Department of Agriculture and Fisheries

Macadamia industry benchmark report

2009 to 2015 seasons

Project MC15005

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Contents

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The project has been funded by Horticulture Innovation Australia Limited using the macadamia levy and funds from the Australian Government. The Queensland Government has also co-funded the project through the Department of Agriculture and Fisheries.

Disclaimer

Results presented in this report are based on data provided by industry participants. To ensure the confidentiality of individual farm data this report includes group averages only. Figures presented are based on summary statistics using underlying data that is not included in this report.

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About the benchmarking project

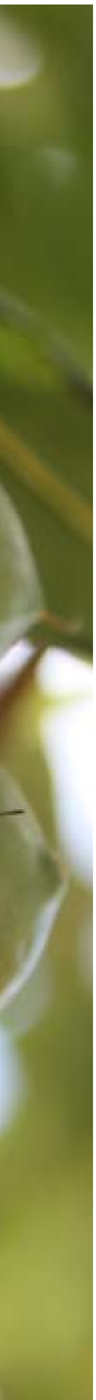
Yield, quality and planting information has been collected annually from macadamia farms throughout Australia since 2009. These data are provided either directly by growers or by processors on their behalf. Participation rates have steadily increased in each year of the study, rising from 144 farms in 2009 up to 269 farms in 2015. These farms covered approximately 10,400 planted hectares and represented 57.6% of total Australian macadamia industry production in 2015, based on the industry nut-in-shell (NIS) estimate of 48,300 tonnes at 10% moisture content. They also represented a cross section of farms in the Australian macadamia industry for location, farm size, tree age and management structure during that season.

Since the 2013 season a smaller subset of participating businesses has also submitted data relating to costs of production. An average of 42 farms per season have submitted cost data over the last three years. These farms covered over 2,000 planted hectares and represented approximately 10% of total Australian macadamia industry production in 2015.

Cost data is collected and categorised according to a standard chart of accounts that was developed in conjunction with industry accountants. A standardised chart of accounts allows comparison of costs across a range of farms and management systems.

Each season all benchmarking participants receive a personalised report that confidentially compares their individual farm performance with the average performance of similar farms based on a range of criteria including region, locality, farm size, management structure, irrigation status and tree age. These reports also highlight individual and average farm performance trends over multiple seasons.

Industry reports such as this one provide all growers, consultants, investors and other stakeholders with an annual summary of benchmark findings. These include yield and quality trends by season, region, farm size and tree age. Analysis of the top performing farms provides insight into current industry best practice benchmarks.



What you need to know about the data

The following rules have been applied to information presented in this report:

- Farm averages presented for a given season are based on data from a minimum of ten farms. This minimum is applied to safeguard the confidentiality of individual farm data;
- Average farm performance over multiple seasons is derived only from farms that have provided data for a minimum of four seasons. This is to minimise the impact of seasonal variability on long-term averages;
- All nut-in-shell weights presented are based on the industry standard moisture content of 10%;
- All kernel weights presented are based on the industry standard moisture content of 1.5%;
- The sum of reject kernel category values presented relate to the total reject kernel recovery percentage, rather than totalling 100%. This standard is applied across the benchmark study to ensure uniformity;
- Only plantings with trees aged five years or older are included in calculations of bearing hectares. Although some farms do start harvesting small amounts of nuts from younger trees, these are generally excluded for consistency across the benchmark sample;
- Whilst we try to use well recognised terms to describe kernel recovery and reject analysis categories, different processors sometimes use different terminology to describe similar reject categories;
- Unless otherwise stated, all averages presented are unweighted. This means that all farms in the sample exert an equal influence on the average regardless of their size.

What is included in this report?

This report summarises macadamia farm yield and quality results for the 2009 to 2015 production seasons. Many of the yield benchmarks presented are based on tonnes of saleable kernel per bearing hectare as this is a widely accepted measure of orchard productivity. Results are divided into the following sections:

Farms and plantings

Annual tree planting data is summarised to reveal planted trees by year and region and also bearing hectares by tree age category and region for all farms participating in benchmarking.

Yield and quality for all farms

This section presents average performance for the whole benchmark sample over multiple seasons. As these averages are based on the maximum data available, they represent the most robust measure of industry performance trends.

Yield and quality for top performing farms

Previous benchmarking rounds have revealed high variability in productivity between farms within the benchmark sample. Analysis of the top performing farms in the benchmark sample is included to determine any relevant trends associated with high orchard productivity. To be regarded as a top performing farm, high orchard productivity must be sustained over several seasons, so only farms that have supplied data for a minimum of four seasons are included. These farms are then ranked according to their average saleable kernel productivity of tonnes per bearing hectare over all seasons for which they have submitted data (currently four to seven seasons). Only farms that fall within the top 25% of this group are regarded as top performing farms.

Yield and quality by region

All participating farms are categorised into one of four major production regions as shown in figure 1.

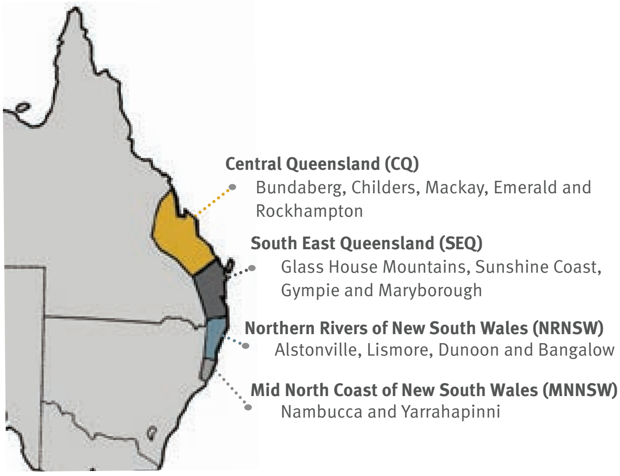


Figure 1: Benchmarking regions

Analysis of regional data provides insight into seasonal trends and yield and quality differences between each of the major production regions. Figure 2 shows the number of farms contributing to benchmarking in the 2015 season from each of these regions.

Yield and quality by tree age

Tree ages may vary substantially within and between production regions so separate analyses of the benchmark sample according to tree age are also included. It is important to note that all age related farm performance analyses are based on weighted average tree age only, as production data is generally provided for whole farms rather than specific tree age groups.

Yield and quality by farm size

Analysis of yield and quality trends reveal some differences related to farm size. Quality differences are most significant among different farm sizes. It should however be noted that certain farm sizes are more prevalent in particular regions so care must be taken when interpreting these results as other causal factors cannot be ignored.

Yield and quality by percentile

Percentile analyses compare averages for the top and bottom 25% with the average of the whole benchmark sample for specific seasons and criteria such as yield or kernel recovery. These criteria are independent of each other, so farms in the top 25% for yield are not necessarily the same farms in the top 25% for kernel recovery. The same applies to seasons, which means the farms in the top 25% for one season are not necessarily the same as those for the next season. Percentiles therefore provide insight into sample variability rather than providing indication of long-term performance. This is an important distinction between percentiles and top performing farms.

Costs of production

Cost data collected from 2012/2013 to 2014/2015 is also compared with data from an earlier economic analysis study in 2003-2006 (MC03023). Costs are categorised into 16 heads of expenditure. These analyses provide insight into changes in specific and overall costs over the last decade.

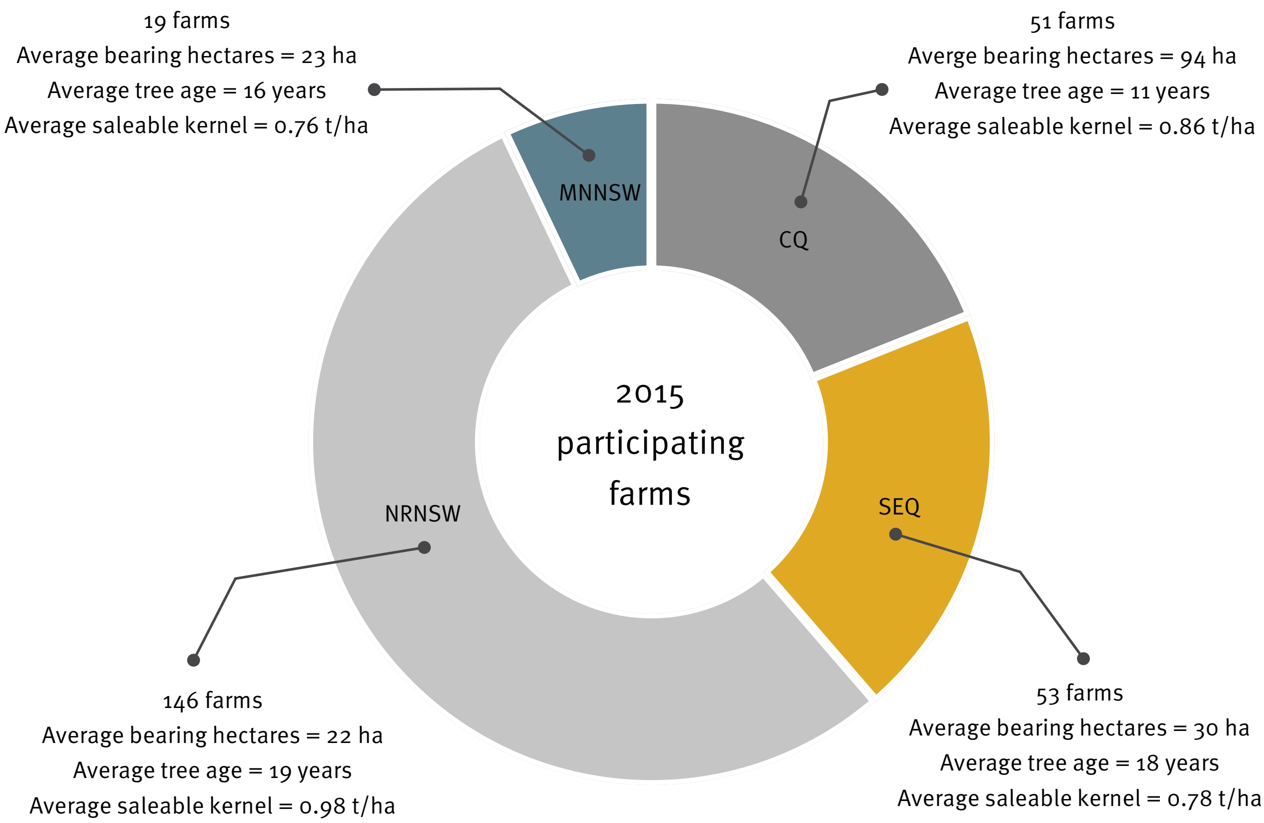


Figure 2: Participating farms by region

Results

Benchmark results presented in this section include plantings, yield, quality and costs of production. Trends are shown for the whole benchmark sample over the last seven seasons (2009-2015) during which data has been collected. The benchmark sample has also been segregated to provide analyses of data by season, region, tree age and farm size. A detailed analysis of the top performing farms over multiple seasons is also included.

Planting information

Historical planting data were collected from 269 farms for the 2015 season. Figure 3 shows the total number of trees planted each year between 1970 and 2015 for these farms. The annual nut-in-shell (NIS) price per kilogram is also plotted for each corresponding year. It is important to note that the chart does not include plantings for young farms that are yet to begin to bear, which means there is limited data for tree plantings in recent years. As these plantings are yet to begin to bear they have not affected yield or quality results in the benchmarking study.

Increases in NIS price have generally corresponded with increased plantings in subsequent years. Similarly, reductions in NIS price generally corresponded with a reduction in tree plantings in subsequent years. There is generally a lag period of 2 to 3 years between a significant downturn in price and a reduction in tree plantings. The industry is currently enjoying high NIS prices and strong demand for nursery trees.

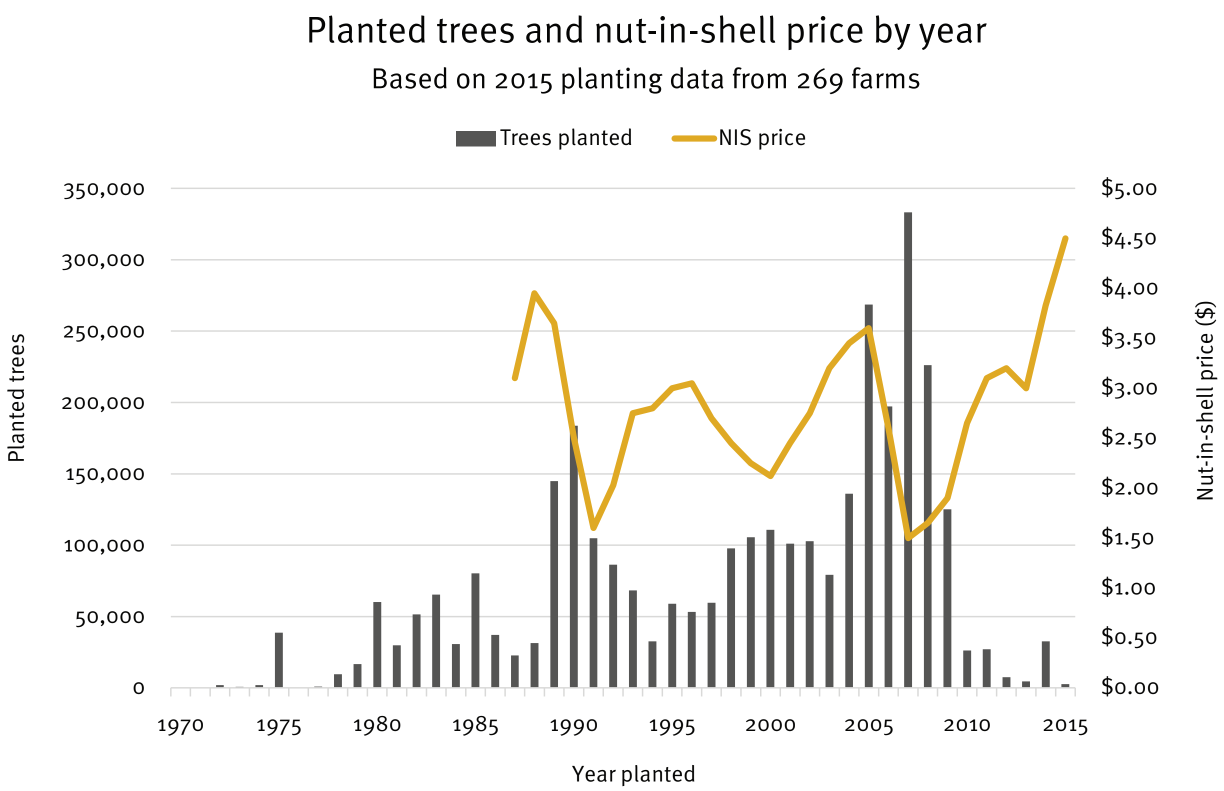


Figure 3: Total planted trees and NIS price by year (2015 data)

More than half of the farms (146) in the benchmark sample are located in the Northern Rivers region of New South Wales (NRNSW). The remainder are located in South East Queensland (SEQ, 53 farms), Central Queensland (CQ, 51 farms) and the Mid North Coast of New South Wales (MNNSW, 19 farms).

Figure 4 shows the number of trees planted on participating farms in each of these regions between 1970 and 2015. It is important to note that this chart shows only tree plantings for farms in the benchmark sample. It does not include plantings for young farms that are yet to begin to bear, which means that there is limited data included for tree plantings in recent years.

The large number of plantings between 2000 and 2010 in the CQ region reflects the significant expansion of the industry in the Bundaberg area during that period.

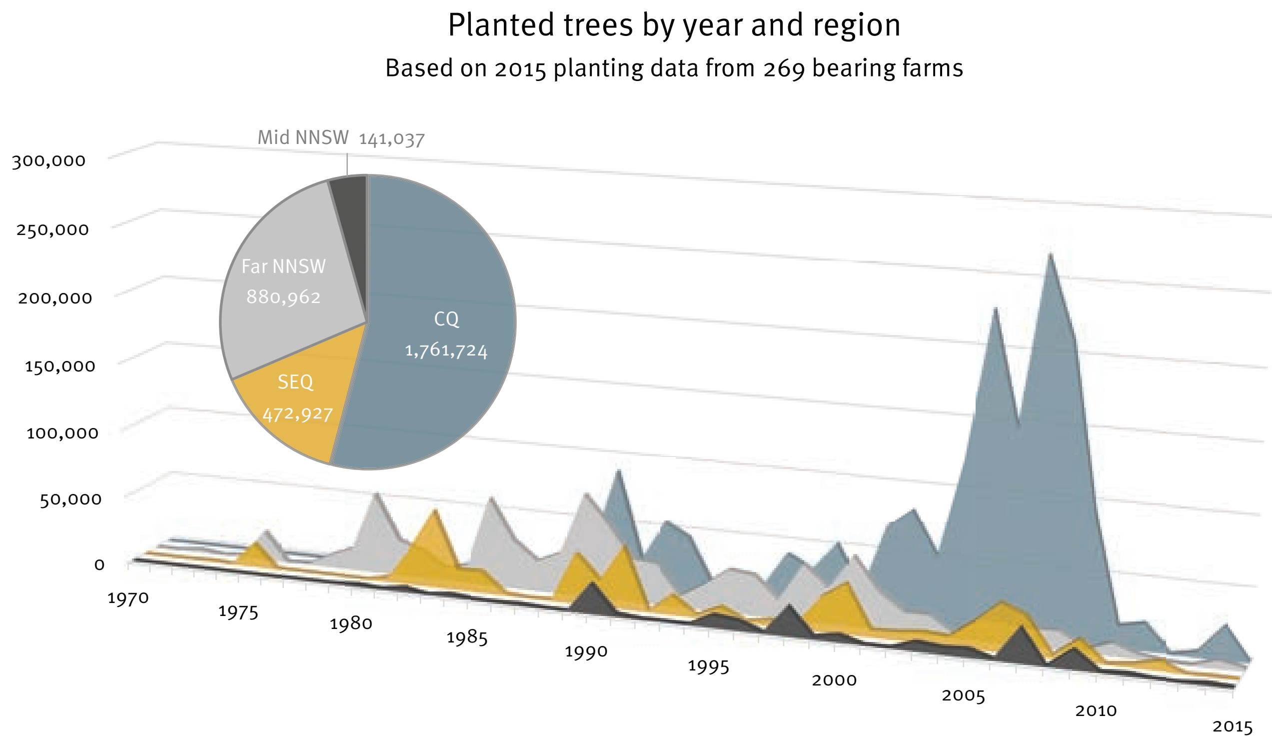


Figure 4: Total planted trees by year and region (2015 data)

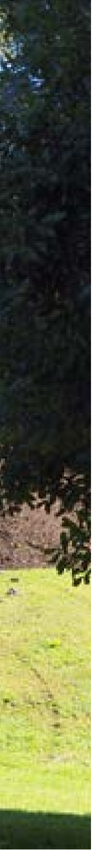


Figure 5 shows the total bearing hectares in the benchmark sample within each tree age category for each of the four major production regions. Trees less than five years of age are excluded as they are not considered bearing. Some farms, particularly in the Central Queensland (CQ) region, harvest nuts from four year old trees but these are usually small amounts.

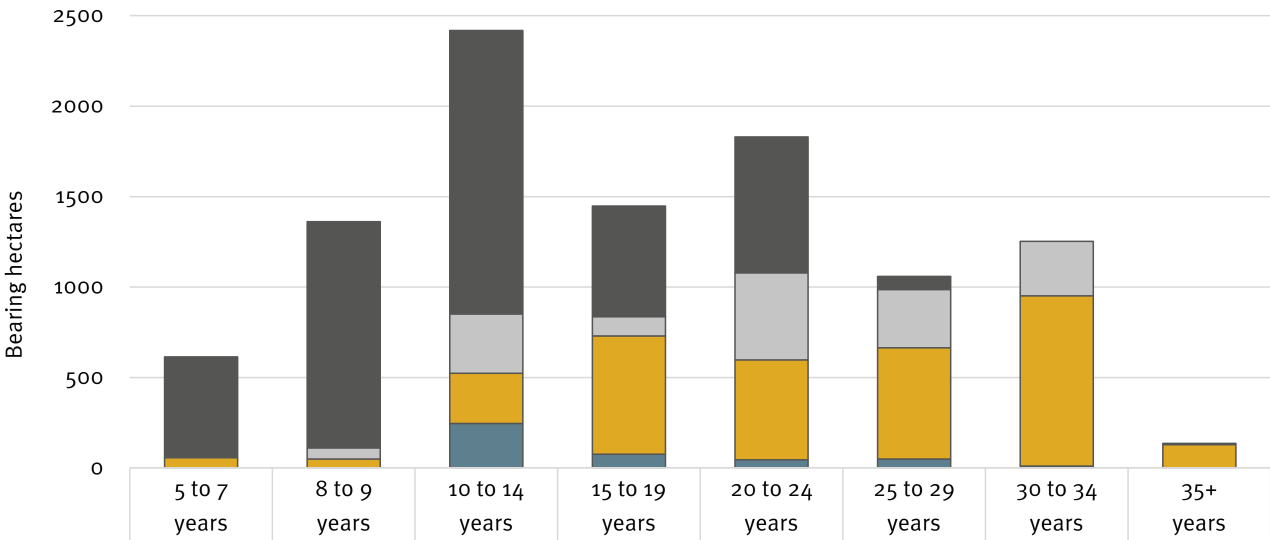
Farms with an average tree age between 10 and 14 years comprise the largest number of bearing hectares in the benchmark sample. Most of these trees are planted in the CQ region.

The largest proportion of plantings in both the CQ and Mid North Coast of New South Wales (MNNSW) regions are aged between 10 and 14 years. This corresponds with trees planted between 2001 and 2005. By comparison, the largest proportion of trees in the Northern Rivers of New South Wales (NRNSW) region are aged 30 to 34 years (planted between 1981 and 1985) and between 20 and 24 years (planted between 1991 and 1995) in the South East Queensland (SEQ) region.

Productivity amongst younger trees typically increases as they approach maturity. Benchmark data shows a general increase in tonnes per bearing hectare of nut-in-shell and saleable kernel as average tree age increases to about 20 to 24 years. Production is therefore expected to continue to increase over the next several years, particularly in the CQ region.

Total bearing hectares by tree age category and region

(2015 season)



	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25 to 29 years	30 to 34 years	35+ years
CQ	557	1251	1568	611	750	72	0	0
SEQ	0	61	327	107	482	322	301	8
NRNSW	57	50	277	653	551	615	940	129
MNNSW	0	0	247	76	46	49	11	0

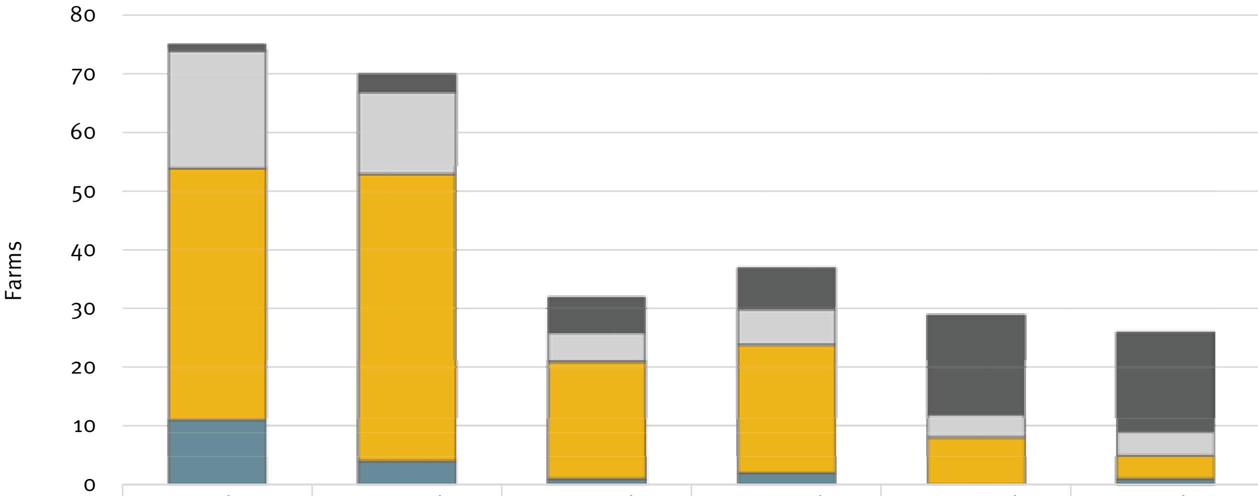
Figure 5: Total bearing hectares by tree age category and region in 2015

Farms in the benchmark sample were categorised according to their size for comparison. Figure 6 shows the number of farms by size category in the benchmark sample in 2015 for each of the major production regions.

Most farms in the benchmark sample have less than 10 hectares of bearing trees (75 farms) or between 10 and 20 hectares (70 farms). The majority of these farms are located in the MNNSW, NRNSW and SEQ regions. By comparison, the majority of larger farms (> 50 hectares) in the benchmark sample are in the CQ region.

Total bearing farms by farm size category and region

(2015 season)



	< 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	> 100 ha
CQ	1	3	6	7	17	17
SEQ	20	14	5	6	4	4
NRNSW	43	49	20	22	8	4
MNNSW	11	4	1	2	0	1

Figure 6: Total bearing farms by farm size category and region in 2015

The average size of farms in the benchmark sample is 37 hectares. The highest proportion of farms, particularly amongst NSW and SEQ farms, are less than 20 hectares.

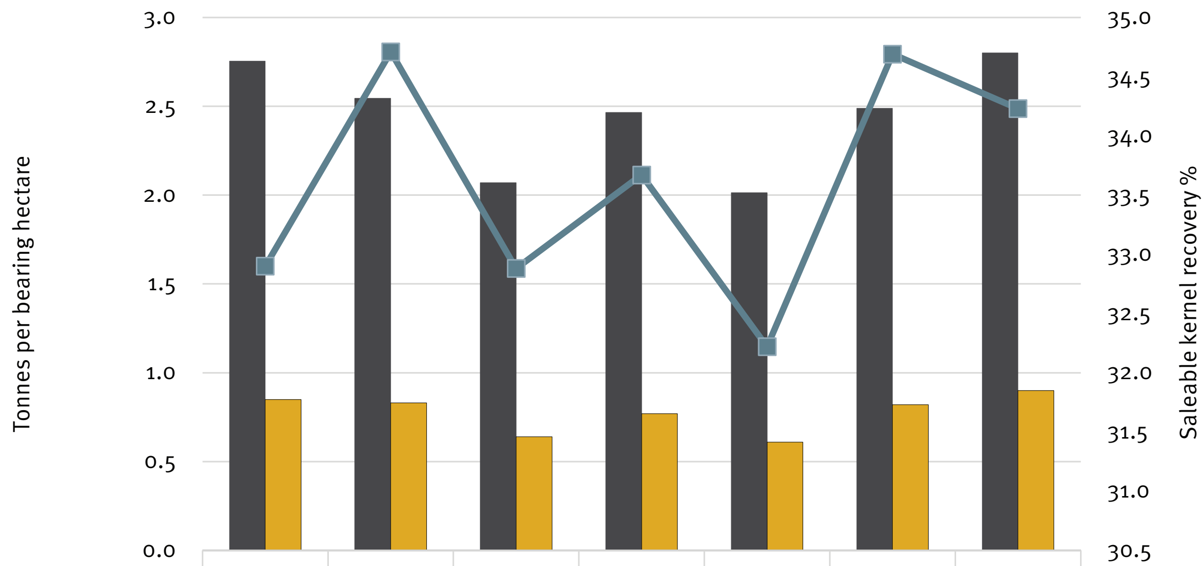
Yield and quality for all farms

A total of 269 farms participated in the benchmarking study in 2015. This section shows trends for the whole benchmark sample for all seasons from 2009 to 2015. Yield data includes both nut-in-shell (NIS) and saleable kernel production per bearing hectare. Quality data includes premium kernel recovery (PKR), commercial kernel recovery (CKR), reject kernel recovery (RKR) and saleable kernel recovery (SKR). SKR is equal to the sum of PKR and CKR.

The 2015 season was very productive in terms of both yield and kernel recovery. Figure 7 shows average yield as tonnes per hectare of NIS and saleable kernel and also SKR trends for the whole benchmark sample from 2009 to 2015.

There was a major increase in average yield per hectare from 2014 to 2015 and this followed an even larger increase from 2013 to 2014. The average yield of NIS and saleable kernel tonnes per bearing hectare was higher in 2015 than in all other years from 2009 to 2014. The lowest average yield per hectare (both NIS and saleable kernel) was recorded in 2013.

Average SKR in 2015 was the highest it has been since 2009 (excluding 2010 and 2014). As with yield, the average SKR in 2013 was lower than for each of the other years from 2009 to 2015.



	2009	2010	2011	2012	2013	2014	2015
NIS yield	2.75	2.54	2.07	2.47	2.01	2.49	2.80
Saleable kernel yield	0.85	0.83	0.64	0.77	0.61	0.82	0.90
Saleable KR %	32.90	34.71	32.88	33.67	32.22	34.69	34.23

Figure 7: Average yield and quality trends for the whole benchmark sample (2009 – 2015)

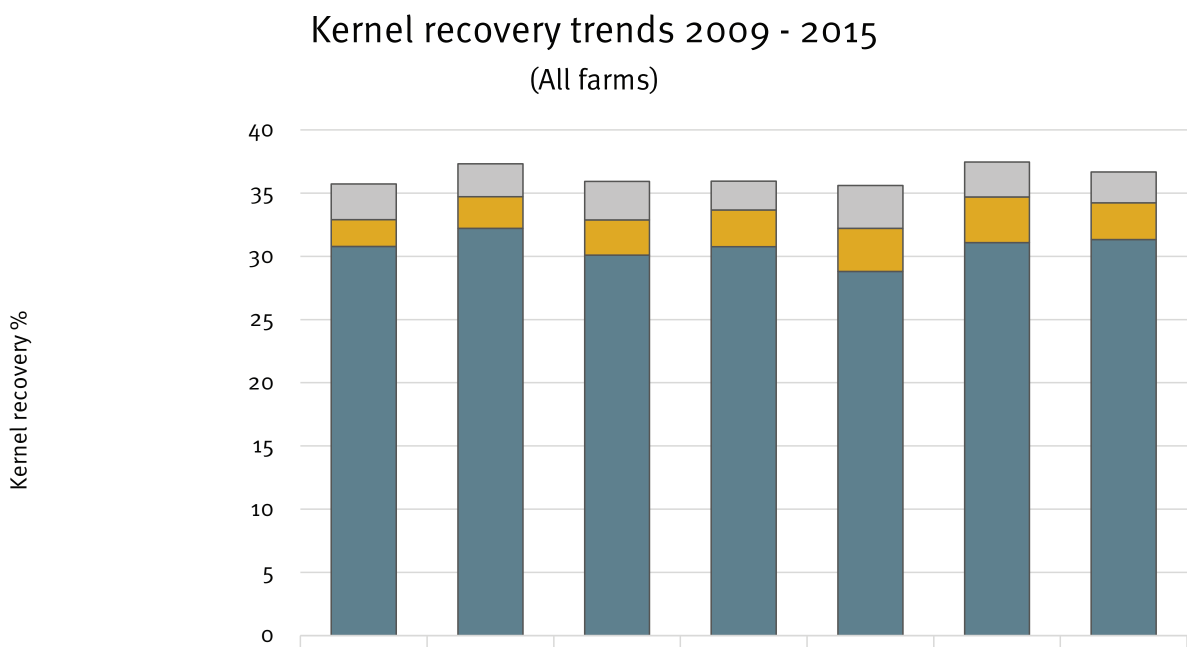
Average NIS and saleable kernel yields per hectare increased two years in a row from 2013 to 2014 and from 2014 to 2015. Both NIS and saleable kernel yields per hectare were higher in 2015 than in any other year since the benchmarking began in 2009.

Figure 8 shows average PKR, CKR and RKR trends for the whole benchmark sample from 2009 to 2015.

The high SKR in 2015 is generally related to higher-than-average PKR that year compared with the average for the 2009 to 2015 period (31.33% vs 30.68%).

Average CKR in 2015 fell slightly below average levels (2.9% vs 2.96%) following two seasons of higher-than-average CKR levels in 2013 and 2014. It is important to note that one major processor only began reporting CKR in 2010, so the low average CKR in 2009 is influenced by this.

Average RKR in 2015 also fell below the long term average for 2009 to 2015 (2.43% vs 2.76%). The average RKR in 2013 was greater than in each of the other years. This was largely driven by high levels of immaturity (particularly in South East Queensland), insect damage (particularly in NSW) and brown centres (particularly in Central Queensland) during that year.



	2009	2010	2011	2012	2013	2014	2015
Reject kernel recovery (RKR)	2.82	2.60	3.04	2.28	3.39	2.76	2.43
Commercial kernel recovery (CKR)	2.13	2.51	2.79	2.91	3.41	3.61	2.90
Premium kernel recovery (PKR)	30.77	32.20	30.09	30.76	28.80	31.08	31.33

Figure 8: Average kernel recovery for the whole benchmark sample (2009 – 2015)

In 2015 average RKR was at its lowest level since 2012 following reductions over the last two consecutive seasons.

Analysis of reject categories provides insight into the specific causes of RKR in any given season. Figure 9 shows the average percentage of rejects for all major reject categories for the whole benchmark sample from 2009 to 2015. 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 regardless of its size or level of production.

Insect damage was responsible for the highest average percentage of reject across the benchmark sample in all years except 2014. Following a significant decline in 2014, insect damage rejects increased again in 2015. This increase was evident in all production regions and led to insect damage being the most significant cause of rejects in all production regions in 2015.

Average **immaturity** levels decreased substantially in 2015 after very high average levels in 2013 and 2014.

Data from productivity groups showed that the high average immaturity in 2013 and 2014 (particularly in South East Queensland) was largely due to very dry conditions, leading to moisture stress during key nut development and oil accumulation stages in the latter parts of 2012 and 2013. This followed very wet conditions earlier in 2012. Favourable rainfall patterns led to a significant reduction in average immaturity rejects in 2015.

In both 2014 and 2015 average rejects due to **brown centres** were below the long term average of 0.49%. Brown centres rejects for the benchmark sample peaked in 2011 and again in 2013, mainly due to high levels within the Central Queensland region.

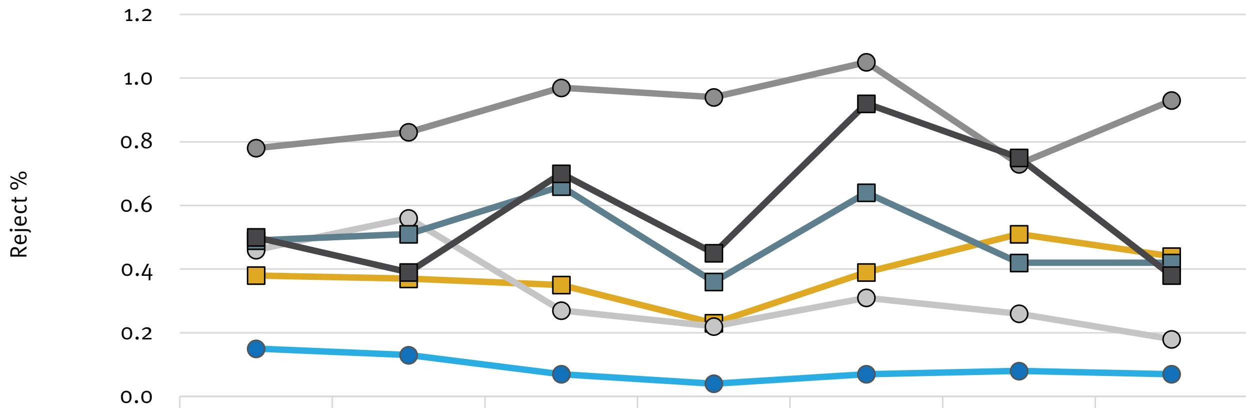
Although average rejects due to **mould** decreased from 2014 to 2015, they remained higher than the long term average of 0.39%.

Conversely, average **discolouration** was lower in 2015 than in each of the previous years since 2009.

Long term average rejects due to **germination** are typically substantially lower than all other reject categories and this trend continued in 2015.

Reject trends by percentage 2009 - 2015

(All farms)



	2009	2010	2011	2012	2013	2014	2015
Insect	0.78	0.83	0.97	0.94	1.05	0.73	0.93
Mould	0.38	0.37	0.35	0.23	0.39	0.51	0.44
Discoloured	0.46	0.56	0.27	0.22	0.31	0.26	0.18
Brown centres	0.49	0.51	0.66	0.36	0.64	0.42	0.42
Immature	0.50	0.39	0.70	0.45	0.92	0.75	0.38
Germinated	0.15	0.13	0.07	0.04	0.07	0.08	0.07

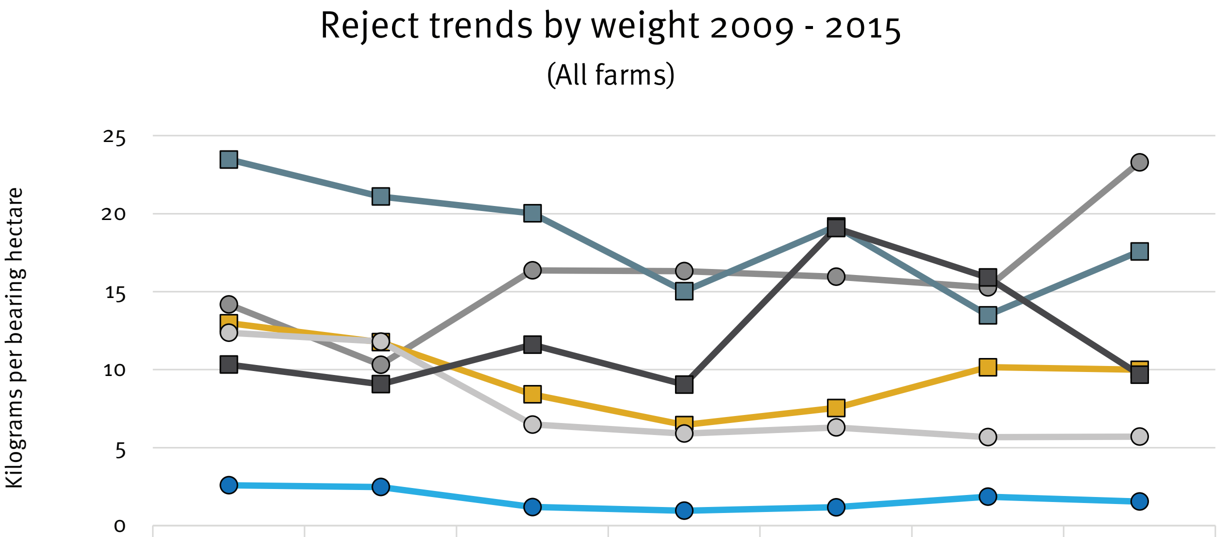
Figure 9: Seasonal comparison of reject percentages for the whole benchmark sample (2009 to 2015)

The average weight of rejects was measured for all reject categories across the benchmark sample to quantify reject losses. Figure 10 shows the average kilograms per bearing hectare for each reject analysis category for the whole benchmark sample for 2009 to 2015. It is important to note that these are weighted averages that are calculated by dividing the total kilograms of rejects by the total bearing hectares in the benchmark sample. Both production and reject levels impact on the average calculation, therefore larger farms with larger yields and reject levels will exert more influence (weight) on the average than farms with smaller yields and reject levels.

Insect damage caused the largest average weight of reject kernel per bearing hectare in 2015, followed by brown centres, mould and immaturity. Average reject weights due to insect damage were higher in 2015 than in any other year since 2009 and substantially higher than the long term average of 16.4 kg per bearing hectare.

In 2015 the average weight of rejects due to **brown centres** was slightly lower than the long term average of 18.1 kg. Brown centres caused the highest average weight of reject kernel in the benchmark sample from 2009 to 2011 and again in 2013.

In 2015 more favourable rainfall patterns contributed to a significant reduction in the average weight of rejects due to **immaturity**. Levels fell below the long term average of 12.5 kg following higher-than-average levels in both 2013 and 2014.



	2009	2010	2011	2012	2013	2014	2015
Insect	14.18	10.31	16.37	16.32	15.96	15.27	23.29
Mould	12.98	11.76	8.42	6.45	7.55	10.16	9.99
Discoloured	12.37	11.80	6.48	5.91	6.30	5.67	5.71
Brown centres	23.48	21.10	20.03	15.03	19.18	13.48	17.58
Immature	10.33	9.07	11.60	9.04	19.07	15.91	9.68
Germinated	2.59	2.48	1.19	0.96	1.18	1.86	1.54

Figure 10: Seasonal comparison of reject categories based on average weighted kilograms of kernel per bearing hectare (2009 to 2015)

Yield and quality for top performing farms

The most productive 25% of farms for saleable kernel per bearing hectare were ranked over the seven seasons from 2009 to 2015. Farms must have provided data for at least four years (including 2015) to be considered for inclusion within this group. It is important to note that these top performing farms are identified based on their average yield per hectare over multiple seasons. Some of these farms may not have been among the most productive farms in all years.

The highest proportion of top performing farms were from the Northern Rivers of New South Wales (NRNSW), with between 10 and 20 planted hectares and an average tree age between 25 and 29 years.

Figure 11 shows a breakdown of the top performing farms (inner circle) by region and compares this with the regional breakdown of farms for the whole benchmark sample (outer circle).

The Central Queensland (CQ) region was less strongly represented among the top performing farms than other regions, although it is important to remember that farms in the CQ region are younger on average than other regions and many are yet to reach peak production.

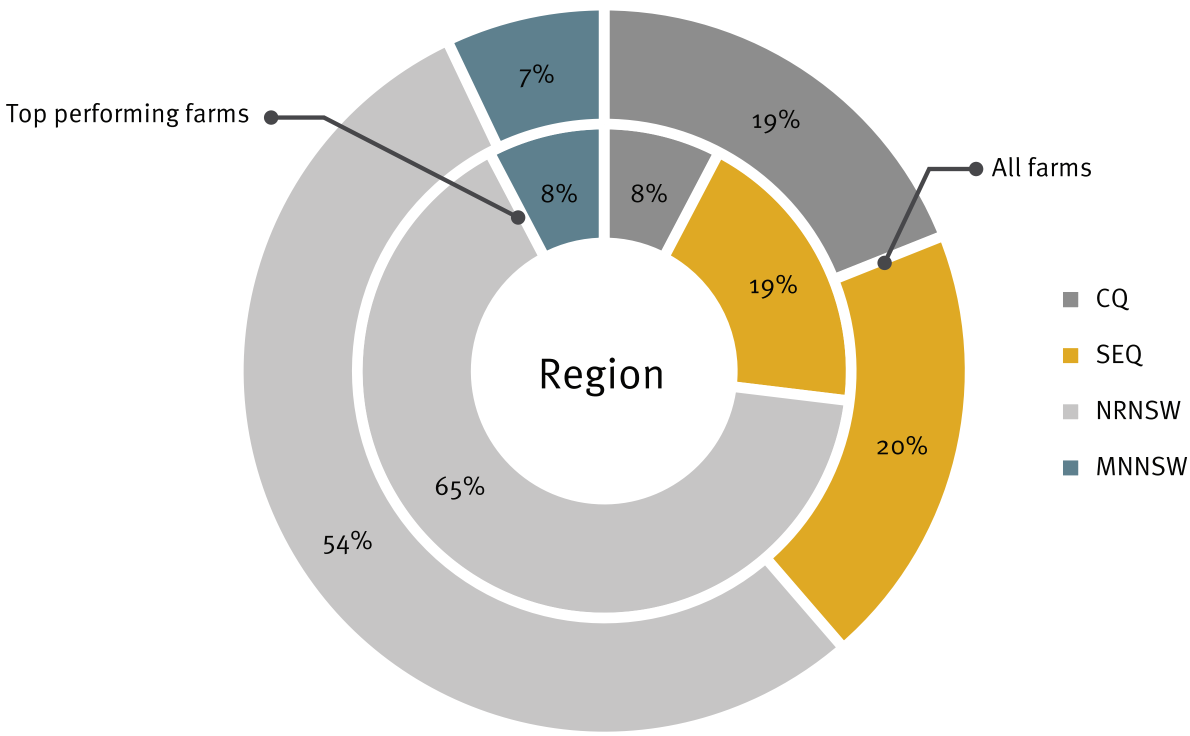


Figure 11: Regions of top performing farms vs the whole benchmark sample (2009 – 2015)

Figure 12 compares the breakdown of the top performing farms by farm size and compares this with the whole benchmark sample. Small to medium farms made up the majority of top performing farms. Almost 70% of the top performing farms are less than 20 hectares in size compared with 54% for the whole benchmark sample. Approximately 86% of top performing farms are less than 30 hectares compared with 66% for the whole sample. It is important to remember that many larger farms in the benchmark sample are, on average, younger than smaller farms and therefore yet to reach their bearing potential.

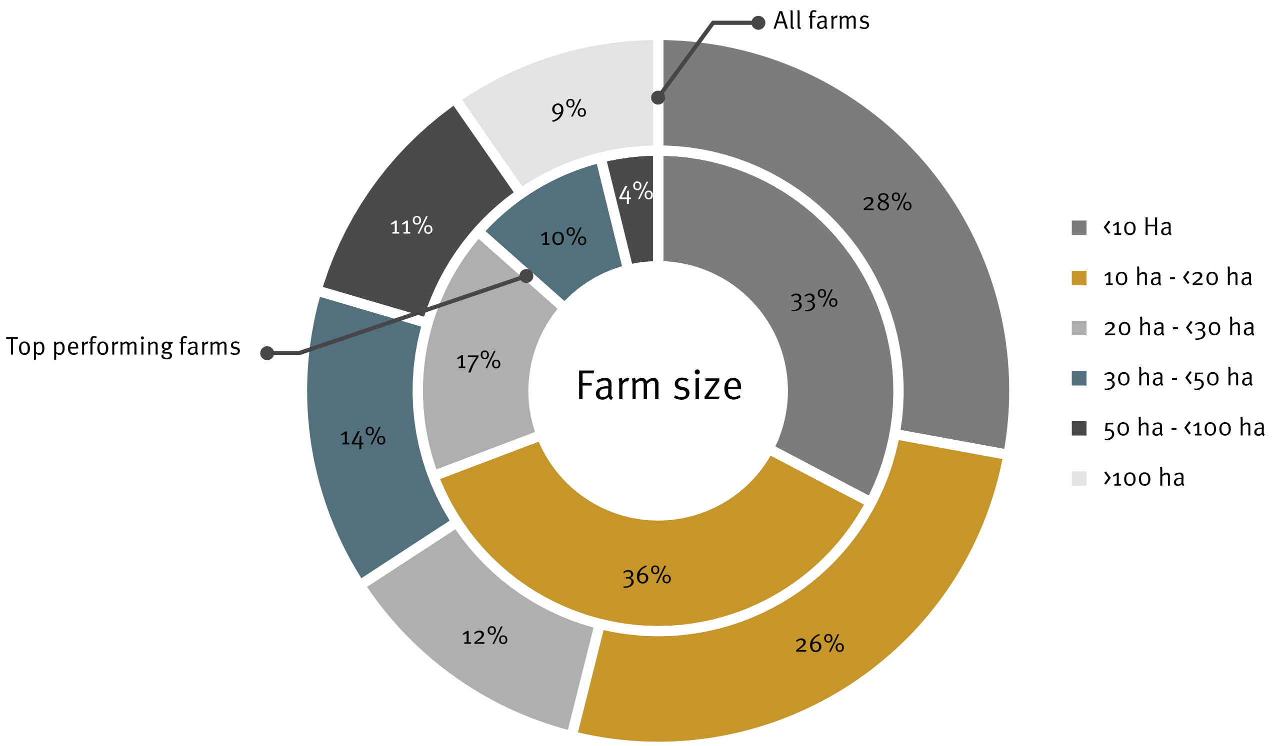


Figure 12: Farm size categories of top performing farms vs the whole benchmark sample (2009 – 2015)

Figure 13 shows the breakdown of the top performing farms by tree age and compares this with the whole benchmark sample. The top performing farms included seven farms (14%) with an average tree age of less than 15 years, including one highly productive farm from the CQ region in the 8 to 9 year old age group. By comparison, 26% of the whole benchmark sample had an average tree age of less than 15 years.

The proportion of top performing farms aged 15 to 24 years (46%) closely matched that of the wider benchmark sample (45%). Farms aged 25 to 29 years were most strongly represented among the top performing farms (38%) compared with the wider benchmark sample (17%). The top performing farms also included one farm with an average tree age in excess of 30 years.

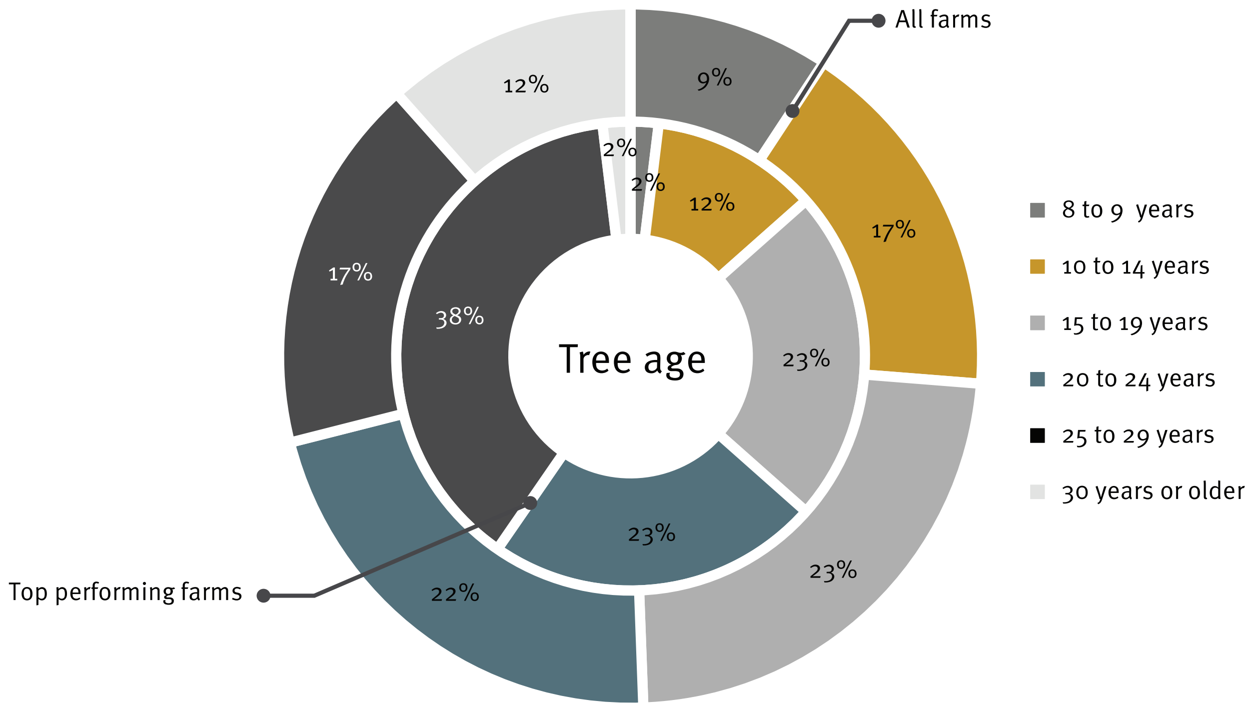


Figure 13: Average tree age of top performing farms vs the whole benchmark sample (2009 – 2015)

Figure 14 shows the breakdown of the top performing farms by planting density and compares this with the whole benchmark sample.

All four of the planting density groups shown were common among both the top performing farms and the whole benchmark sample. Planting densities of between 270 to 350 trees were represented slightly more among the top performing farms however these densities are also common among the benchmark sample.

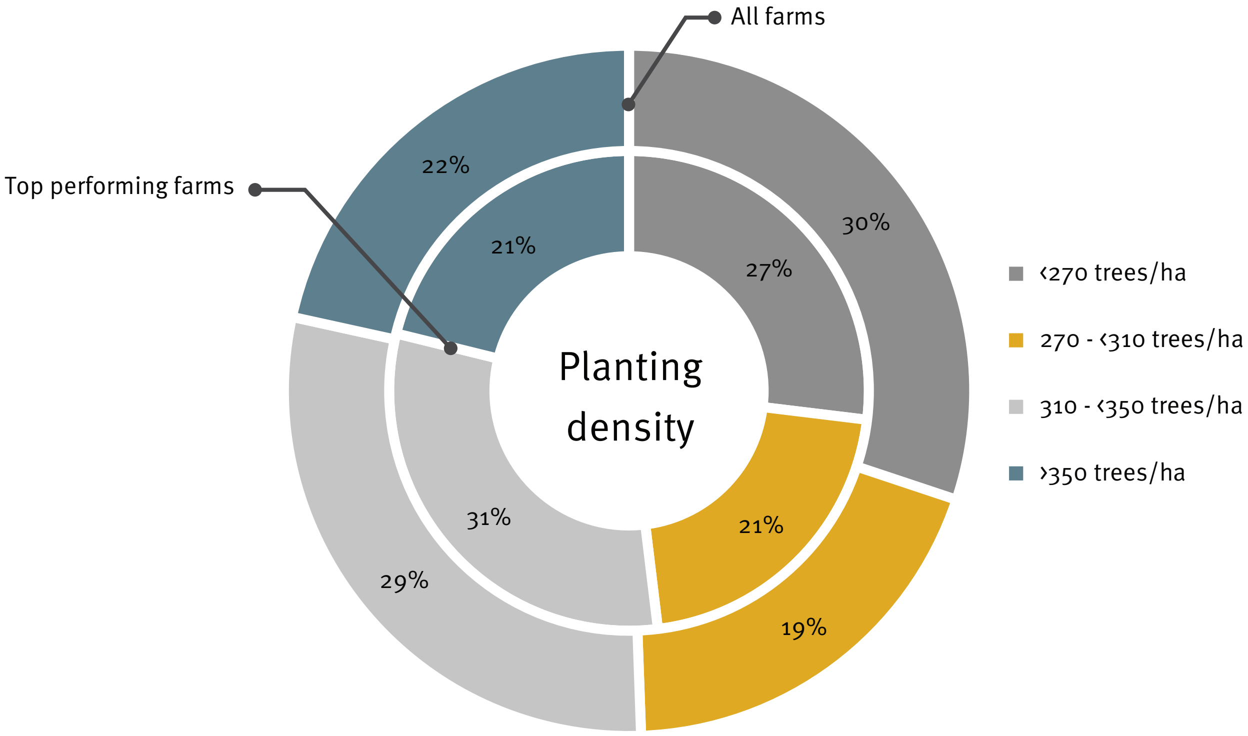


Figure 14: Average planting density of top performing farms vs the whole benchmark sample (2009 – 2015)

Figure 15 shows the average saleable tonnes per bearing hectare and saleable kernel recovery (SKR) for 2009 to 2015 for the top performing farms and compares these with all mature farms in the benchmark sample with an average age of 10 or more years. Farms with an average tree age of less than 10 years were excluded to ensure a fair comparison with the top 25%, which predominantly comprised farms above this age.

It is important to remember that top performing farms must have provided data for at least four years, including 2015, to be considered for inclusion within this group.

This chart confirms that many farms experience seasonal fluctuations in both yield and quality, including the top performing farms. It also shows that the pattern of this fluctuation is reasonably consistent from season to season. It is important to remember that although the number of farms in the benchmark sample changes from season to season (generally increasing), the top performing farm results track the performance of a static group of 52 farms over those same seasons.

The top performing farms averaged 1.21 tonnes of saleable kernel per bearing hectare over the seven years from 2009 to 2015 compared with 0.83 tonnes for all farms in the benchmark sample with an average tree age of 10 years or more. This is a difference of almost 46%, which is equivalent to approximately 380 kilograms of saleable kernel per bearing hectare per season.

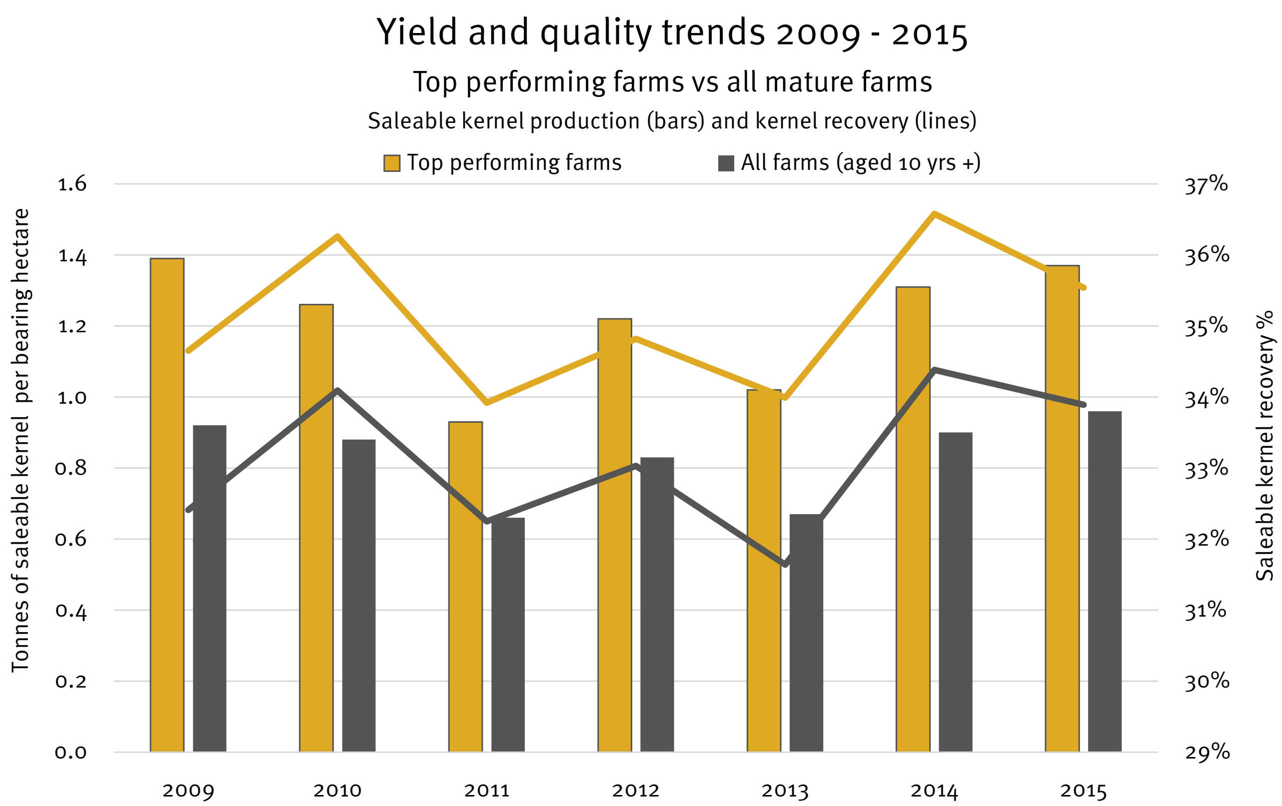


Figure 15: Yield and quality trends for top performing farms vs the whole benchmark sample (2009 – 2015)

The lowest average annual yields per hectare of the top performing farms were 0.93 tonnes in 2011 and 1.02 tonnes in 2013. The highest average yields were 1.39 tonnes in 2009 and 1.37 tonnes in 2015. By comparison, the lowest average yields per hectare for all farms aged 10 years or older were 0.66 tonnes in 2011 and 0.67 tonnes in 2013 and the highest average yields were 0.92 tonnes in 2009 and 0.96 tonnes in 2015. It is therefore worth noting that average yields for the top performing farms in the worst cropping years of 2011 and 2013 were similar to average yields in the best cropping years of 2009 and 2015 for all mature farms in the benchmark sample.

The top performing farms (based on their average yield per hectare) also averaged 35.1% saleable kernel recovery (SKR) over the seven years compared with 33.1% for all the farms with an average tree age of 10 years of more. This is equivalent to a difference of 2.0% in SKR. The top performing farms consistently achieved a higher average SKR than the average of all mature farms in the benchmark sample in each season. The difference in SKR varied from 1.6% in 2011 to 2.4% in 2013. The SKR difference means that the top performing farms also achieved a higher price per kilogram of nut-in-shell each year than all the farms aged 10 years of older in the benchmark sample.

IT PAYS TO INCREASE PRODUCTION

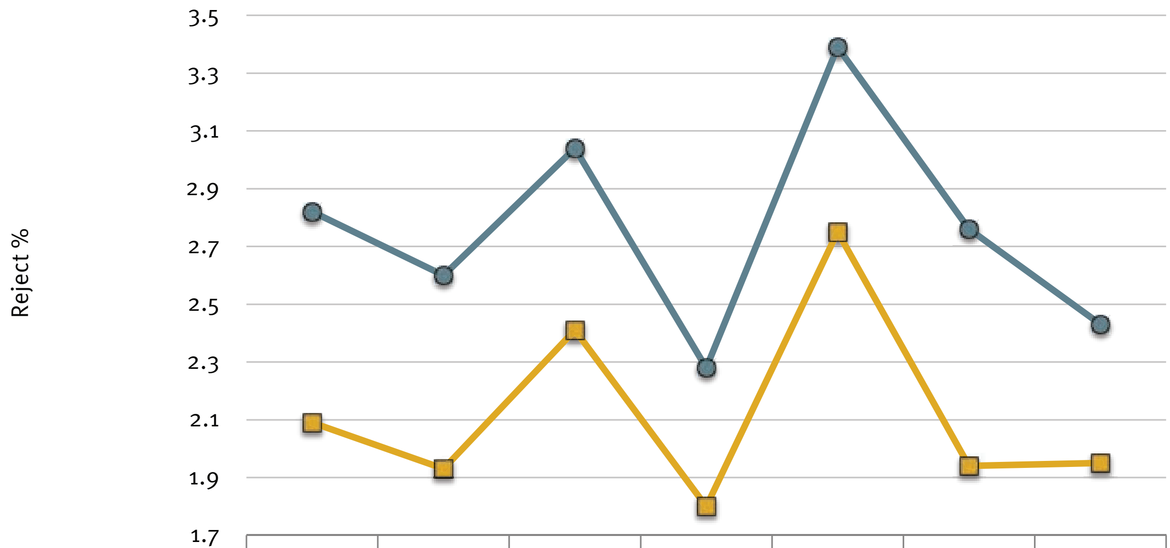
Over the last seven seasons the top 25% of farms participating in benchmarking produced an average of **380 kg** more saleable kernel per hectare than the average of all benchmarked farms. At 2015 prices this amounted to a difference of more than **$6,000 per hectare**, which is enough to cover operating costs on most farms.

Based on an average sized farm in the benchmark sample (37 hectares) this amounts to additional revenue of more than **$227,000** for the 2015 season. Despite significant fluctuations in NIS prices between 2009 and 2015, the net difference over these seven seasons, based on standard price tables for each year, amounted to more than **$1,050,000**. That’s an average difference of **$150,000** per season.

Figure 16 compares average reject kernel recovery (RKR) from 2009 to 2015 for the top performing farms with all farms in the benchmark sample with an average tree age of 10 years or more. The top performing farms consistently achieved lower average RKR each season than the benchmark average (2.12% vs 2.76%).

Reject kernel recovery trends 2009 - 2015

(Top performing farms vs all farms)



	2009	2010	2011	2012	2013	2014	2015
RKR - Top performing farms	2.09	1.93	2.41	1.80	2.75	1.94	1.95
RKR - All farms	2.82	2.60	3.04	2.28	3.39	2.76	2.43

Figure 16: Average reject kernel recovery for the top performing farms vs all farms in the benchmark sample (2009 – 2015)

The top performing farms for orchard productivity also averaged just 2.12% reject kernel recovery over the seven seasons from 2009 to 2015 compared to 2.76% for all farms in the benchmark sample.

Figure 17 shows the average percentage of rejects by reject category for the top performing farms compared with all mature farms in the benchmark sample (10+ years old) from 2009 to 2015. These averages are unweighted, which means that each farm in the data sample exerts equal influence on the average regardless of size or amount of production.

The top performing farms had similar seasonal reject patterns but lower total rejects compared with all farms in the benchmark sample over the seven seasons. The average level of rejects amongst the top performing farms over the seven seasons was less for each reject category than for all farms.

Insect damage caused the most significant average reject in each season. Top performing farms averaged 0.11% lower insect damage than the benchmark average between 2009 and 2015. Insect damage levels generally increased from 2014 to 2015 following a significant decrease from 2013 to 2014.

Top performing farms average 0.14% lower immaturity rejects than the benchmark average over the seven seasons. Favourable rainfall patterns (particularly in South East Queensland) led to a significant reduction in average rejects due to immaturity in 2015 for both top performing farms and all farms in the benchmark sample. Very dry conditions in the latter parts of 2012 and 2013 had led to high average levels of immaturity in 2013 and 2014.

Brown centres was the reject category that showed the greatest average difference (0.22%) between the top performing farms and all farms in the benchmark sample over the seven seasons. Benchmark data has shown that brown centres is more prevalent on larger farms, which were not strongly represented among the top performing farms. It is important to remember that many large farms participating in benchmarking are younger than the sample average and therefore yet to reach their optimum yield.

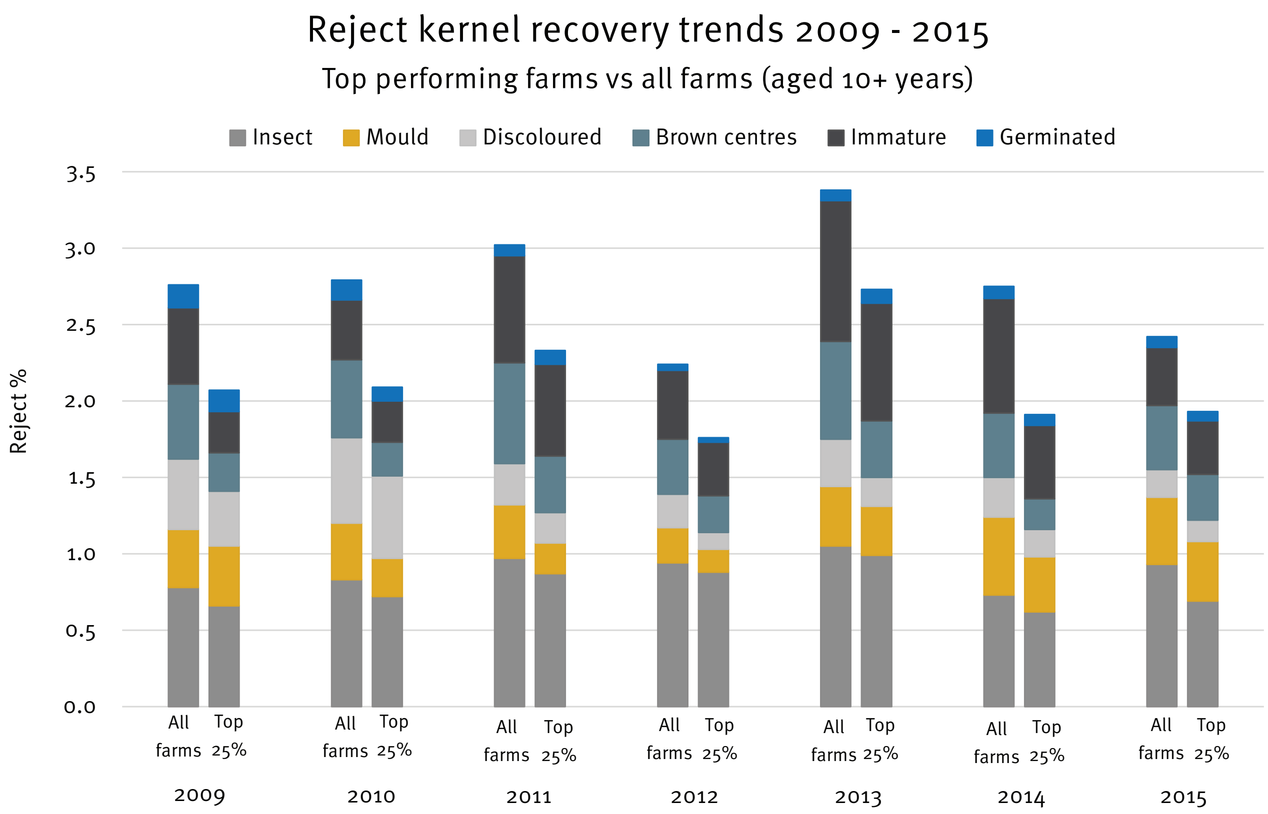
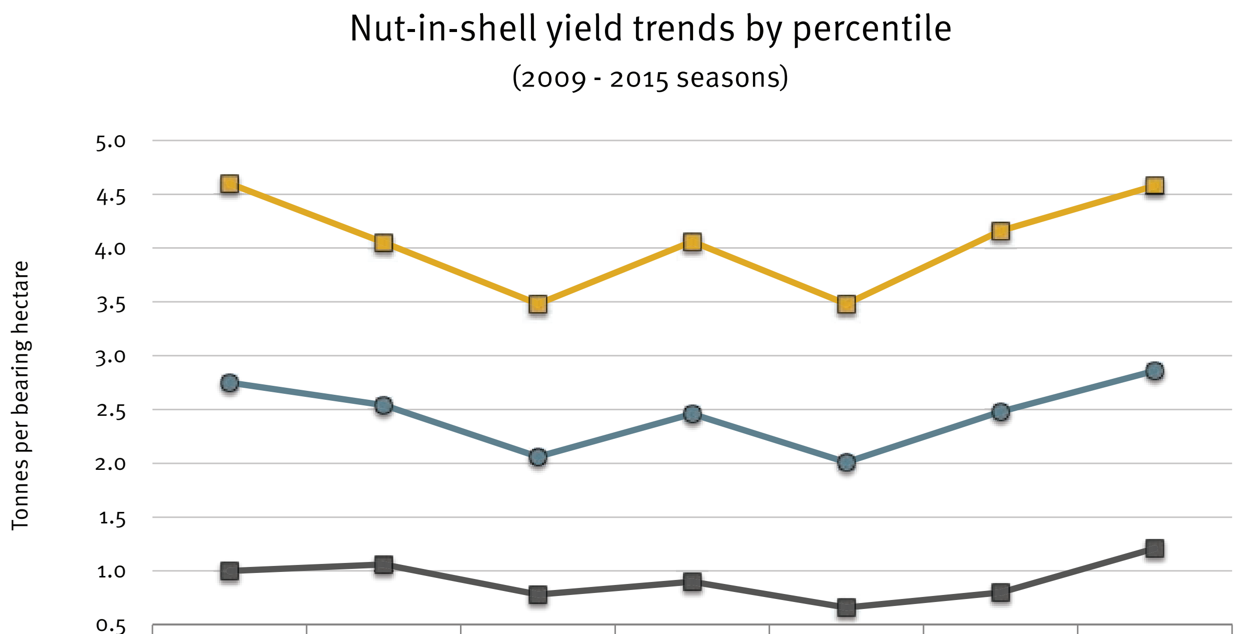


Figure 17: Seasonal comparison of reject categories for the top performing farms vs the average for all farms (2009 – 2015)

Yield and quality by season

This section presents yield and quality trends for the whole benchmark sample over the last seven seasons (2009-2015). Significant variability in both yield and quality was evident within the benchmark sample, so results are presented as percentiles to demonstrate the extent of this variability for various yield and quality attributes. Averages for the top 25% and bottom 25% of the sample are compared with the sample average. It is important to note that the subsets on which these averages are based are different for each attribute. This means for example that the top 25% of farms for nut-in-shell (NIS) production in any given season may not be the same farms as the top 25% for saleable kernel production. This is quite different to the top performing farms in the previous section, which are based on a static group of farms that returned consistently high saleable kernel production per bearing hectare over multiple seasons.

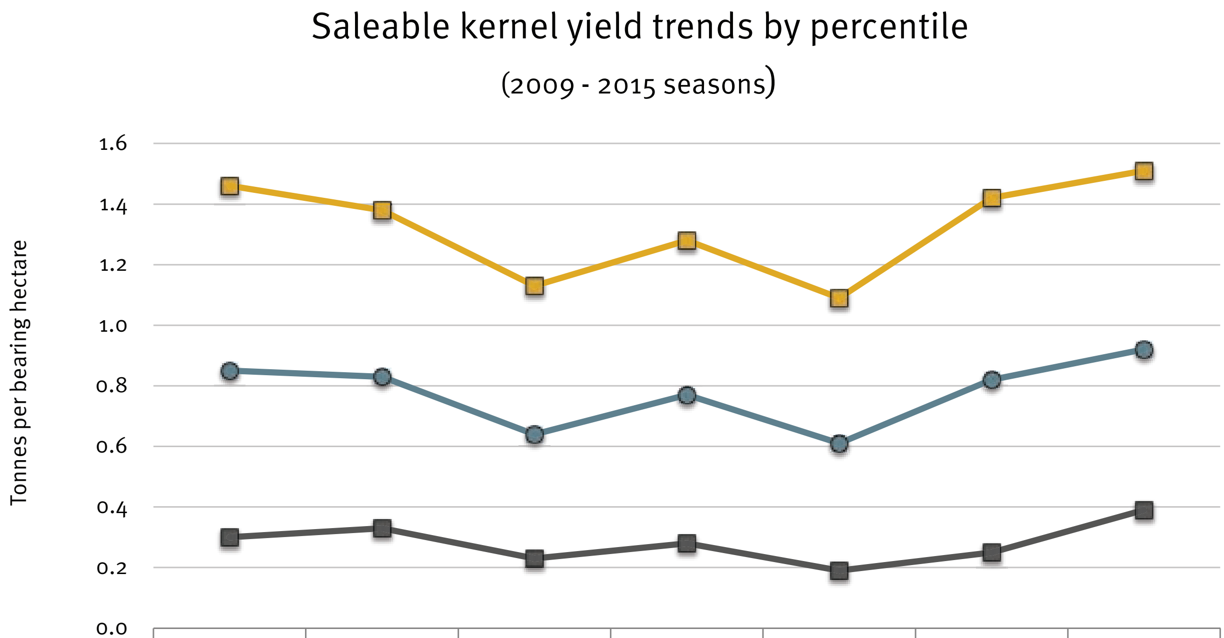
Figure 18 compares the average tonnes of NIS per bearing hectare for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. Average NIS yield increased within each of these groups from 2013 to 2014 and again from 2014 to 2015. NIS yield peaked in 2015 for both the bottom 25% and the sample average, however the top 25% achieved a slightly higher yield in 2009.



	2009	2010	2011	2012	2013	2014	2015
Top 25%	4.60	4.05	3.48	4.06	3.48	4.16	4.58
All farms	2.75	2.54	2.06	2.46	2.01	2.48	2.86
Bottom 25%	1.00	1.06	0.78	0.90	0.66	0.80	1.21

Figure 18: Comparison of average farm yields of tonnes of nut-in-shell per bearing hectare (2009 – 2015)

Figure 19 compares the average tonnes of saleable kernel per bearing hectare for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. Saleable kernel was lowest in 2013 for each group and peaked in 2015 following increases over two consecutive seasons.



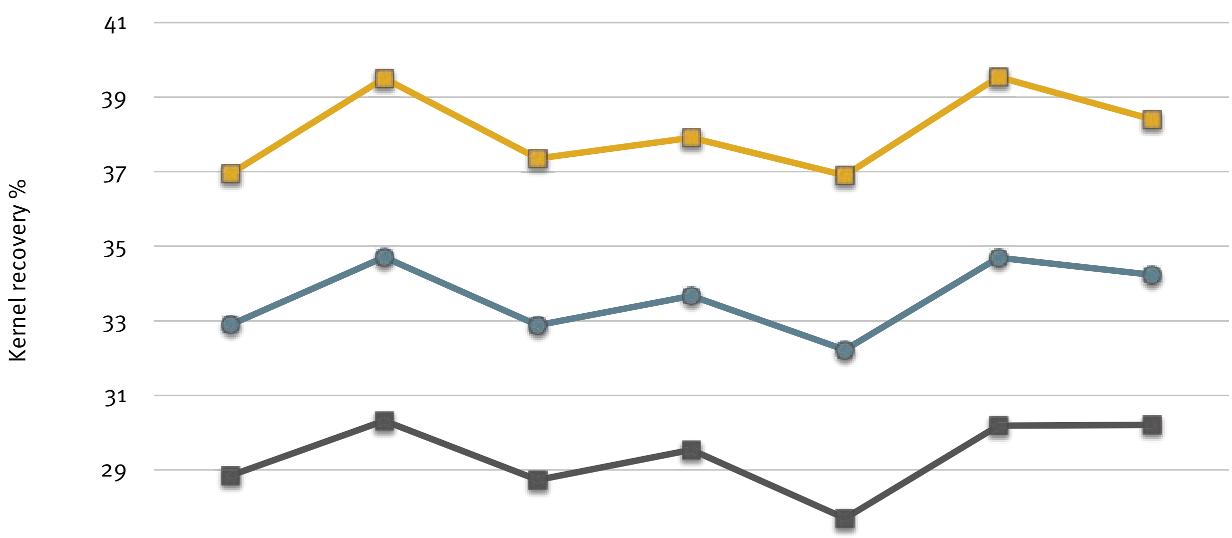
	2009	2010	2011	2012	2013	2014	2015
Top 25%	1.46	1.38	1.13	1.28	1.09	1.42	1.51
All farms	0.85	0.83	0.64	0.77	0.61	0.82	0.92
Bottom 25%	0.30	0.33	0.23	0.28	0.19	0.25	0.39

Figure 19: Comparison of average farm yields of tonnes of saleable kernel per bearing hectare (2009 – 2015)

Figure 20 compares average saleable kernel recovery (SKR) for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. SKR is equivalent to the sum of premium kernel recovery (PKR) and commercial kernel recovery (CKR). Average SKR was lower for both the top 25% and the whole sample in 2015 compared with 2014 but increased slightly for the bottom 25%. This follows substantial increases across all groups from 2013 to 2014. Average SKR was lower for all groups in 2013 than in all other years between 2009 and 2015.

Saleable kernel recovery trends by percentile

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
Top 25%	36.95	39.50	37.35	37.91	36.90	39.54	38.40
All farms	32.90	34.71	32.88	33.67	32.22	34.69	34.23
Bottom 25%	28.85	30.32	28.73	29.54	27.70	30.19	30.21

Figure 20: Comparison of average farm saleable kernel recovery (2009 – 2015)

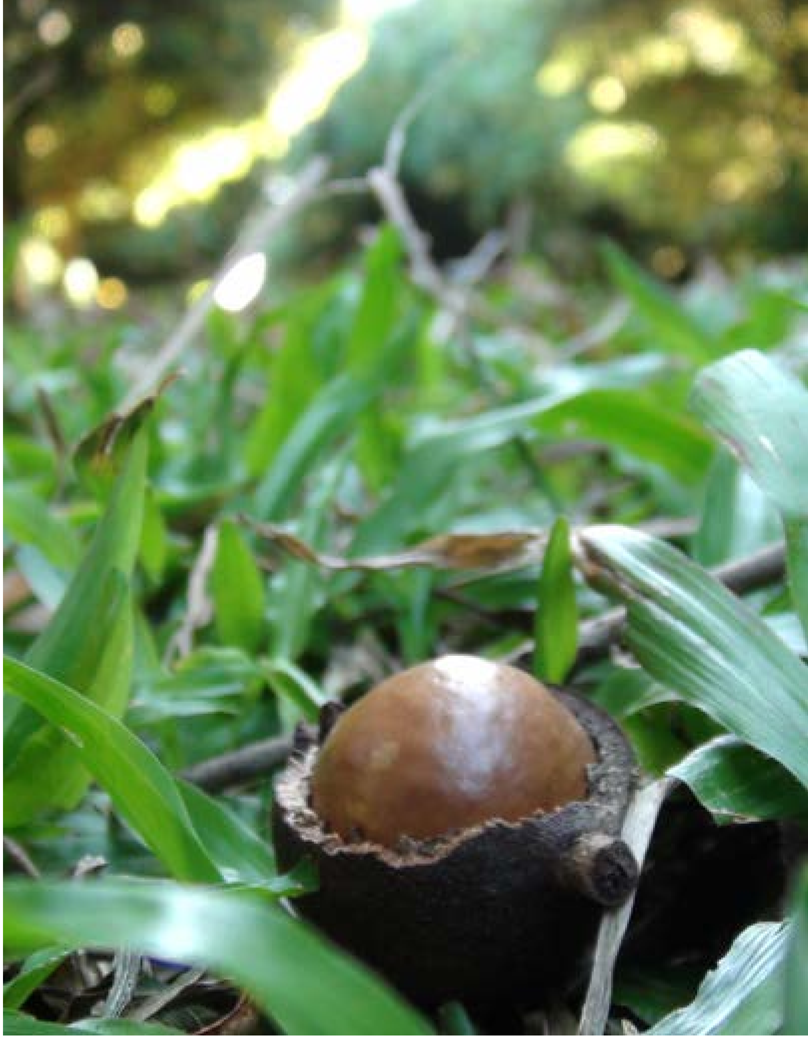
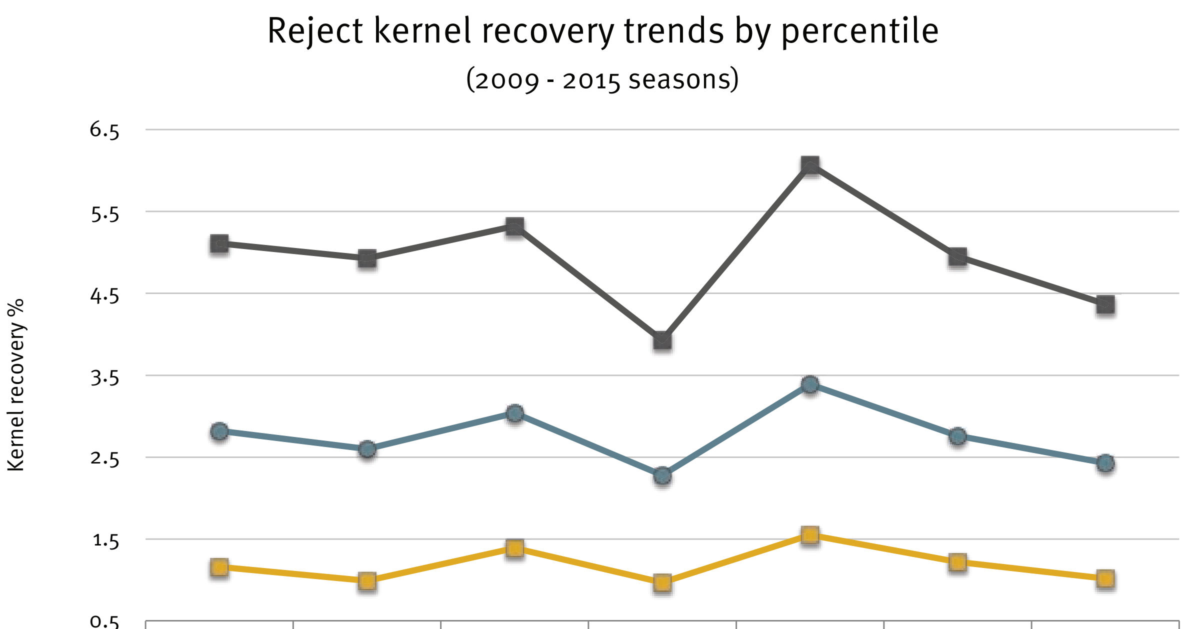


Figure 21 compares average reject kernel recovery (RKR) for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. RKR and associated reject category percentiles are inverted as low RKR and individual reject levels represent better quality.

RKR decreased across all groups from 2014 to 2015 following an even larger decrease for each of these groups from 2013 to 2014. For the seven seasons shown average RKR levels were lowest in 2012 and peaked in 2013 across all groups.



	2009	2010	2011	2012	2013	2014	2015
Top 25%	1.16	0.99	1.39	0.97	1.55	1.22	1.02
All farms	2.82	2.60	3.04	2.28	3.39	2.76	2.43
Bottom 25%	5.11	4.93	5.32	3.93	6.07	4.95	4.37

Figure 21: Comparison of average farm reject kernel recovery (2009 – 2015)

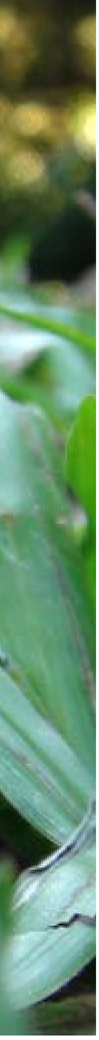
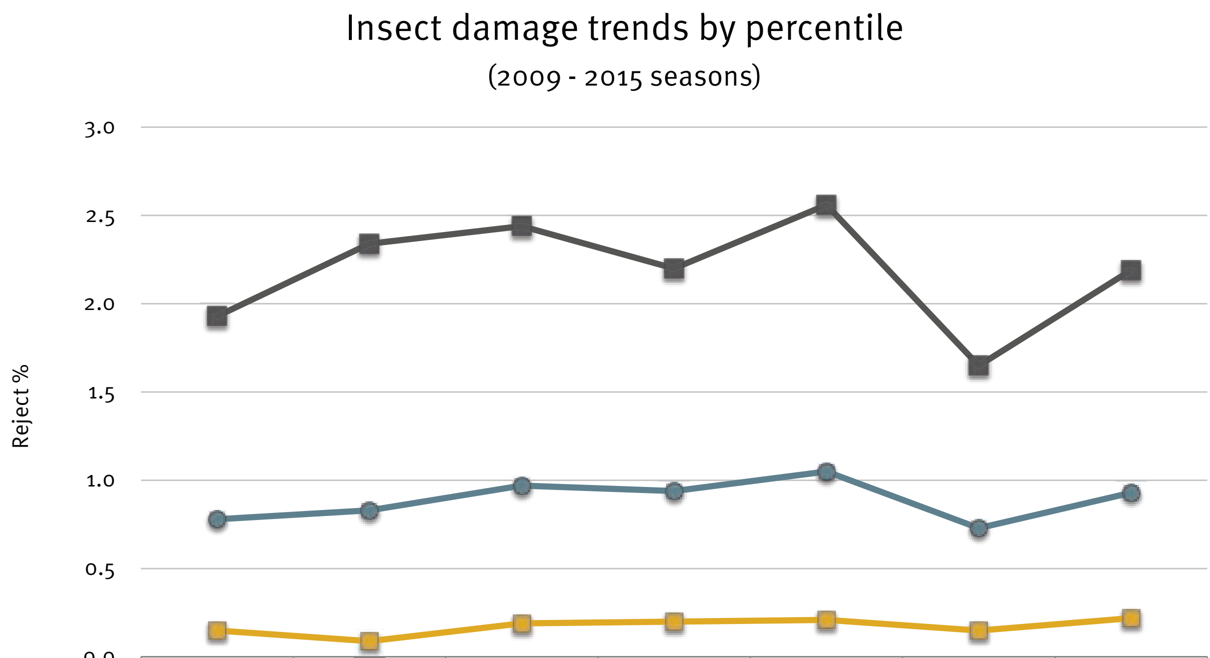


Figure 22 shows average rejects due to insect damage for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. Average rejects due to insect damage increased from 2014 to 2015 across all groups following a decrease for each group from 2013 to 2014. Insect damage caused the highest percentage of rejects in 2015 across all regions and percentiles.

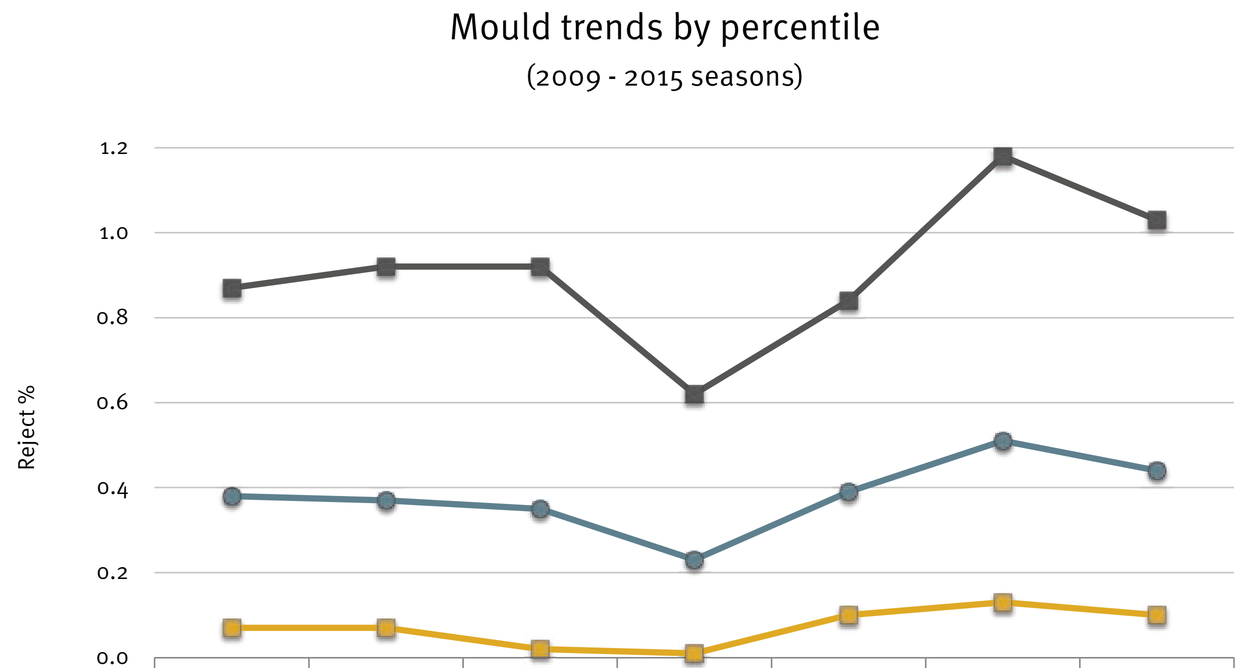


	2009	2010	2011	2012	2013	2014	2015
Top 25%	0.15	0.09	0.19	0.20	0.21	0.15	0.22
All farms	0.78	0.83	0.97	0.94	1.05	0.73	0.93
Bottom 25%	1.93	2.34	2.44	2.20	2.56	1.65	2.19

Figure 22: Comparison of average insect damage reject levels (2009 – 2015)

Figure 23 shows average rejects due to mould for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. There was a decrease in average mould reject levels in 2015 across all groups following consecutive increases in the previous two seasons.

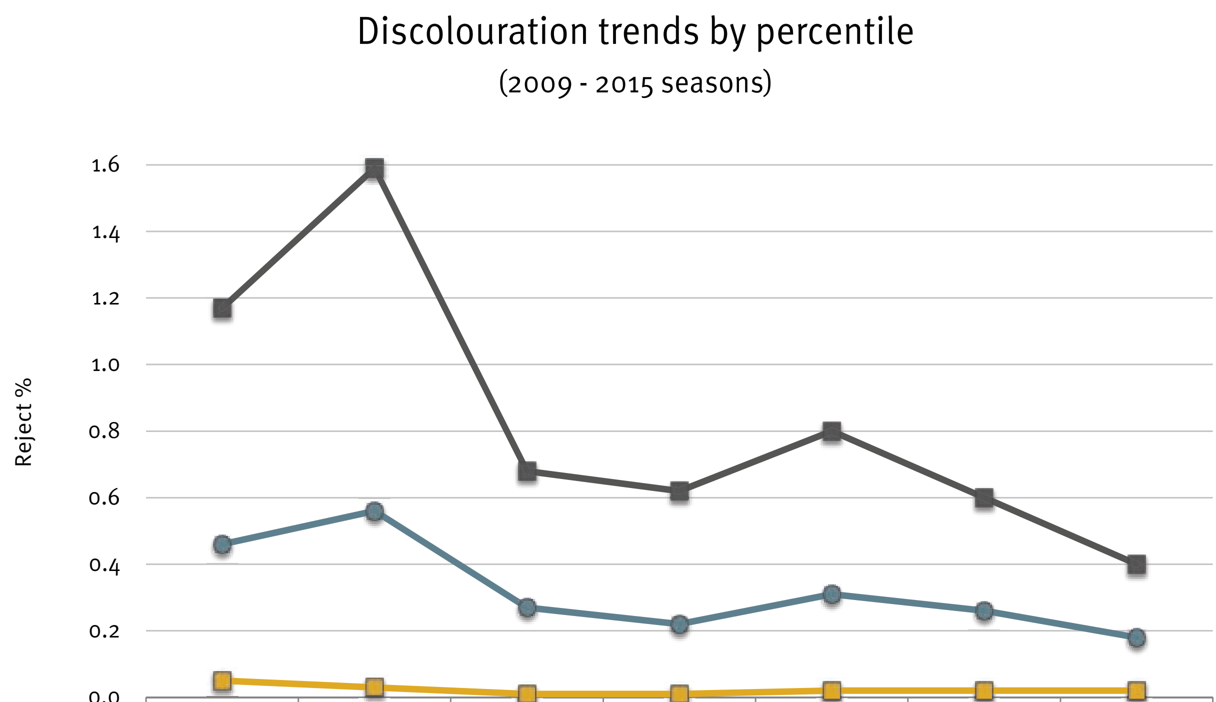
Mould reject levels in 2014 for each percentile group were more than in each of the other years from 2009 to 2015. Mould reject levels in 2012 were the lowest for each group between 2009 and 2015.



	2009	2010	2011	2012	2013	2014	2015
Top 25%	0.07	0.07	0.02	0.01	0.10	0.13	0.10
All farms	0.38	0.37	0.35	0.23	0.39	0.51	0.44
Bottom 25%	0.87	0.92	0.92	0.62	0.84	1.18	1.03

Figure 23: Comparison of average mould reject levels (2009 – 2015)

Figure 24 shows average rejects due to discolouration for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. Average discolouration reject levels decreased from 2014 to 2015 across all the farms in the benchmark sample and for the bottom 25% of farms following a decrease from 2013 to 2014. Average discolouration rejects in 2015 across all farms and for the bottom 25% were less than in each of the other years. Average levels for the top 25% of farms in 2015 remained low, as they have in previous seasons. Discolouration reject levels in 2009 and 2010 for each percentile group were higher than in each of the other years.



	2009	2010	2011	2012	2013	2014	2015
Top 25%	0.05	0.03	0.01	0.01	0.02	0.02	0.02
All farms	0.46	0.56	0.27	0.22	0.31	0.26	0.18
Bottom 25%	1.17	1.59	0.68	0.62	0.80	0.60	0.40

Figure 24: Comparison of average discolouration reject levels (2009 – 2015)

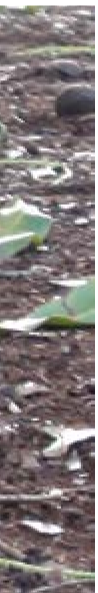
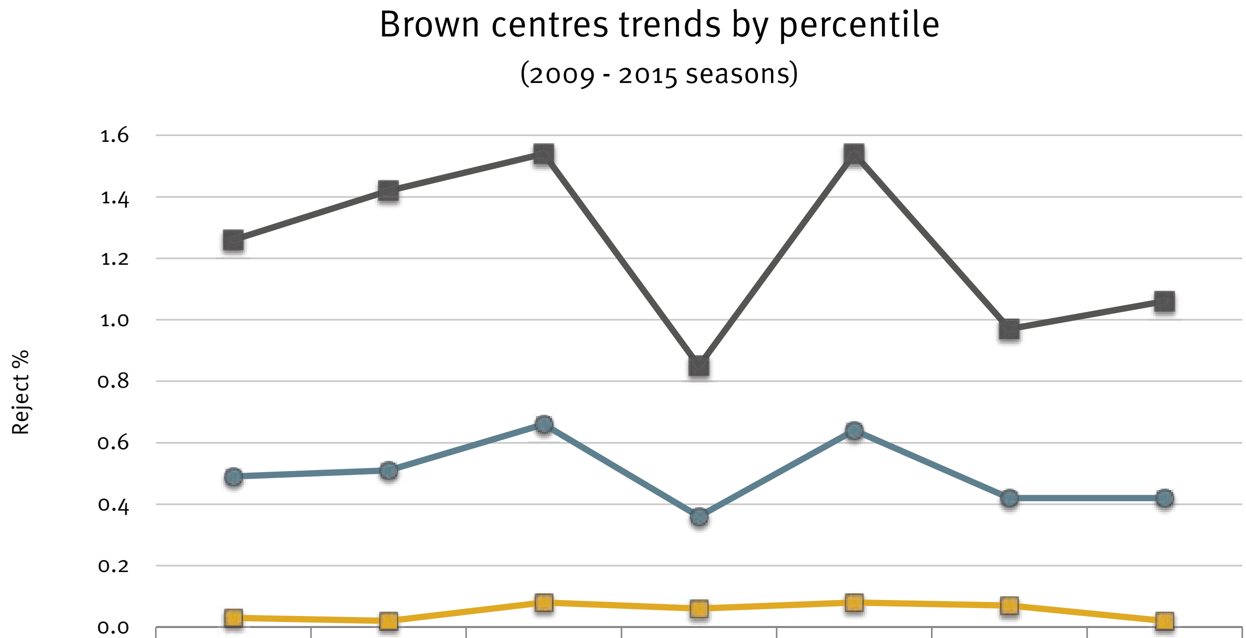


Figure 25 shows average rejects due to brown centres for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. Average brown centre reject levels in 2015 were similar to that of the previous season across all the farms in the benchmark sample. There was a small decrease amongst the top 25% of farms and a small increase amongst the bottom 25% of farms from 2014 to 2015. This follows a general decrease in average brown centres rejects from 2013 to 2014. Brown centres reject levels peaked in 2011 and 2013 for each percentile group.



	2009	2010	2011	2012	2013	2014	2015
Top 25%	0.03	0.02	0.08	0.06	0.08	0.07	0.02
All farms	0.49	0.51	0.66	0.36	0.64	0.42	0.42
Bottom 25%	1.26	1.42	1.54	0.85	1.54	0.97	1.06

Figure 25: Comparison of average brown centres reject levels (2009 – 2015)

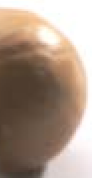
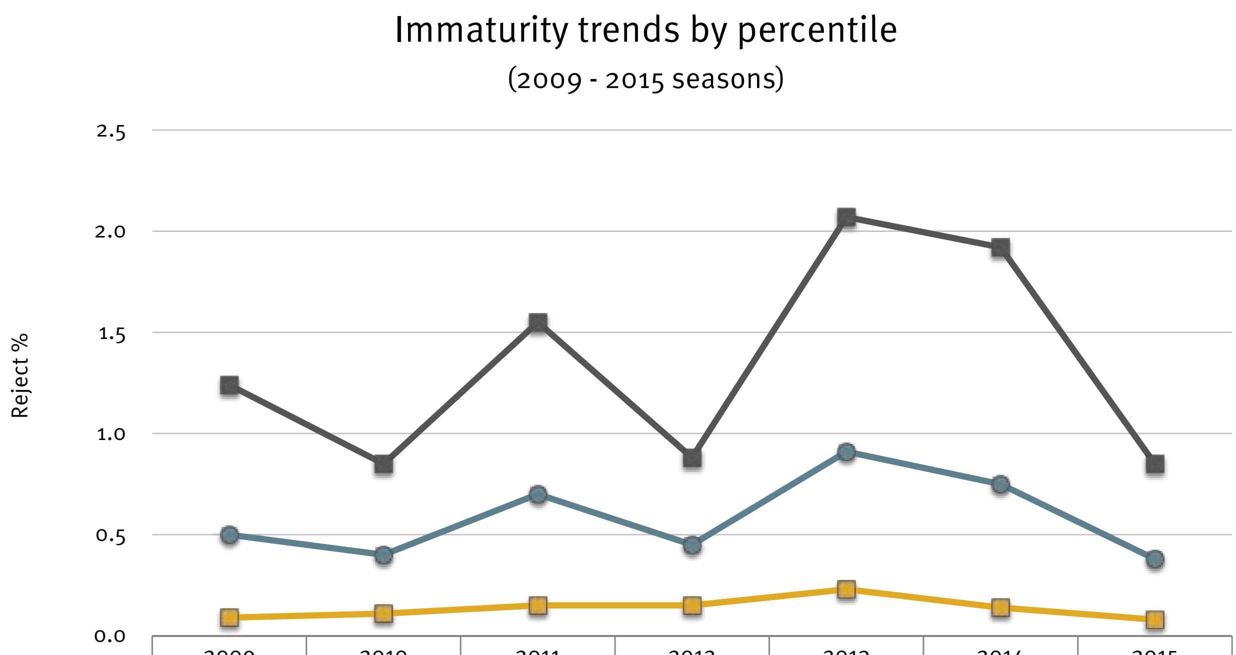


Figure 26 shows average rejects due to immaturity for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. Average immaturity reject levels decreased across all groups from 2014 to 2015 following a smaller decrease from 2013 to 2014.

Average immaturity rejects were lower in 2015 than each other year from 2009 to 2014. Peak immaturity levels across all groups were recorded in 2013. Similarly high immaturity rejects were recorded in 2014. Immaturity was particularly prevalent in the South East Queensland region in both 2013 and 2014. Data from productivity groups showed that these high levels of immaturity were largely due to very dry conditions leading to moisture stress during nut growth 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, those on soils with poor water holding capacity and farms that missed opportune spring storms during key nut growth stages.



	2009	2010	2011	2012	2013	2014	2015
Top 25%	0.09	0.11	0.15	0.15	0.23	0.14	0.08
All farms	0.50	0.40	0.70	0.45	0.91	0.75	0.38
Bottom 25%	1.24	0.85	1.55	0.88	2.07	1.92	0.85

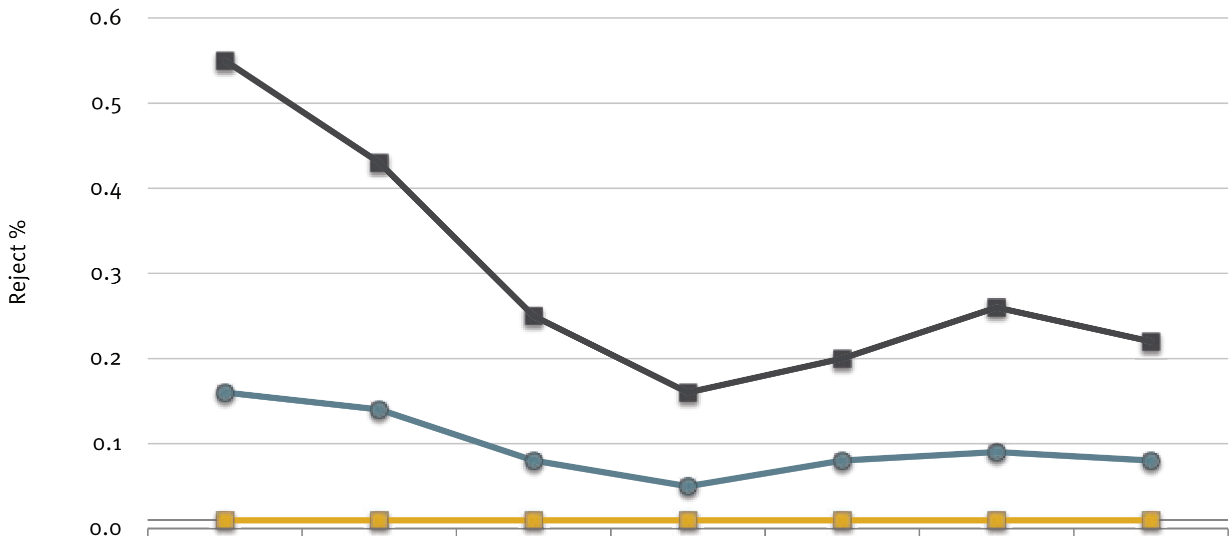
Figure 26: Comparison of average immaturity reject levels (2009 – 2015)

Figure 27 shows average rejects due to germination for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2015. There was a slight decrease in average germination reject levels across all farms in the benchmark sample and amongst the bottom 25% of farms from 2014 to 2015. This follows increases from 2012 to 2013 and again from 2013 to 2014.

The top 25% of farms recorded no germination rejects from 2009 to 2015. Germination represented the lowest of all reject categories for each group from 2009 to 2015.

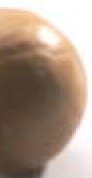
Germination trends by percentile

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
Top 25%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
All farms	0.15	0.13	0.07	0.04	0.07	0.08	0.07
Bottom 25%	0.54	0.42	0.24	0.15	0.19	0.25	0.21

Figure 27: Comparison of average germination reject levels (2009 – 2015)



Yield and quality by region

Yield and quality results were compared across four major production regions including Central Queensland (CQ), South East Queensland (SEQ), Northern Rivers of New South Wales (NRNSW) and the Mid North Coast of New South Wales (MNNSW).

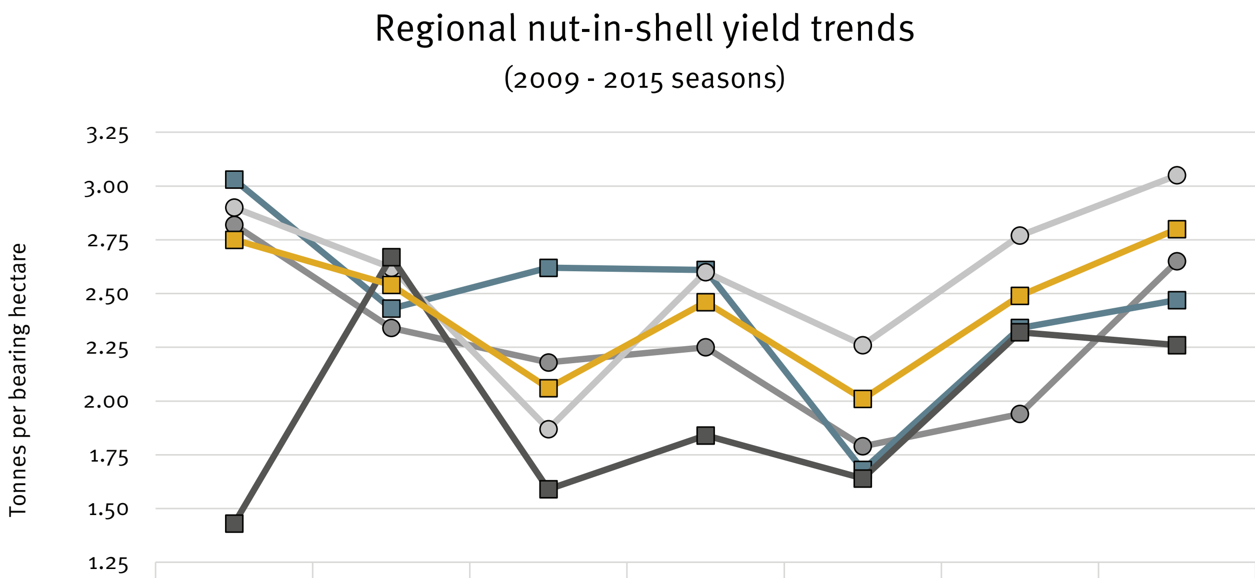
Figure 28 compares average yield of nut in shell (NIS) per bearing hectare from 2009 to 2015 for each of the four regions in the benchmark sample. Average NIS yield increased from 2014 to 2015 in CQ, SEQ and NRNSW following increases in these regions from 2013 to 2014. Average NIS yield decreased slightly in the MNNSW region in 2015 following a major increase from 2013 to 2014. Average NIS yield across all regions was higher in 2015 (2.8 t/ha) than any other year since benchmarking began in 2009.

CQ farms had the greatest average increase in NIS per hectare from 2014 to 2015 (1.94 to 2.65 t/ha). In 2015 average NIS yield for this region was at its highest since 2009.

Average NIS yield per hectare in SEQ was higher in 2015 than in 2010, 2013 and 2014 but lower than in 2009, 2011 and 2012. There was high variability in yield amongst SEQ farms in 2015 with some farms achieving highly productive results.

NRNSW farms achieved the highest average yield of NIS per hectare of all the regions in 2013 (2.26 t/ha), 2014 (2.77 t/ha) and 2015 (3.05 t/ha). NRNSW farms also had their highest average yield per hectare in 2015 since the benchmarking began.

MNNSW farms achieved higher average NIS yields per hectare in 2015 than in 2009, 2011, 2012 and 2013 but lower than in 2010 and 2014. MNNSW farms achieved their highest average NIS yield in 2010 (2.67 t/ha).



	2009	2010	2011	2012	2013	2014	2015
CQ	2.82	2.34	2.18	2.25	1.79	1.94	2.65
SEQ	3.03	2.43	2.62	2.61	1.68	2.34	2.47
NRNSW	2.90	2.62	1.87	2.60	2.26	2.77	3.05
MNNSW	1.43	2.67	1.59	1.84	1.64	2.32	2.26
All regions	2.75	2.54	2.06	2.46	2.01	2.49	2.80

Figure 28: Comparison of average regional yields of tonnes of nut-in-shell (NIS) per bearing hectare (2009 to 2015)

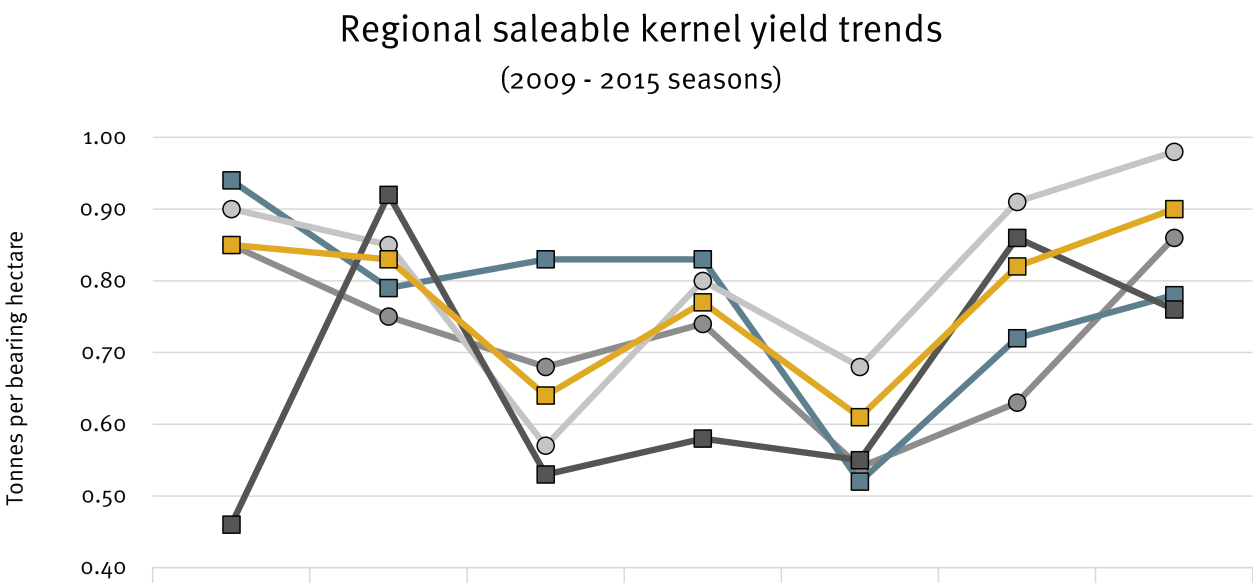
Figure 29 compares average yields of saleable kernel per bearing hectare from 2009 to 2015 for each of the four regions in the benchmark sample. In 2015 average yield of saleable kernel increased in all regions except MNNSW. This follows increases in all regions from 2013 to 2014.

CQ farms had the greatest increase from 2014 to 2015 to record their highest saleable kernel yield per bearing hectare since benchmarking began in 2009.

Although average saleable kernel yield in SEQ increased in 2015 it remained lower than in 2009 to 2012.

NRNSW farms achieved the highest average yield of saleable kernel per hectare of all the regions in 2013 (0.68 t/ha), 2014 (0.91 t/ha) and 2015 (0.98 t/ha). NRNSW farms also had their highest average saleable kernel yield in 2015 since the benchmarking began.

MNNSW farms achieved higher average yields of saleable kernel per hectare in 2015 than in 2009, 2011, 2012 and 2013 but lower than in 2010 and 2014. MNNSW farms achieved their highest average saleable kernel yield in 2010 (0.92 t/ha).



	2009	2010	2011	2012	2013	2014	2015
CQ	0.85	0.75	0.68	0.74	0.54	0.63	0.86
SEQ	0.94	0.79	0.83	0.83	0.52	0.72	0.78
NRNSW	0.90	0.85	0.57	0.80	0.68	0.91	0.98
MNNSW	0.46	0.92	0.53	0.58	0.55	0.86	0.76
All regions	0.85	0.83	0.64	0.77	0.61	0.82	0.90

Figure 29: Comparison of average regional yields of tonnes of saleable kernel per bearing hectare (2009 to 2015)

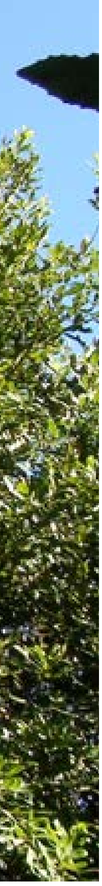


Figure 30 compares average saleable kernel recovery (SKR) from 2009 to 2015 for each of the four regions in the benchmark sample. SKR is the sum of premium kernel recovery (PKR) and commercial kernel recovery (CKR).

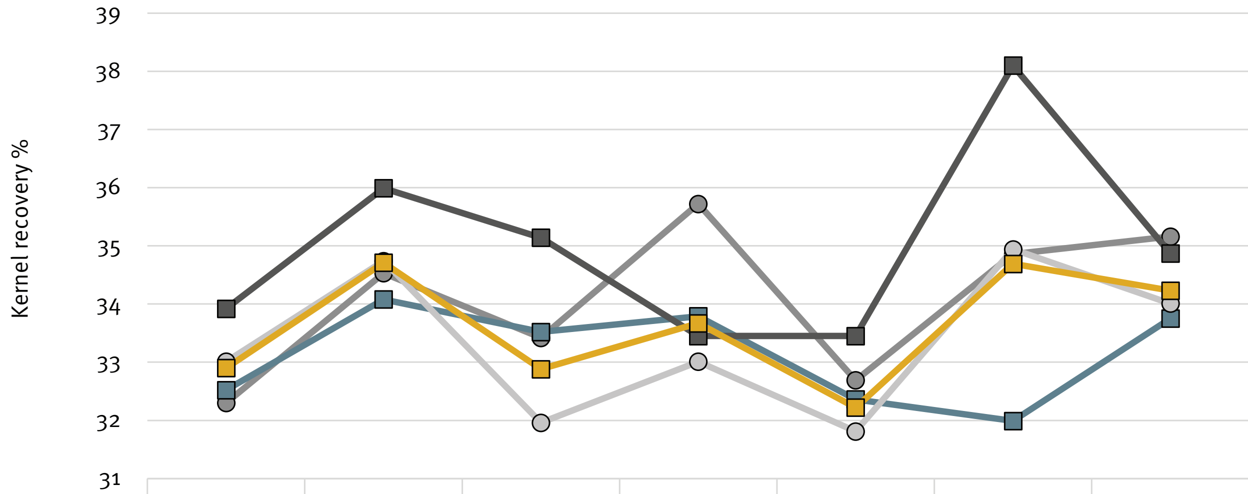
Average SKR in 2015 increased in CQ and SEQ but decreased in NRNSW and MNNSW.

SKR amongst MNNSW farms decreased substantially from 2014 to 2015 after a major increase from 2013 to 2014. SKR amongst MNNSW farms was also more than the average for all the farms in the benchmark sample in each year except 2012.

Analysis of tree age data shows that farms with a younger average tree age tend to have higher average SKR than farms with older trees. Planting data shows that trees in CQ and MNNSW are on average younger than those in SEQ and NRNSW. The high average SKR in the MNNSW region is also influenced by the high percentage of “A” series cultivars grown in this region, which tend to have high kernel recoveries.

Regional saleable kernel recovery trends

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
CQ	32.30	34.53	33.42	35.72	32.69	34.86	35.16
SEQ	32.52	34.08	33.52	33.79	32.36	31.99	33.75
NRNSW	33.01	34.74	31.96	33.01	31.81	34.94	34.01
MNNSW	33.92	35.99	35.14	33.45	33.45	38.10	34.87
All regions	32.90	34.71	32.88	33.67	32.22	34.69	34.23

Figure 30: Comparison of average regional saleable kernel recoveries (2009 to 2015)

Figure 31 compares average reject kernel recovery (RKR) from 2009 to 2015 for each region. Average RKR across all regions was lower in 2015 (2.43%) than in each of the previous years except 2012 (2.28%).

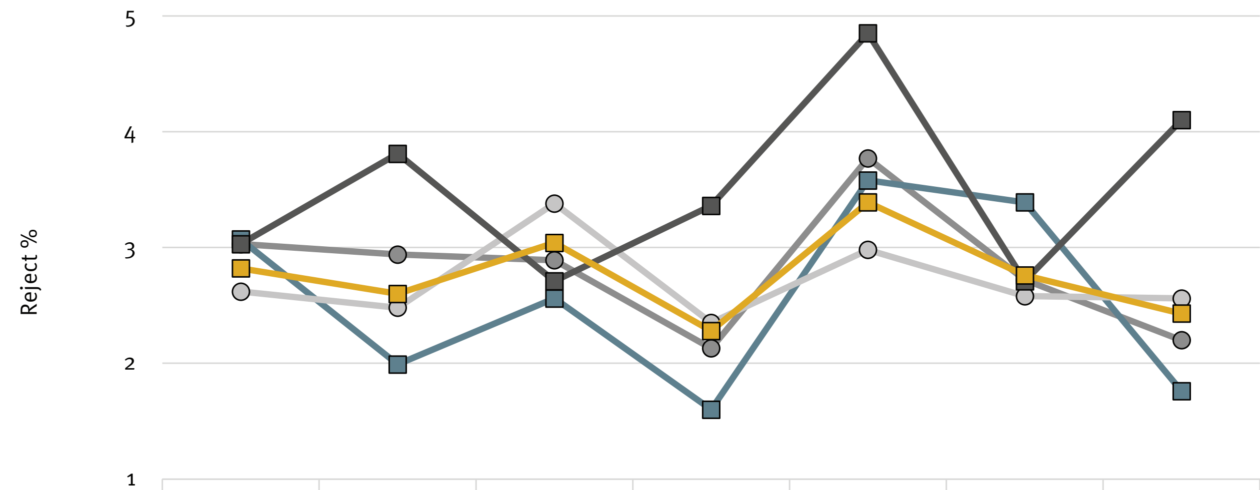
Average RKR in 2015 decreased in CQ, SEQ and NRNSW. Average RKR increased in MNNSW in 2015, largely due to insect damage.

In 2015 RKR amongst CQ and SEQ farms was less than in each of the other years except 2012. The major decrease in RKR in the SEQ region in 2015 was largely due to lower levels of reject due to immaturity.

RKR amongst NRNSW farms in 2015 was less than in each year except than in 2010 and 2012.

Regional reject kernel recovery trends

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
CQ	3.03	2.94	2.89	2.13	3.77	2.72	2.20
SEQ	3.07	1.99	2.56	1.60	3.58	3.39	1.76
NRNSW	2.62	2.48	3.38	2.35	2.98	2.58	2.56
MNNSW	3.03	3.81	2.71	3.36	4.85	2.71	4.10
All regions	2.82	2.60	3.04	2.28	3.39	2.76	2.43

Figure 31: Comparison of average regional reject kernel recoveries (2009 to 2015)

Figure 32 shows average rejects due to insect damage from 2009 to 2015 for each of the four regions in the benchmark sample. Average insect damage increased from 2014 to 2015 across all regions and also within each individual region, following a decrease from 2013 to 2014. Insect rejects were higher in 2015 than all other reject analysis categories in each region.

Insect rejects peaked in 2015 in CQ but were still lower than the average of all farms in the benchmark sample. This was also the case from 2009 to 2014.

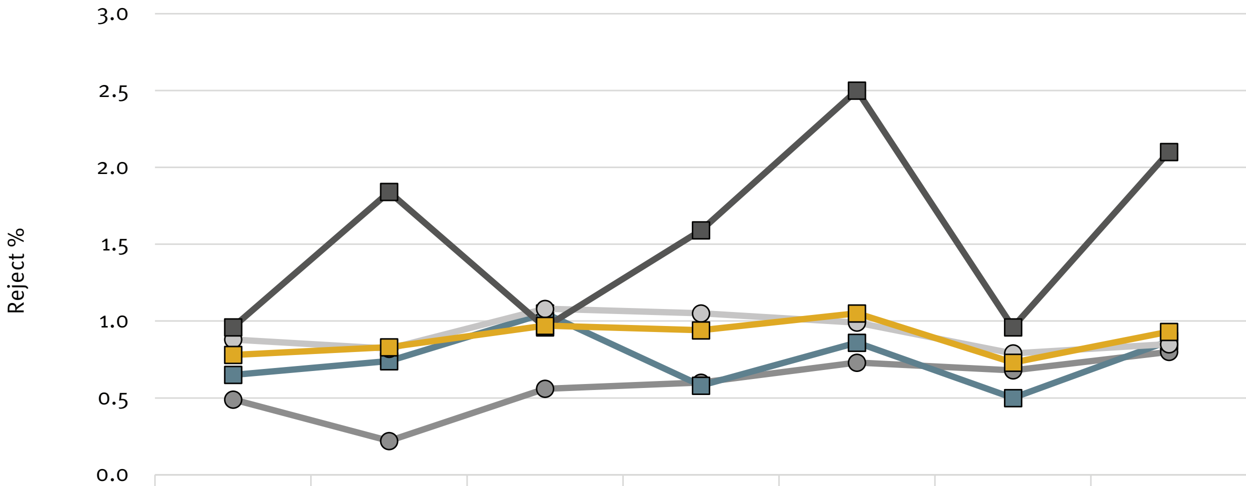
Insect rejects in SEQ were higher in 2015 than in each other year except 2011. Insect damage in SEQ was also lower than the average of all regions in each year except 2011.

Insect rejects in the NRNSW increased in 2015 but still remained lower than in previous years such as 2009 and 2011 to 2013.

Insect rejects for MNNSW farms were higher in 2015 than in all previous years except 2013. Insect damage in MNNSW was generally higher than the benchmark sample average in each year except 2011.

Regional insect damage trends

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
CQ	0.49	0.22	0.56	0.60	0.73	0.68	0.80
SEQ	0.65	0.74	1.05	0.58	0.86	0.50	0.87
NRNSW	0.88	0.82	1.08	1.05	0.99	0.79	0.85
MNNSW	0.96	1.84	0.96	1.59	2.50	0.96	2.10
All regions	0.78	0.83	0.97	0.94	1.05	0.73	0.93

Figure 32: Comparison of average regional insect damage reject levels (2009 to 2015)

Figure 33 shows average rejects due to mould from 2009 to 2015 for each of the four regions in the benchmark sample. Average mould rejects across all regions decreased from 2014 to 2015 after reaching their peak in 2014. Average mould levels across all regions reached their lowest point in 2012.

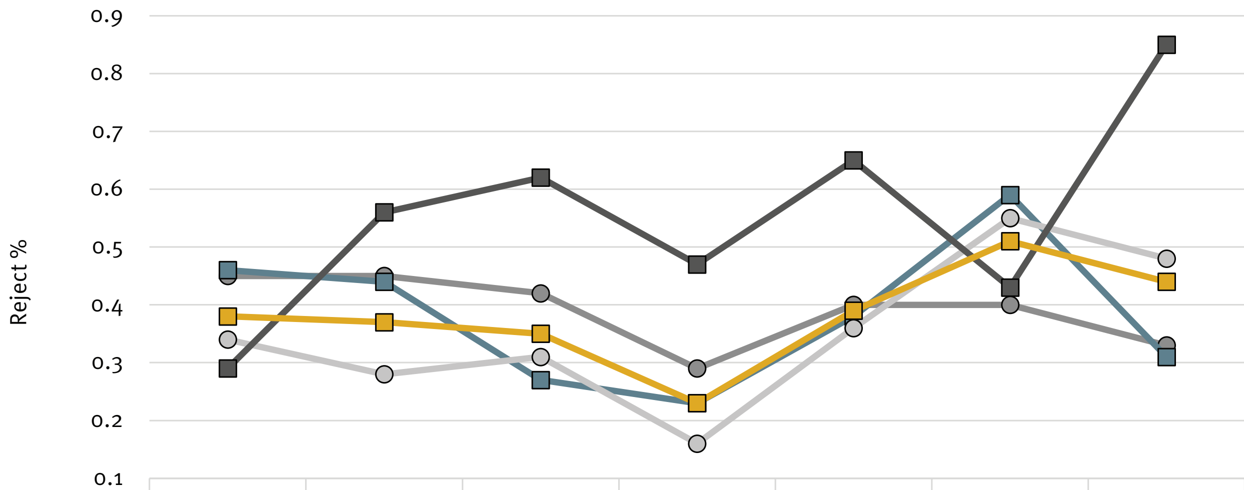
From 2014 to 2015 mould rejects decreased in CQ, SEQ and NRNSW and increased on MNNSW farms.

In 2015 mould rejects in CQ reached their second lowest level since 2009. Mould rejects amongst SEQ farms were also low compared with 2009-10 and 2013-14. Mould reject levels in NRNSW were higher in 2015 than most other years since 2009, with the exception of 2014.

Unlike other regions, average mould rejects in MNNSW increased in 2015 to reach their highest point since benchmarking began in 2009. This follows a decline in mould rejects in this region from 2013 to 2014. Mould rejects in MNNSW were substantially higher than the average across all regions in each year except 2009 and 2014.

Regional mould trends

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
CQ	0.45	0.45	0.42	0.29	0.40	0.40	0.33
SEQ	0.46	0.44	0.27	0.23	0.38	0.59	0.31
NRNSW	0.34	0.28	0.31	0.16	0.36	0.55	0.48
MNNSW	0.29	0.56	0.62	0.47	0.65	0.43	0.85
All regions	0.38	0.37	0.35	0.23	0.39	0.51	0.44

Figure 33: Comparison of average regional mould reject levels (2009 to 2015)

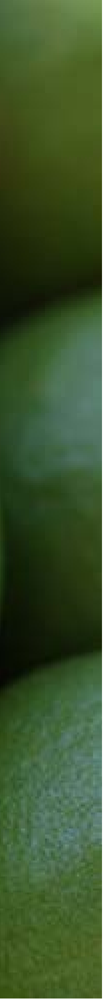


Figure 34 shows average rejects due to discolouration from 2009 to 2015 for each of the four regions in the benchmark sample. Average discolouration across all regions was lower in 2015 than any other year since 2009.

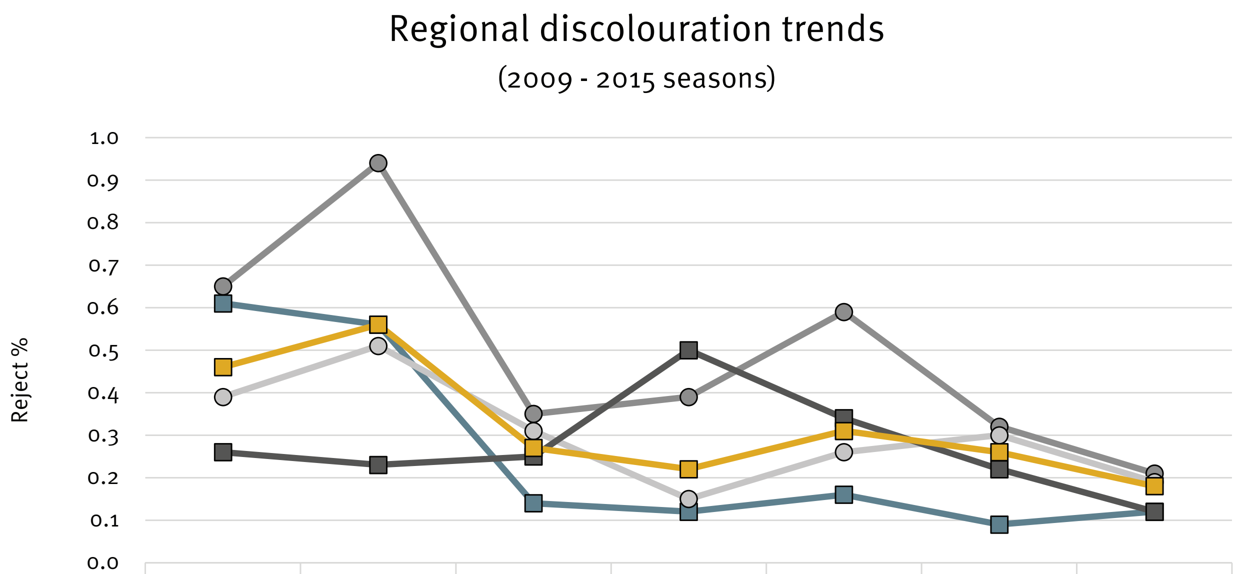
In 2015 average discolouration decreased in CQ, NRNSW and MNNSW and increased slightly in SEQ compared with the previous season.

In the CQ region average discolouration in 2015 was lower than in all other seasons since 2009. Despite this result average annual discolouration in the CQ region remained slightly higher than the average across all regions.

Discolouration rejects in SEQ increased slightly from 2014 to 2015 but remained lower than average discolouration levels across all regions.

Discolouration rejects in NRNSW were lower in 2015 than the previous season but remained slightly higher than the average for all regions. In the NRNSW region the lowest average discolouration was recorded in 2012.

Average discolouration rejects in MNNSW have steadily declined since their peak in 2012. Discolouration levels MNNSW were lower in 2015 than in any other season since benchmarking began in 2009. MNNSW and SEQ recorded the equal lowest average discolouration of all regions in 2015.



	2009	2010	2011	2012	2013	2014	2015
CQ	0.65	0.94	0.35	0.39	0.59	0.32	0.21
SEQ	0.61	0.56	0.14	0.12	0.16	0.09	0.12
NRNSW	0.39	0.51	0.31	0.15	0.26	0.30	0.19
MNNSW	0.26	0.23	0.25	0.50	0.34	0.22	0.12
All regions	0.46	0.56	0.27	0.22	0.31	0.26	0.18

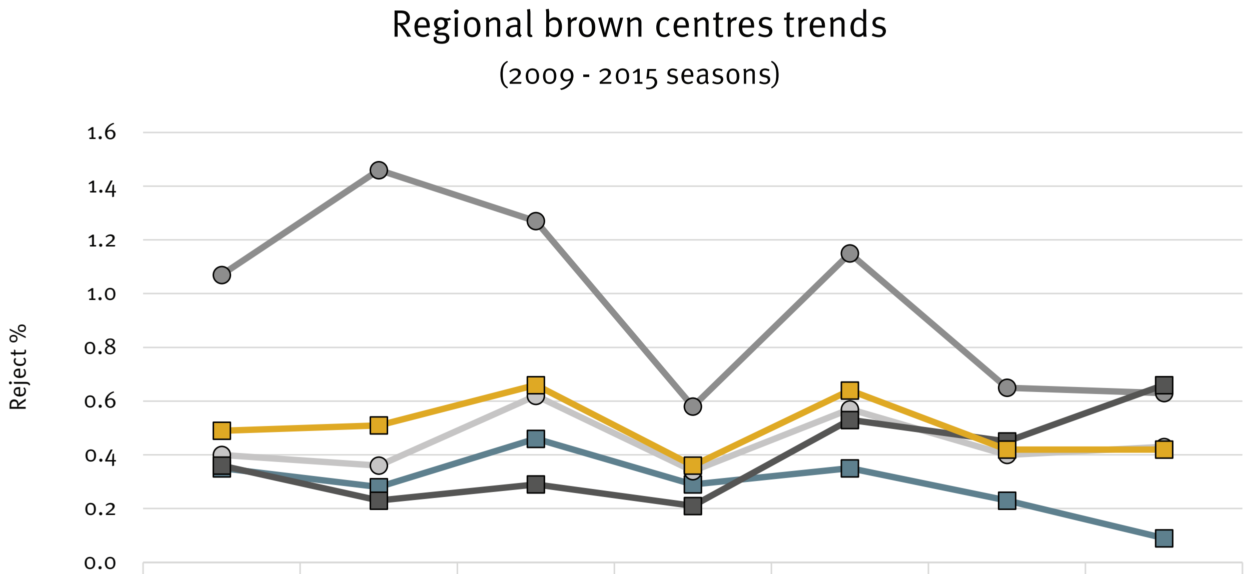
Figure 34: Comparison of average regional discolouration reject levels (2009 to 2015)

Figure 35 shows average rejects due to brown centres from 2009 to 2015 for each of the four regions in the benchmark sample. In 2015 average rejects due to brown centres remained similar to those in 2014. Increases in brown centres in NRNSW and MNNSW were balanced by reductions in CQ and SEQ.

Brown centres reject levels amongst CQ farms were higher than the average across all regions each year from 2009 to 2015. Benchmark data has shown that CQ farms are on average much larger than farms in the other regions. Grower surveys from the Macadamia Kernel Quality project (MC07008) found that on average brown centres increased with increasing farm size, maximum silo size and nut storage bed depth.

Brown centres reject levels amongst SEQ farms decreased in 2014 and again in 2015 to reach their lowest recorded level since benchmarking began in 2009. In SEQ rejects due to brown centres have been lower each year than the average for all regions.

Brown centres reject levels in MNNSW increased in 2015 to reach their highest level since benchmarking began in 2009.



	2009	2010	2011	2012	2013	2014	2015
CQ	1.07	1.46	1.27	0.58	1.15	0.65	0.63
SEQ	0.35	0.28	0.46	0.29	0.35	0.23	0.09
NRNSW	0.40	0.36	0.62	0.34	0.57	0.40	0.43
MNNSW	0.36	0.23	0.29	0.21	0.53	0.45	0.66
All regions	0.49	0.51	0.66	0.36	0.64	0.42	0.42

Figure 35: Comparison of average regional brown centres reject levels (2009 to 2015)

Farms in the benchmark sample from the Central Queensland region are on average younger and larger than farms from NSW and SEQ.

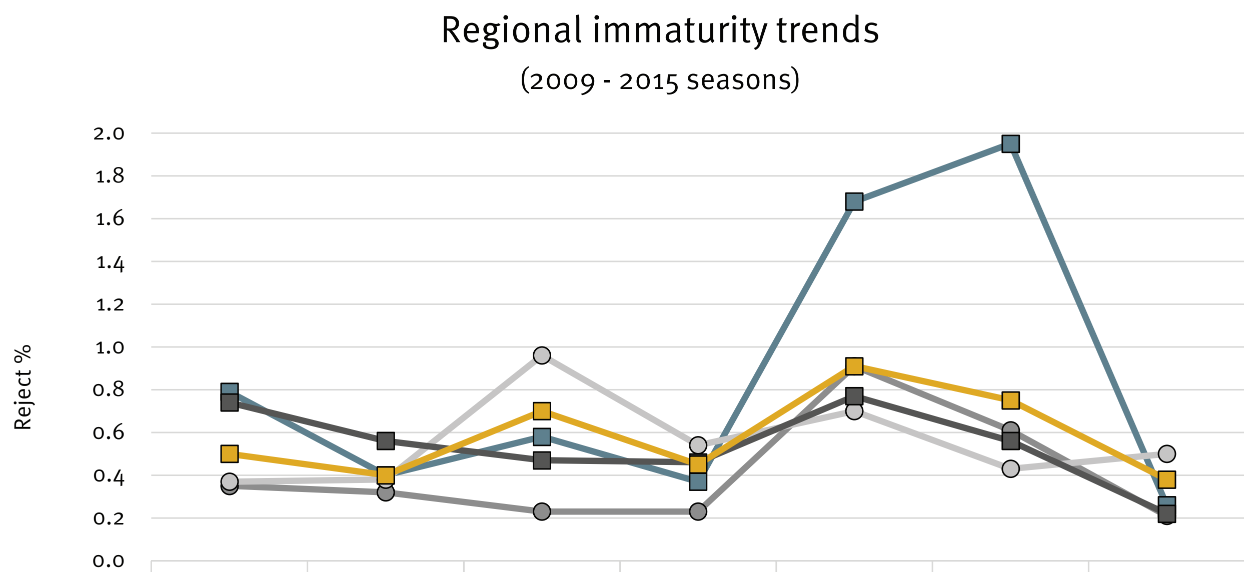
Figure 36 shows average rejects due to immaturity from 2009 to 2015 for each of the four regions in the benchmark sample. In 2015 average rejects due to immaturity across the benchmark sample reached their lowest levels since 2009. This was the result of lower immaturity levels in all regions except NRNSW.

Immaturity reject levels in CQ have typically been lower than the average for the benchmark sample from 2009 to 2015.

Immaturity in SEQ decreased substantially in 2015 following high levels in both 2013 and 2014. These high levels have 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.

Prior to 2013 much of the immaturity in SEQ and NSW was attributed to premature nut drop caused by husk spot. Husk spot was not as prevalent during 2012 to 2014 and was not considered a major cause of immaturity in the 2013 and 2014 crops.

Immaturity reject levels in MNNSW peaked in 2013 before declining in 2014. Levels declined further in 2015 to their lowest point since benchmarking began in 2009.



	2009	2010	2011	2012	2013	2014	2015
CQ	0.35	0.32	0.23	0.23	0.91	0.61	0.21
SEQ	0.79	0.40	0.58	0.37	1.68	1.95	0.26
NRNSW	0.37	0.38	0.96	0.54	0.70	0.43	0.50
MNNSW	0.74	0.56	0.47	0.46	0.77	0.56	0.22
All regions	0.50	0.40	0.70	0.45	0.91	0.75	0.38

Figure 36: Comparison of average regional immaturity reject levels (2009 to 2015)

Figure 37 shows average rejects due to germination from 2009 to 2015 for each of the four regions in the benchmark sample. Average germination reject levels have remained fairly stable since 2012. Germination is the least significant average cause of reject across the benchmark sample from 2009 to 2015.

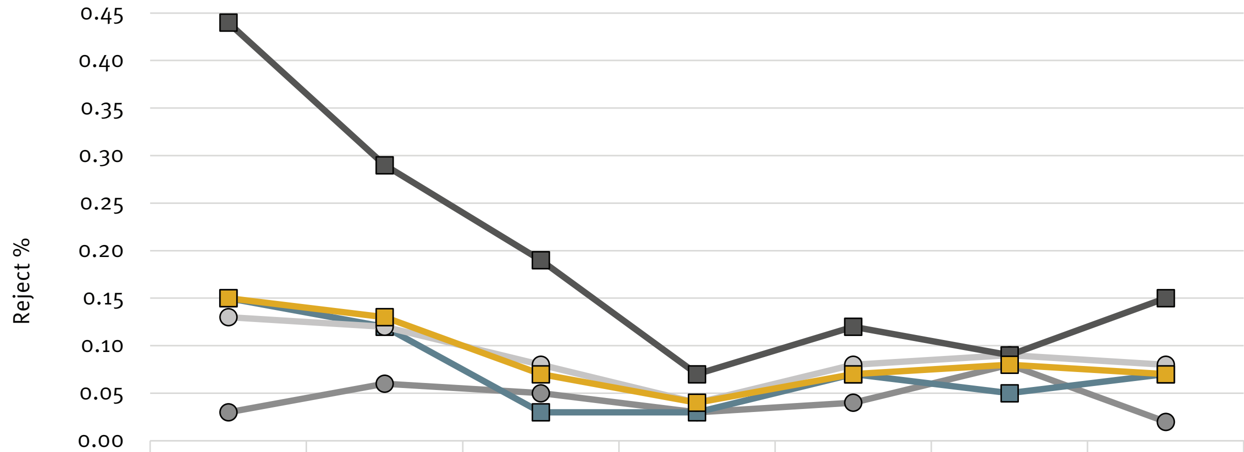
In 2015 average germination rejects decreased slightly amongst CQ and NRNSW farms and increased slightly amongst SEQ and MNNSW farms.

Germination rejects amongst CQ farms were less than or equal to the average for all regions from 2009 to 2015.

Germination rejects in MNNSW decreased sharply from 2009 to reach their lowest level in 2012.

Regional germination trends

(2009 - 2015 seasons)



	2009	2010	2011	2012	2013	2014	2015
CQ	0.03	0.06	0.05	0.03	0.04	0.08	0.02
SEQ	0.15	0.12	0.03	0.03	0.07	0.05	0.07
NRNSW	0.13	0.12	0.08	0.04	0.08	0.09	0.08
MNNSW	0.44	0.29	0.19	0.07	0.12	0.09	0.15
All regions	0.15	0.13	0.07	0.04	0.07	0.08	0.07

Figure 37: Comparison of average regional germination reject levels (2009 to 2015)

Yield and quality by tree age

Yield and quality results were analysed according to tree age to identify age-related trends in orchard performance. It is important to note that all age related analyses are based on weighted average tree age as very few farms record harvest results by individual block or tree age group. A weighted average tree age is calculated from planting data recorded for each farm. Tree age categories are used to identify and compare data from farms of similar ages within this section.

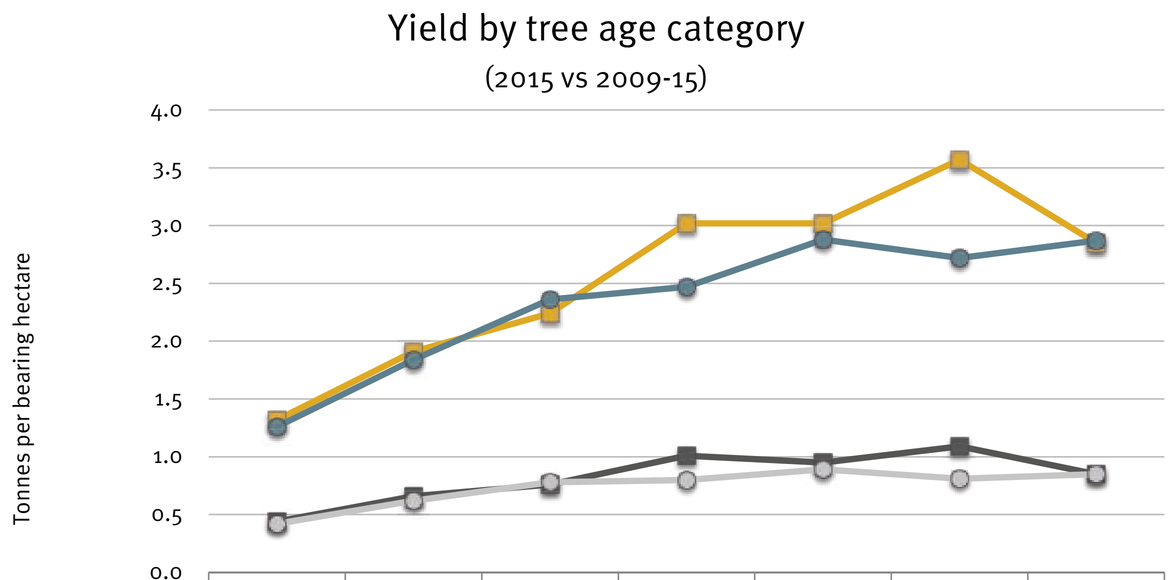
Planting densities varied between farms in these categories and this may impact on yields per hectare, particularly during the early bearing years before trees grow together within rows. Some farms also had plantings of different tree ages and this will impact on the weighted average tree age.

Figure 38 shows average yields of nut in shell (NIS) and saleable kernel per bearing hectare for 2015 and for all years from 2009 to 2015 for farms from various tree age categories.

For farms with an average tree age of 15 to 29 years both NIS and saleable kernel were higher in 2015 than the average for 2009 to 2015. In 2015 peak yield was achieved among trees aged 25 to 29 years. By comparison, yields of both NIS and saleable kernel over the seven seasons from 2009 to 2015 were highest among trees aged between 20 and 24 years.

The major differences between 2015 and the average of all seasons were evident in the 15 to 19 and 25 to 29 year old categories. By comparison, average NIS and saleable kernel for tree age categories younger than 15 years and older than 30 years were similar in 2015 to the average for all years from 2009 to 2015.

Farms older than 30 years had similar long term NIS yield per hectare to those aged 20 and 24 years but a slightly lower yield of saleable kernel per hectare. This difference was due to farms aged 20 to 24 having a higher average saleable kernel recovery (SKR) than the older farms.



	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25-29 years	30+ years
Nut-in-shell 2015	1.32	1.91	2.24	3.02	3.02	3.57	2.85
Nut-in-shell 2009-15	1.26	1.84	2.36	2.47	2.88	2.72	2.87
Saleable kernel 2015	0.44	0.66	0.76	1.01	0.95	1.09	0.85
Saleable kernel 2009-15	0.42	0.62	0.78	0.80	0.89	0.81	0.85

Figure 38: Comparison of yield per bearing hectare for farms by tree age category for 2015 and for all years from 2009 to 2015

The rate of yield increase was greatest in the early bearing stages. In 2015 this rate of increase, particularly for average yield of saleable kernel per bearing hectare, slowed when farms reached an average tree age of between 15 and 19 years. Over the seven seasons this yield rate slowed at between 10 and 14 years of age.

This levelling of the rate of increase was not as pronounced with the average yield of NIS per bearing hectare. Benchmark data has shown a peak SKR for farms with an average tree age of 8 to 9 years and a decrease in average SKR with increasing tree age. The higher average SKR amongst the younger farms has helped compensate for the lower average NIS yield in reducing the difference in the average saleable kernel yield per hectare between the younger and older farms.

In 2015 average NIS and saleable kernel yields per hectare were highest for farms with an average tree age of between 25 and 29 years of age. Over the seven seasons from 2009 to 2015 farms between 20 and 24 years of age had the highest average yield per hectare.

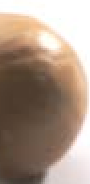
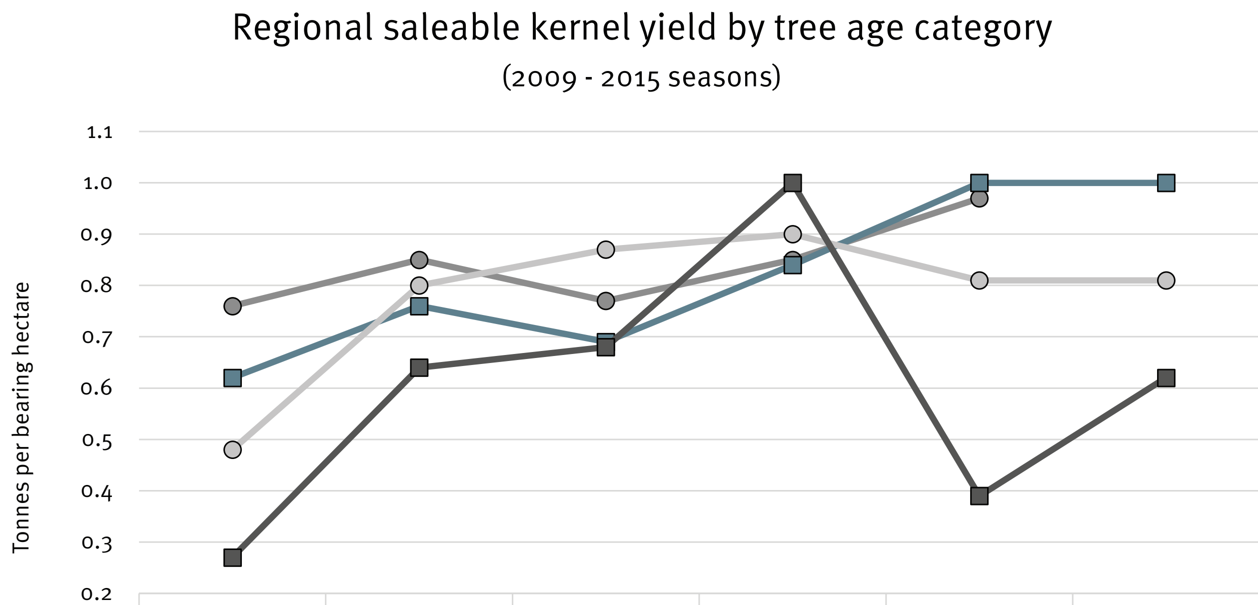


Figure 39 shows the average yield of saleable kernel per bearing hectare for farms in the different tree age categories for the four regions in the benchmark sample for all years from 2009 to 2015,

Farms with an average tree age older than 25 years in Central Queensland (CQ) and South East Queensland (SEQ) had a higher average yield of saleable kernel per hectare than farms with an average tree age younger than 25 years. By comparison, farms with an average tree age older than 25 years in the Northern Rivers of New South Wales (NRNSW) and the Mid North Coast of New South Wales (MNNSW) had a lower average yield per hectare than farms with an average tree age of between 15 and 24 years.

There were no CQ farms in the benchmark sample with an average tree age older than 25 years. The CQ farms with an average tree age younger than 14 years had a higher average yield of saleable kernel per hectare than the farms of the same age in the other three regions. Many of the younger CQ farms are managed through higher crop inputs to achieve bigger yields earlier in the life of the orchard.

In the MNNSW region yield of saleable kernel per hectare peaked at age 20 to 24 years.



	8 to 9	10 to 14	15 to 19	20 to 24	25-29	30+
CQ	0.76	0.85	0.77	0.85	0.97	
SEQ	0.62	0.76	0.69	0.84	1.00	1.00
NRNSW	0.48	0.80	0.87	0.90	0.81	0.81
MNNSW	0.27	0.64	0.68	1.00	0.39	0.62

Figure 39: Saleable kernel production by tree age category and region for all years from 2009 to 2015

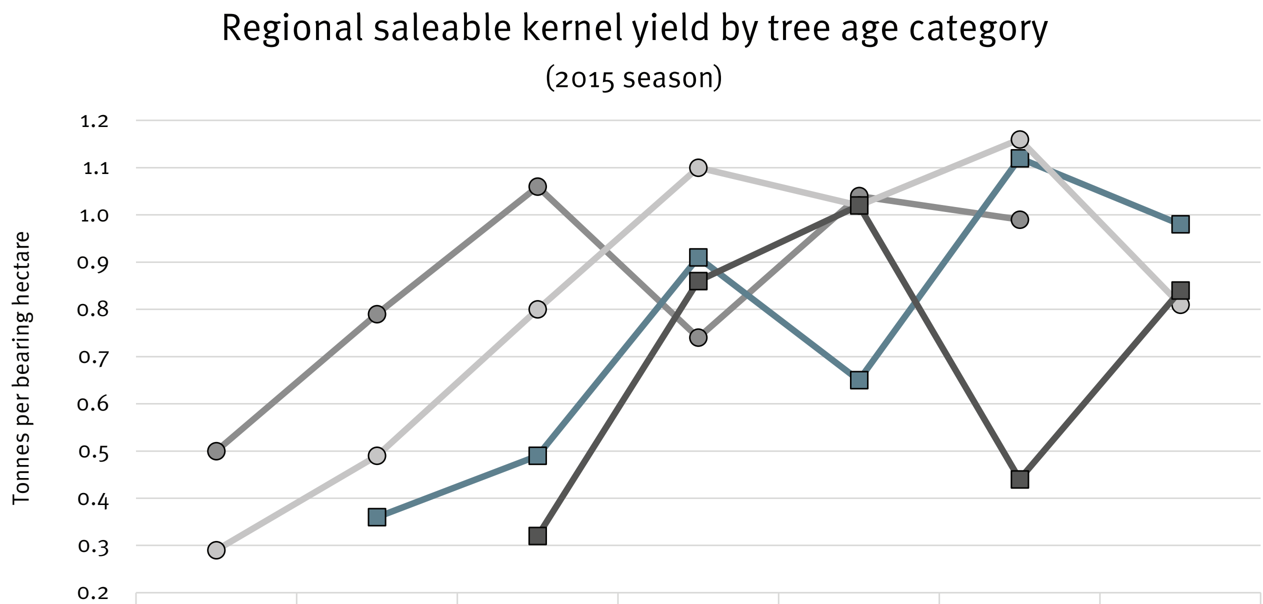
Figure 40 shows average yield of saleable kernel per bearing hectare for farms in the different tree age categories for the four production regions in the benchmark sample for 2015.

In 2015 there were no CQ farms in the benchmark sample with an average tree age older than 30 years. Similarly there were no SEQ farms with an average tree age younger than 7 years and no MNNSW farms with an average tree age younger than 9 years.

In 2015 peak average saleable kernel yield in CQ was achieved by farms with an average tree age of 10 to 14 years and 20 to 24 years. In SEQ peak saleable kernel was recorded for trees aged 25 to 29. In NRNSW peak saleable kernel was between age 15 and 29 years and in MNNSW it was between age 20 and 24 years.

CQ farms with an average tree age younger than 14 years had a higher average yield of saleable kernel per hectare than farms of the same age in the other three regions. There were some very productive younger CQ farms in 2015. These farms have been managed to achieve high yields of saleable kernel per hectare in their early bearing years.

Average premium, saleable and total kernel recovery decreased with increasing tree age for farms with an average tree age older than 9 years. Varietal selection is one of the major factors influencing kernel recovery. Many macadamia varieties planted on younger farms have a higher potential kernel recovery than those planted on older farms.



	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25-29 years	30+ years
CQ	0.50	0.79	1.06	0.74	1.04	0.99	
SEQ		0.36	0.49	0.91	0.65	1.12	0.98
NRNSW	0.29	0.49	0.80	1.10	1.02	1.16	0.81
MNNSW			0.32	0.86	1.02	0.44	0.84

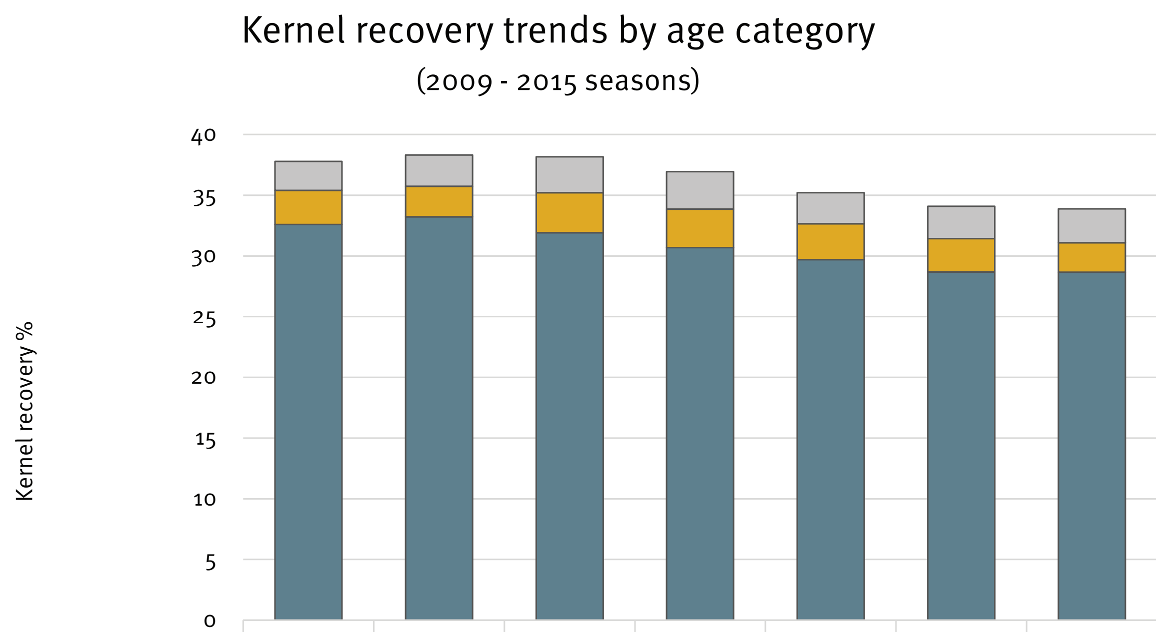
Figure 40: Saleable kernel production by tree age category and region for 2015

Figure 41 shows a breakdown of average kernel recovery for farms in different average tree age categories in the benchmark sample for all years from 2009 to 2015. This breakdown includes premium (PKR), commercial (CKR) and reject (RKR) kernel recovery. Saleable kernel recovery (SKR) is equivalent to the sum of PKR and CKR. Total kernel recovery (TKR) is equivalent to the sum of PKR, CKR and RKR.

Farms in the younger age categories achieved higher average TKR, SKR and PKR than farms in the older age categories. For farms with an average age of more than 9 years average TKR, SKR and PKR decreased with increasing tree age. Farms with an average tree age between 10 and 19 years had the highest average CKR. The major component of CKR amongst farms in the benchmark sample is light discolouration.

Varietal selection is one of the major factors influencing kernel recovery. Many macadamia varieties planted on younger farms have higher potential kernel recoveries than many of the varieties planted on older farms. Farms with an average tree age younger than 15 years achieved average PKR of 32.36% and SKR of 35.36%. By comparison, farms older than 15 years achieved average PKR of 29.66% and SKR of 32.57%.

Farms with an average tree age between 15 and 19 years averaged the highest RKR (3.07%) whereas younger and older farms averaged lower RKR (average 2.67%).



	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25 to 29 years	30+ years
Reject kernel recovery (RKR)	2.39	2.58	2.96	3.07	2.54	2.66	2.79
Commercial kernel recovery (CKR)	2.80	2.51	3.29	3.17	2.96	2.74	2.43
Premium kernel recovery (PKR)	32.59	33.22	31.92	30.69	29.70	28.68	28.66

Figure 41: Kernel recovery breakdown by tree age category for all years from 2009 to 2015

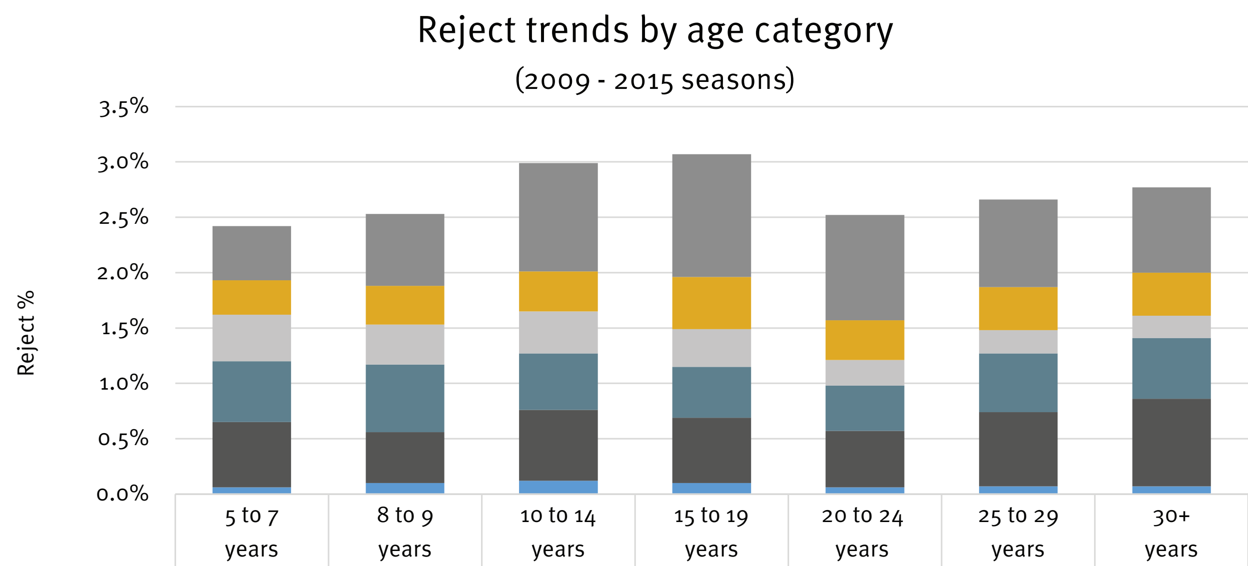
Figure 42 shows a breakdown of reject kernel recovery (RKR) into major reject categories for farms in different tree age categories within the benchmark sample for all years from 2009 to 2015. Insect damage was the major reject category for farms with an average tree age between 8 and 29 years. Farms with an average tree age of 25 years and older had higher average immaturity levels than younger farms. Farms with average tree ages younger than 10 years or older than 24 years had higher levels of brown centres than those aged 10 to 24 years.

Farms with an average tree age between 10 and 14 and between 15 and 19 had higher average RKR than both younger and older farms.

Farms with an average tree age between 15 and 19 years had higher levels of rejects due to insect damage (1.11%) than both younger and older farms.

Immaturity and insect damage were responsible for most losses amongst farms with an average tree age of more than 30 years.

Immaturity and brown centres were the major reject categories amongst farms with an average tree age less than 8 years. Average rejects due to discolouration were also higher amongst farms younger than 8 years. Most farms in the benchmark sample with an average tree age less than 8 years are also larger farms and mostly located in the Central Queensland region.



	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25 to 29 years	30+ years
Insect	0.49	0.65	0.98	1.11	0.95	0.79	0.77
Mould	0.31	0.35	0.36	0.47	0.36	0.39	0.39
Discolouration	0.42	0.36	0.38	0.34	0.23	0.21	0.20
Brown centres	0.55	0.61	0.51	0.46	0.41	0.53	0.55
Immaturity	0.59	0.46	0.64	0.59	0.51	0.67	0.79
Germination	0.06	0.10	0.12	0.10	0.06	0.07	0.07

Figure 42: Reject category breakdown by tree age category for all years from 2009 to 2015

Yield and quality by farm size

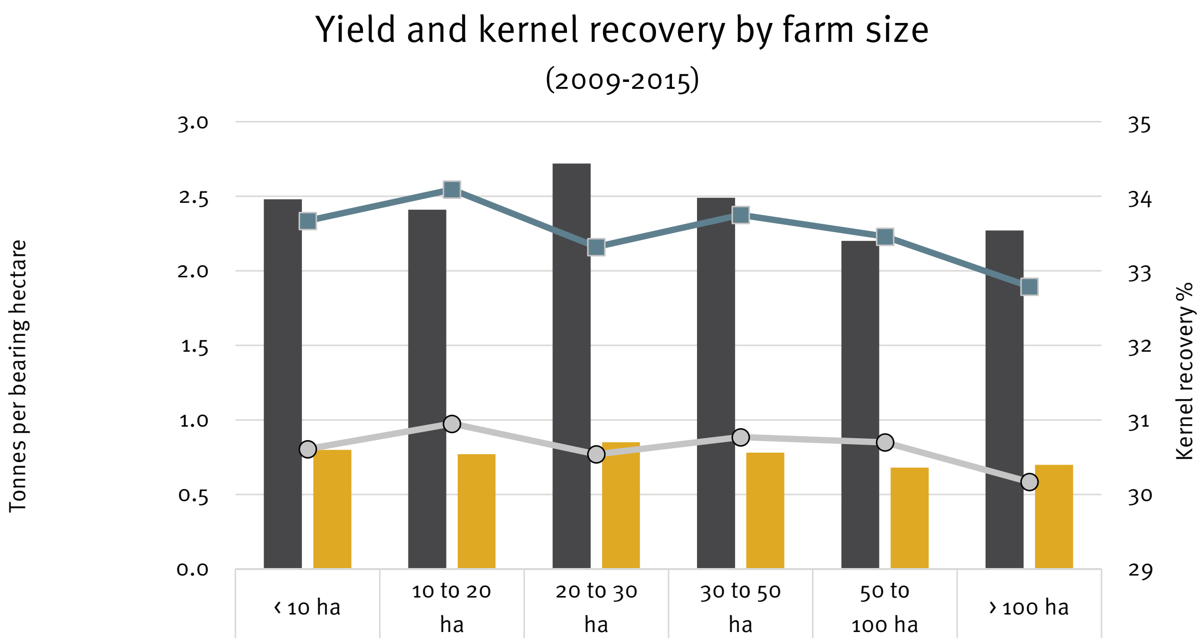
Figure 43 shows average yield of nut-in-shell (NIS), saleable kernel per bearing hectare, saleable kernel recovery (SKR) and premium kernel recovery (PKR) for different farm size categories in the benchmark sample for all years from 2009 to 2015.

Farms smaller than 50 hectares had higher average yield of NIS and saleable kernel per bearing hectare than farms larger than 50 hectares.

Farms between 10 and 20 hectares had the highest average SKR (34.09%) and PKR (30.95%) of all the farm size categories.

Farms larger than 100 hectares had the lowest average SKR (32.79%) and PKR (30.17%) of all the farm size categories.

There was no significant difference in average SKR and PKR between the other farm size categories.



	< 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	> 100 ha
Nut-in-shell	2.48	2.41	2.72	2.49	2.20	2.27
Saleable kernel	0.80	0.77	0.85	0.78	0.68	0.70
Saleable kernel recovery	33.67	34.09	33.32	33.75	33.46	32.79
Premium kernel recovery	30.61	30.95	30.54	30.77	30.70	30.17

Figure 43: Comparison of yield per bearing hectare and saleable and premium kernel recovery by farm size for all years from 2009 to 2015

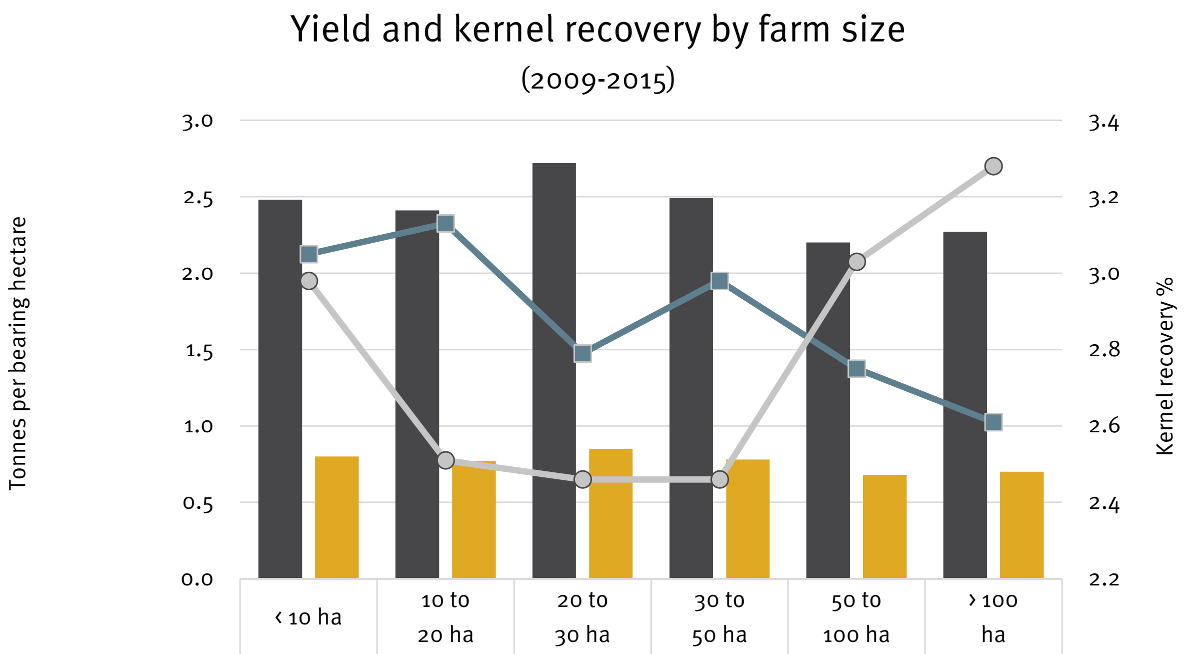
Figure 44 shows average yield (NIS and saleable kernel) per bearing hectare, commercial kernel recovery (CKR) and reject kernel recovery (RKR) for different farm size categories in the benchmark sample for all years from 2009 to 2015.

Farms smaller than 20 hectares had the highest average CKR (more than 3%) of all the farm size categories. Farms between 10 and 50 hectares had lower RKR than both smaller and larger farms.

Farms between 20 and 30 hectares had the highest average yield per bearing hectare of all the farm size categories of both NIS (2.72 tonnes) and saleable kernel (0.85 tonnes).

Farms larger than 100 hectares had the lowest average CKR (2.61%) of all the farm size categories.

Rejects due to brown centres increased with increasing farm size. By comparison, rejects due to insect damage were highest amongst smaller farms and decreased with increasing farm size.



	‹ 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	› 100 ha
Nut-in-shell	2.48	2.41	2.72	2.49	2.20	2.27
Saleable kernel	0.80	0.77	0.85	0.78	0.68	0.70
Commercial kernel recovery	3.05	3.13	2.79	2.98	2.75	2.61
Reject kernel recovery	2.98	2.51	2.46	2.46	3.03	3.28

Figure 44: Comparison of yield per bearing hectare and commercial and reject kernel recovery by farm size for all years from 2009 to 2015

Figure 45 shows both average yield per bearing hectare and reject breakdown for the different farm size categories in the benchmark sample for all years from 2009 to 2015.

Rejects due to brown centres increased with increasing average farm size. Farms less than 10 hectares had average brown centres rejects of 0.29% compared with 1.1% for farms greater than 100 hectares.

This result is consistent with the findings from the *Macadamia kernel quality* project (MC07008) which found that on average brown centres increased with increasing farm size, maximum silo size and nut storage bed depth.

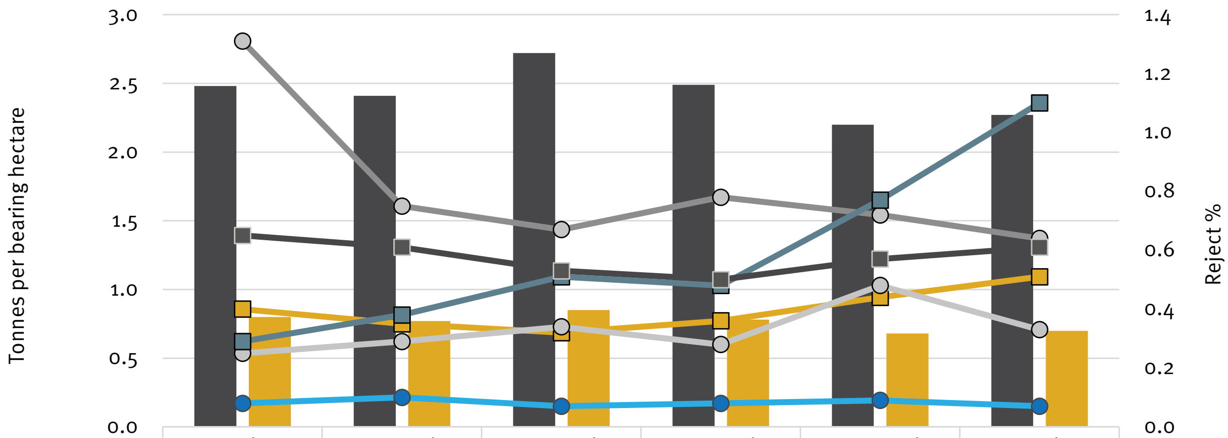
Rejects due to mould were also greater among larger farms. Kernel quality surveys also indicated a significant positive correlation between levels of brown centres and mould.

Rejects due to insect damage were highest among smaller farms. Farms less than 10 hectares had average insect damage rejects of 1.31% compared with 0.64% for farms larger than 100 hectares.

Immaturity, discolouration and germination rejects did not vary as much with farm size as insect damage, brown centres and mould.

Yield and rejects by farm size

(2009-2015)



	‹ 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	› 100 ha
Nut-in-shell	2.48	2.41	2.72	2.49	2.20	2.27
Saleable kernel	0.80	0.77	0.85	0.78	0.68	0.70
Insect	1.31	0.75	0.67	0.78	0.72	0.64
Mould	0.40	0.35	0.32	0.36	0.44	0.51
Discolouration	0.25	0.29	0.34	0.28	0.48	0.33
Brown centres	0.29	0.38	0.51	0.48	0.77	1.10
Immaturity	0.65	0.61	0.53	0.50	0.57	0.61
Germination	0.08	0.10	0.07	0.08	0.09	0.07

Figure 45: Comparison of yield per bearing hectare and consignment reject analysis by farm size for all years from 2009 to 2015

Costs of production

Costs of production were collected from a large industry sample as part of the On-farm economic analysis project (MC03023) from 2003 to 2006. These data included a breakdown of total costs according to standard heads of expenditure. More recently the scope of data collected as part of the industry benchmarking project has been expanded to include production costs across the same heads of expenditure, resulting in comparable data for the last three financial years (2012/13 to 2014/15). Comparison of the data collected during both of these studies provides insight into changes to overall costs and also individual heads of expenditure over the last decade.

The term "farm year" is used in this benchmarking study to describe a record for an individual farm for a given year. A total of 155 farm years of financial data were analysed from 2003 to 2006 and 127 farm years were analysed from 2012/13 to 2014/15. Only bearing farms were included in both studies. It is important to note that these analyses focus only on cash costs. Other costs such as unpaid labour, capital expenditure, depreciation and taxation are therefore excluded.

Figure 46 shows average costs per hectare for the standard heads of expenditure for both the 2003 to 2006 and the 2012/13 to 2014/15 analyses.

Average annual costs of production for bearing farms increased from $5510 per planted hectare in 2003-06 to $5840 in 2012/13 to 2014/15 (an increase of $330 per planted hectare). Employment represented the largest proportion of costs followed by repairs and maintenance (plant) and crop nutrition.

There were some significant differences in both total costs and the breakdown of costs by heads of expenditure between farms. This wide variation was observed in both studies. These variations were related to individual farm characteristics, farm management and the stage of development within the orchard.

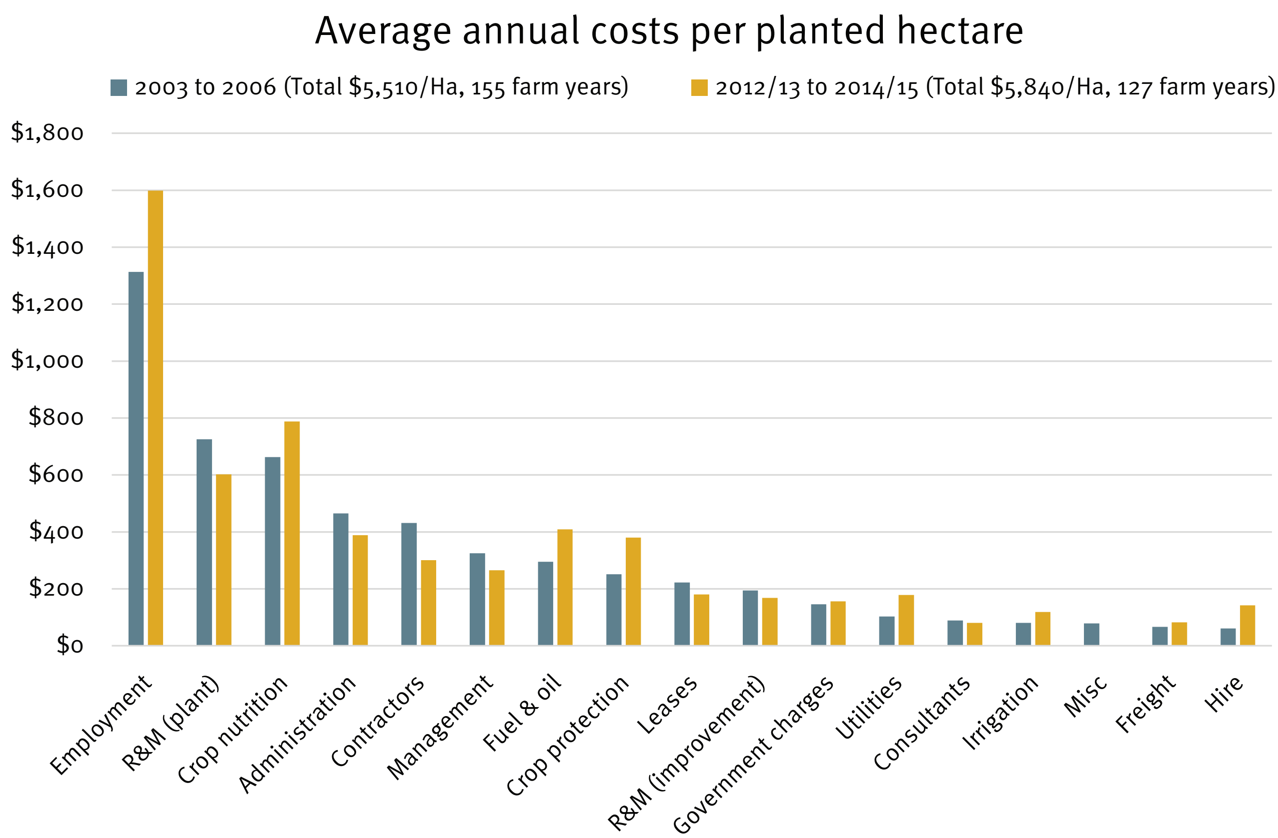


Figure 46: Production costs per hectare by head of expenditure for 2003 to 2006 vs 2012/13 to 2014/15

Figures 47 and 48 show the relative proportions of the costs per hectare by head of expenditure for the 2003-06 and 2012/13-14/15 studies respectively.

Average employment costs increased from $1313 to $1599 per hectare (up by $286/ha). This includes all costs associated with employment including permanent and casual wages, superannuation, training and expenses incurred as part of occupational health and safety and worker's compensation. It does not include unpaid labour costs.

Other costs that increased significantly from 2003-06 to 2012/13-2014/15 included crop nutrition (up by $125/ha), fuel and oil (up by $114/ha) and crop protection (up by $128/ha).

Some average costs per hectare were actually lower than those recorded a decade earlier. These included repairs and maintenance of plant and improvements, management, contractors, leases and consultants. It is not possible from the available data to identify whether these reductions are the result of efficiency gains, changes to farm management or other potential factors. Variation in the farms participating between these two studies and also the high variability of cost data between farms limit the potential for further interpretation of cost trends at this stage. Collection and analysis of additional cost data over the next couple of seasons will make these trends clearer.

The most significant items of expenditure from both studies included:

Head of expenditure	2003–06	2012/13–2014/15
Employment	24%	27%
Repairs and maintenance of plant	13%	10%
Crop nutrition	12%	13%

The latest cost data collected for the 2012/13 to 2014/15 seasons was statistically compared with production data to identify any correlations between expenditure and orchard productivity. This analysis showed that productivity is significantly positively correlated with total production costs per bearing hectare. This means that on average, participating farms with higher costs achieved higher yields of both nut-in-shell and saleable kernel per bearing hectare.

Further analyses were conducted to see how strongly productivity was correlated with the individual heads of expenditure. A strong positive correlation was found between orchard productivity and expenditure on crop nutrition and crop protection. As with total production costs, this means that on average, participating farms that spent more on crop nutrition and crop protection per hectare also achieved higher yields per hectare.

Average annual costs of production per hectare increased from $5510 in 2003 to 2006 to $5840 in 2012/13 to 2014/15. Employment represented the largest proportion of costs followed by repairs and maintenance of plant and crop nutrition.

Annual costs of production 2003 - 2006
(total $5,510 per hectare)

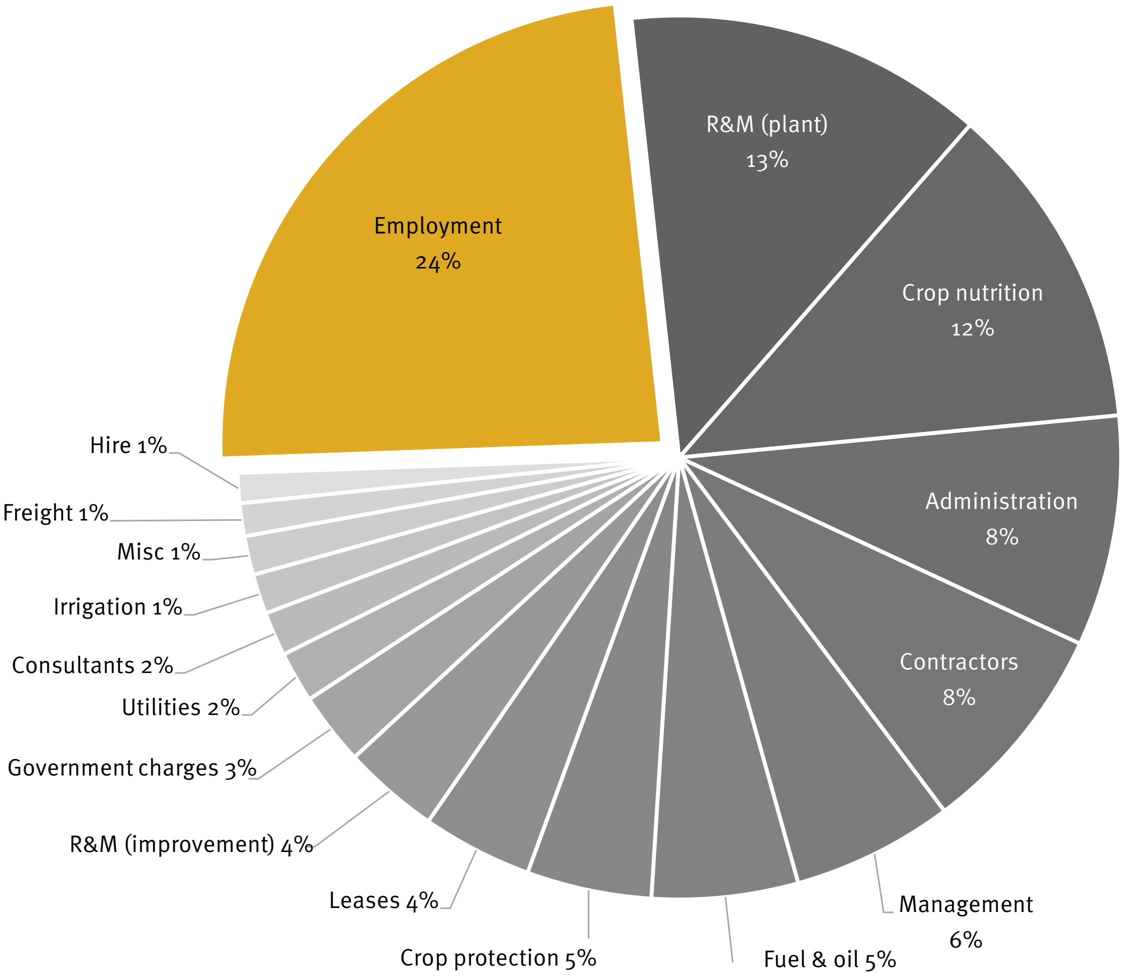


Figure 47: Breakdown of average costs of production for 2003 to 2006

Average annual expenditure per hectare on employment, crop nutrition, fuel and oil and crop protection all increased over the last decade.

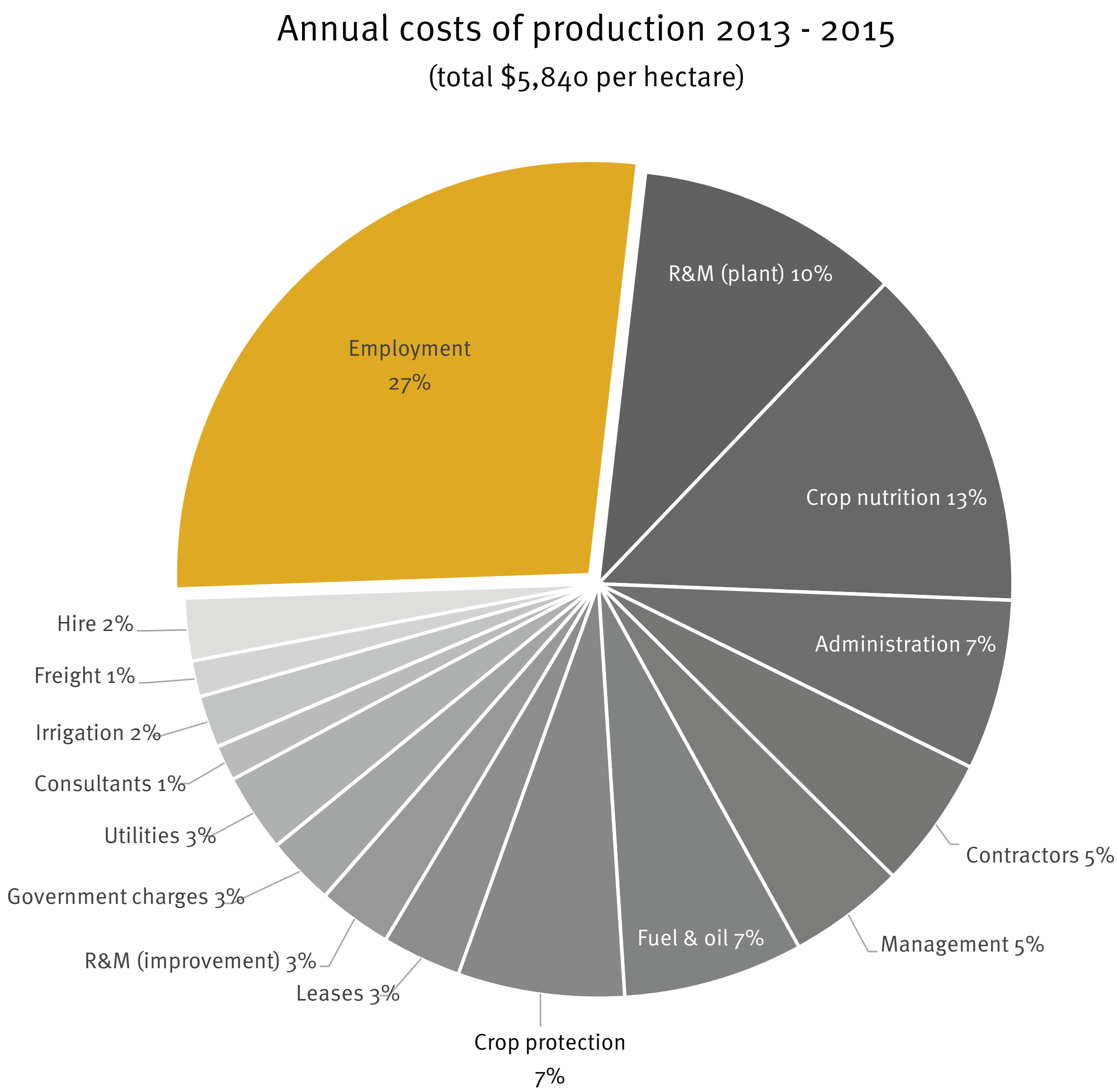


Figure 48: Breakdown of average costs of production for 2012/13 to 2014/15

Orchard productivity has been found to be strongly positively correlated with expenditure on crop nutrition and crop protection.

Costs by farm size

Figure 49 shows average annual expenditure per planted hectare for different farm size categories in the benchmark sample. Farms larger than 50 hectares had the lowest average cost per planted hectare at just over $5000/ha. These larger farms were younger on average than the smaller farms and many of them have not yet reached their peak production. These farms yielded an average of just under 2.0 tonnes of nut-in-shell (NIS) and just over 0.6 tonnes of saleable kernel per hectare during the three years of the analysis.

Farms between 10 and 20 hectares averaged the highest cost of production at $6742 per hectare. These farms averaged 3.14 tonnes of NIS and 1.02 tonnes of saleable kernel per hectare.

Farms between 20 and 30 hectares averaged $5973/ha and achieved the highest average productivity at 3.48 tonnes of NIS and 1.31 tonnes of saleable kernel per hectare.

The farms with an average planted area less than 10 hectares had an average cost of production of $6102 per hectare and yielded an average of 2.92 tonnes of NIS and 0.97 tonnes of saleable kernel per hectare. Farms less than 10 hectares tended to have a higher level of unpaid labour per hectare than larger farms.

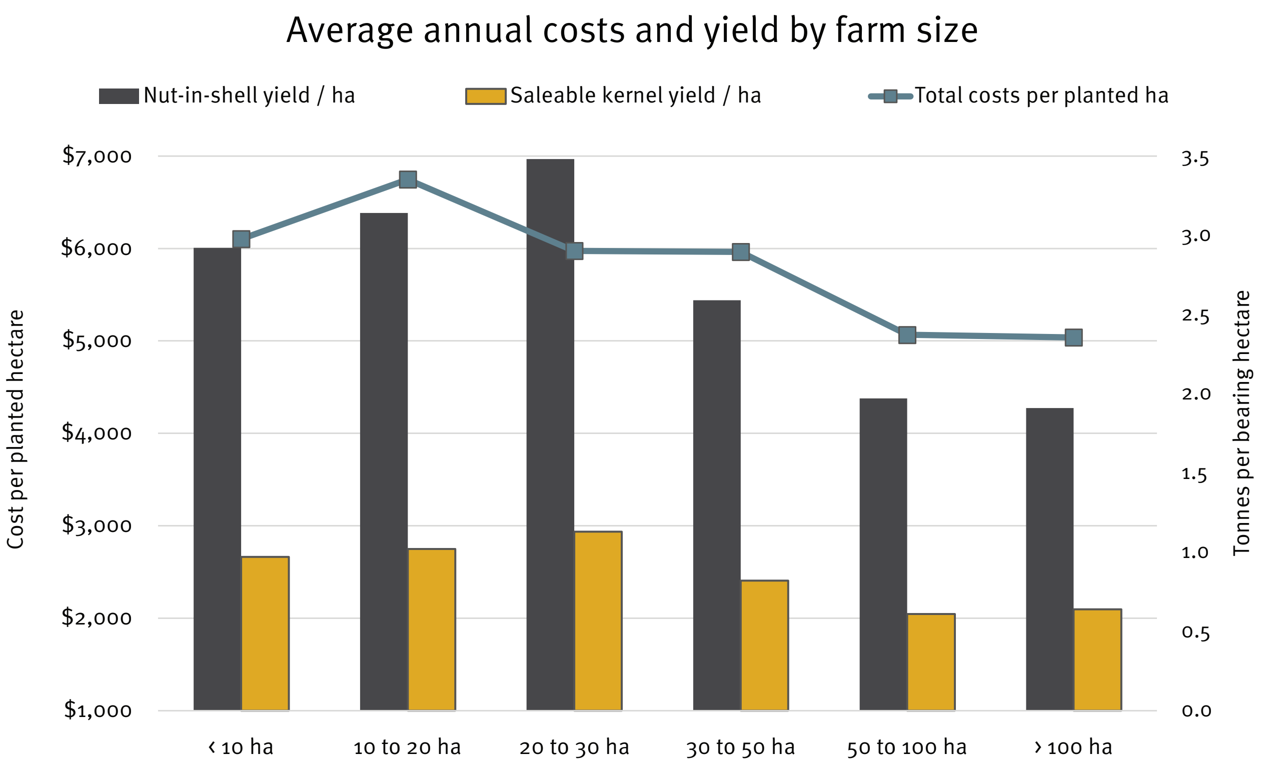
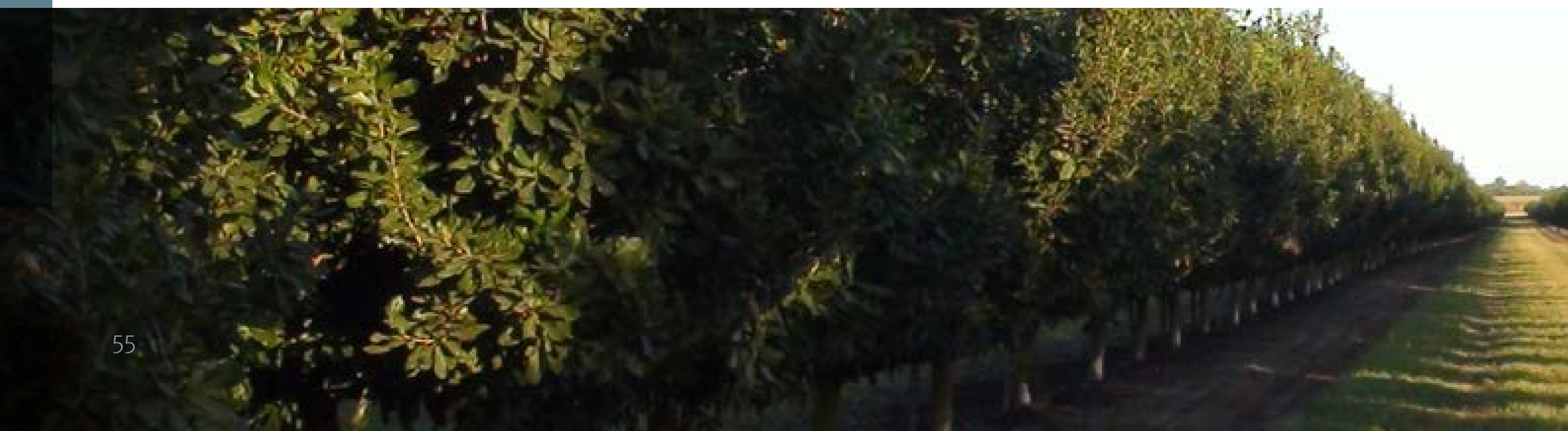


Figure 49: Production costs per hectare by farm size for 2012/13 to 2014/15



Analysis methods

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%, average and bottom 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. A standard approach was used to identify these groups. The following example shows how this process works on a 100 point data sample:

The sample is ranked according to a dependent variable such as tonnes of saleable kernel per bearing hectare.

A marker is placed on the 25th data point and its value is identified.

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.

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%. 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.

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