) onwards in the example profile, net cash inflows exceed cash outflows and increase in line with the increase in yield per hectare seen in figure 1, up to the point where maximum production is reached in year 19 (2031) which then begins to plateau. The inflation rate of 3% means that costs also continue to rise after the orchard reaches maturity.

Table 6: Summary of the working capital required for the example 30 hectare new farm

Operating cash flows										
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Nut Sales	$ -	$ -	$ -	$ -	$ 35,760	$ 75,960	$ 116,693	$ 158,323	$ 200,778	$ 243,245
Cash outflows	-$72,550	-$74,727	-$76,968	-$79,277	-$139,119	-$158,861	-$179,981	-$202,563	-$226,666	-$234,856
Cash Surplus/Deficit	-$ 72,550	-$ 74,727	-$ 76,968	-$ 79,277	-$103,359	-$ 82,901	-$ 63,288	-$ 44,240	-$ 25,888	$ 8,389
Working capital contributions	$ 72,550	$ 74,727	$ 76,968	$ 79,277	$ 103,359	$ 82,901	$ 63,288	$ 44,240	$ 25,888	$ -
Net Cash Flows	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,389

Table 6 shows the working capital contributions needed to achieve annual net cash balances of zero leading up to year 10 (2022) when cash inflows first exceed cash outflows. Given the total initial investment to buy the farm and establish the orchard in the example profile is $1,508,000 combined with the further investment of $623,198 in working capital, the total investment to get the farm to a point where it is generating positive net cash flows is $2,131,198. Figure 3 shows the yearly cash balances for the example profile with and without the working capital from table 6.

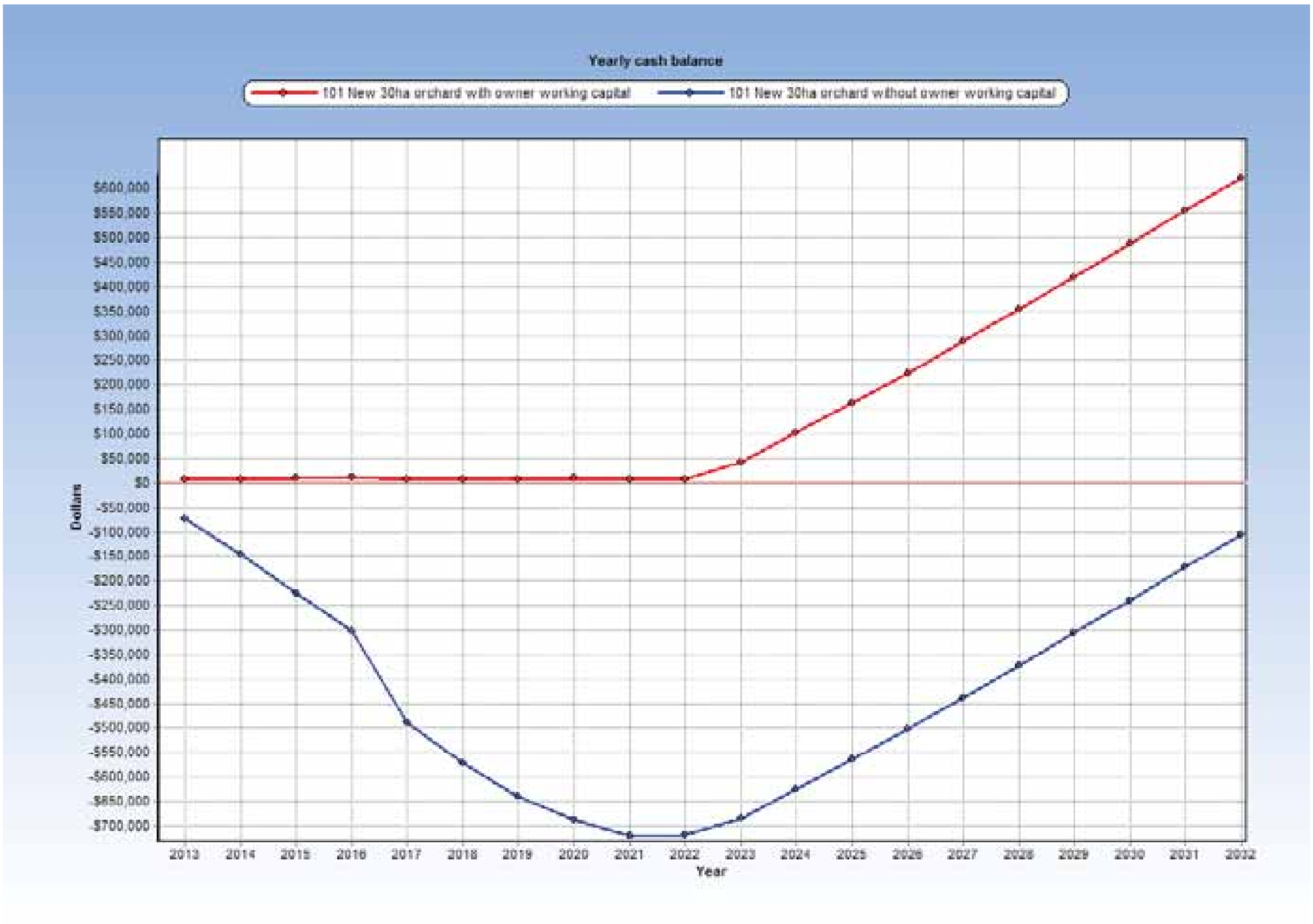

Figure 3: Yearly cash balance with and without the working capital for the example 30 hectare new farm

Conclusion

In the example profile of a 30 hectare new macadamia farm, an initial investment is required to buy the farm and establish the orchard. Cash flow is negative during the initial years when no yield is expected and it is not until year 10 that yield is sufficient to generate sufficient revenue to cover costs. Working capital from either equity or debt will be required to cover cash flows for operating costs until this time. Net cash inflows then continue to exceed net cash outflows as yields per hectare continue to increase.