Department of Agriculture and Fisheries

Macadamia industry benchmark report

2009 to 2016 seasons

Project MC15005

Queensland Government

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Contents

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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

The benchmarking project is supporting improved productivity and profitability within the Australian macadamia industry. The current project builds on previous benchmarking and best practice work conducted since 2001.

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. Cost of production data has also been collected annually since 2013.

Each season all benchmarking participants receive a confidential, personalised interim and final report that 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 highlight individual and average farm performance trends over multiple seasons.

This industry report has been produced to provide growers, processors, consultants, investors and other industry stakeholders with a summary of yield, quality and cost of production trends within the Australian macadamia industry.

Scope and coverage

This report summarises macadamia farm yield and quality results for the 2009 to 2016 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.

A total of 269 bearing farms submitted data for the 2016 season. These farms total 9,998 hectares and produced approximately 29,483 tonnes of nut-in-shell (NIS) at 10% moisture content and 9,480 tonnes of saleable kernel in the 2016 season. This represents approximately 56.7% of the industry's total production in 2016, based on the AMS estimate of 52,000 tonnes of NIS at 10% moisture content (published December 7, 2016). Yield and quality data collected between 2009 and 2016 totals 1863 farm-years.

Some participating businesses have also submitted data relating to costs of production since 2013. A total of 54 businesses submitted cost data in 2016, representing more than 2,100 planted hectares or approximately 15% of total production in that year. Cost data collected between 2013 and 2016 totals 191 data points.

Major production regions are shown in figure 1. These include Central Queensland (CQ), South East Queensland (SEQ), Northern Rivers of NSW (NRNSW) and Mid North Coast of NSW (MNNSW).

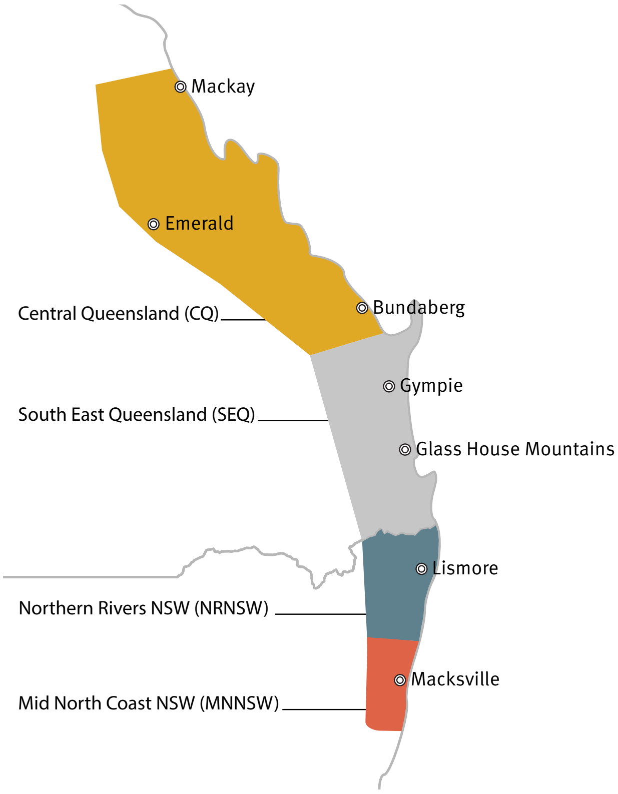


Figure 1: Production regions and localities participating in benchmarking

Table 1 shows information about the farms participating in each production region. More than half of all participating farms are located in NRNSW, while the CQ region represents the largest planted area within the benchmark sample.

The total planted hectares per farm can vary substantially between farms, particularly in some regions. Median planted hectares per farm is shown in the table rather than average planted hectares as this value is more characteristic of typical farm size in these instances.

2016 regional benchmark summary							
Region	**Bearing farms**	**% of sample by number of farms**	**Average tree age**	**Total planted hectares**	**% of sample by planted hectare**	**Median planted hectares per farm**	**% of sample by NIS tonnes**
CQ	48	18%	13	4,870	49%	65.26	52%
SEQ	51	19%	22	1,587	16%	20.92	17%
NRNSW	146	54%	24	3,139	31%	16.20	27%
MNNSW	24	9%	18	402	4%	10.62	4%
All regions	269		17	9,998		19.25	

Table 1: Regional breakdown of farms in the 2016 benchmark sample

What you need to know about the data

Please consider the following points when interpreting results in this report:

- Averages presented for any given season are based on data from a minimum of ten farms for yield and quality and 5 farms for costs. 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 weights presented are based on the industry-standard moisture content of 10% for nut-in-shell and 1.5% for kernel.
- Plantings less than five years of age are generally excluded from estimates of bearing hectares. This is important for consistency across the benchmark sample.
- The sum of reject kernel category values presented relates to the total reject kernel recovery percentage, rather than totalling 100%. This standard is applied across the benchmark study to ensure uniformity.
- While we try to use well recognised terms to describe kernel recovery and reject analysis categories, processors may 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.
- The term farm year is used to describe data for an individual farm for a given year. Yield and quality data comprises 1863 farm years from 2009 to 2016. Cost data comprises 192 farm years from 2012/13 to 2015/16. Unless otherwise specified, averages that span multiple seasons are derived from all available seasons.
- Unless otherwise stated all farm costs per hectare are based on total planted hectares. This may include non-bearing hectares for some farms as most businesses do not separate costs by tree age within their accounting systems.
- Heads of expenditure shown in this report are derived from a standard chart of accounts developed in conjunction with accountants and financial advisers as part of the previous levy funded project *On-farm economic analysis in the Australian macadamia industry* (MC03023). This chart of accounts is used to ensure consistent interpretation of costs across multiple farm businesses.
- Some averages may be based on subsets of the available data. Atypical or non-representative data may be excluded from some analyses to avoid adversely skewing averages. Where this has occurred it will generally be indicated in results (e.g. mature farms only).

Plantings

Historical planting data were collected from 269 farms for the 2016 season. Figure 2 shows the total number of trees planted each year between 1970 and 2016 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.

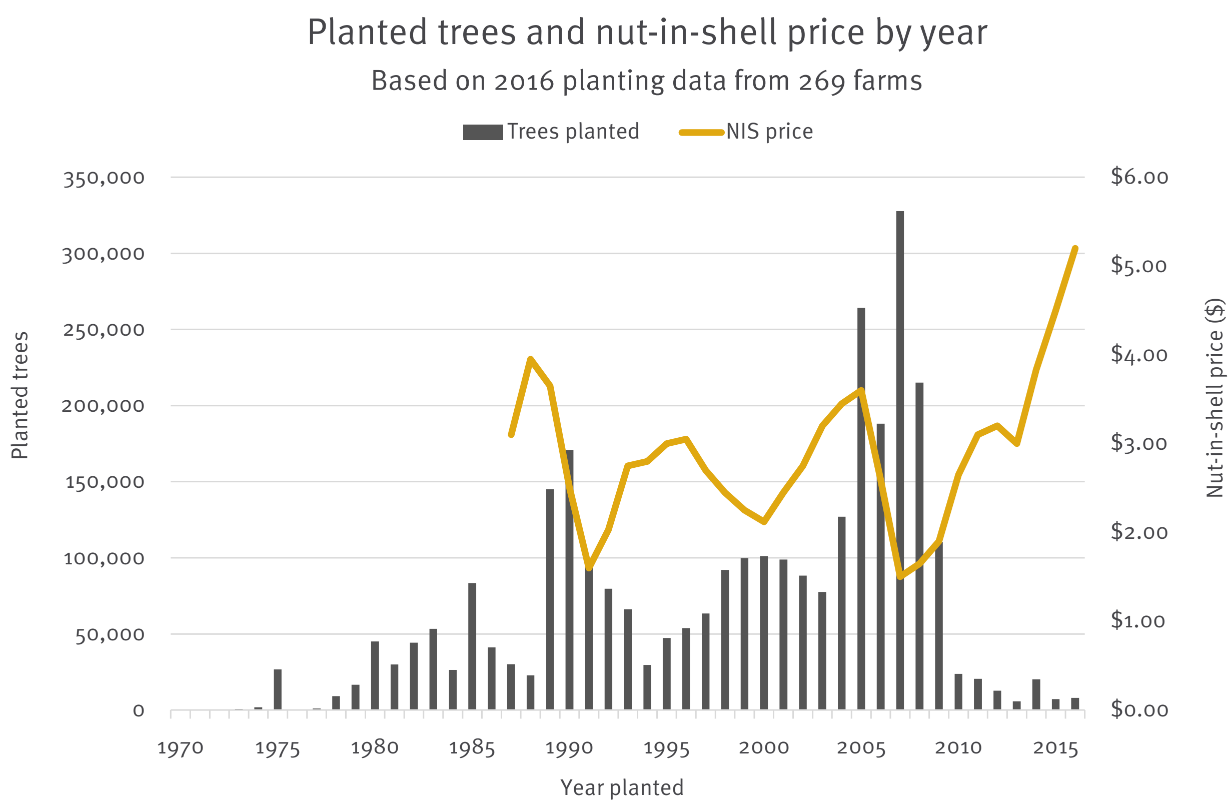


Figure 2: Total planted trees and nut-in-shell price by year (2016)

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. It is therefore anticipated that the number of reported trees planted in recent years will increase as new plantings and orchards are included in the study.

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

Figure 3 shows the number of farms participating in benchmarking from each major production region. It also shows average farm size, tree age, productivity and kernel recovery for farms within each region.

In 2016 more than half of all participating farms were from the Northern Rivers region of NSW (NRNSW). Farms in the NRNSW region were, on average, older than those in other regions. CQ farms had the largest average size, saleable kernel productivity and kernel recovery within the benchmark sample. South East Queensland (SEQ) farms were, on average, much older than farms in the CQ region, but had similar average saleable kernel productivity.

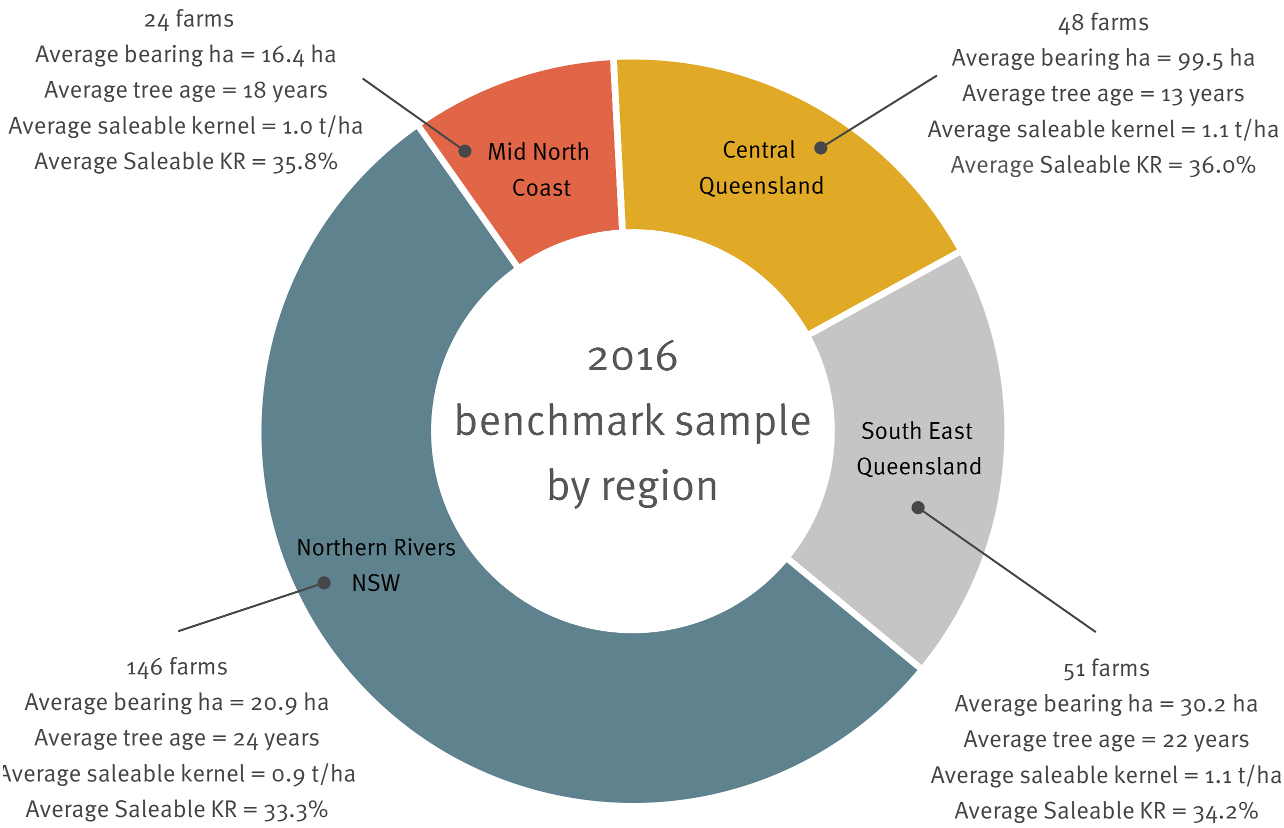
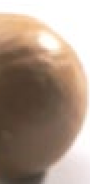


Figure 3: Regional breakdown of farms in the 2016 benchmark sample



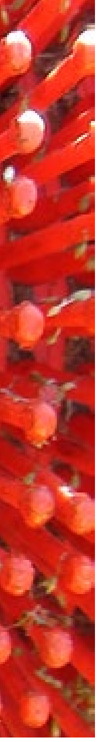
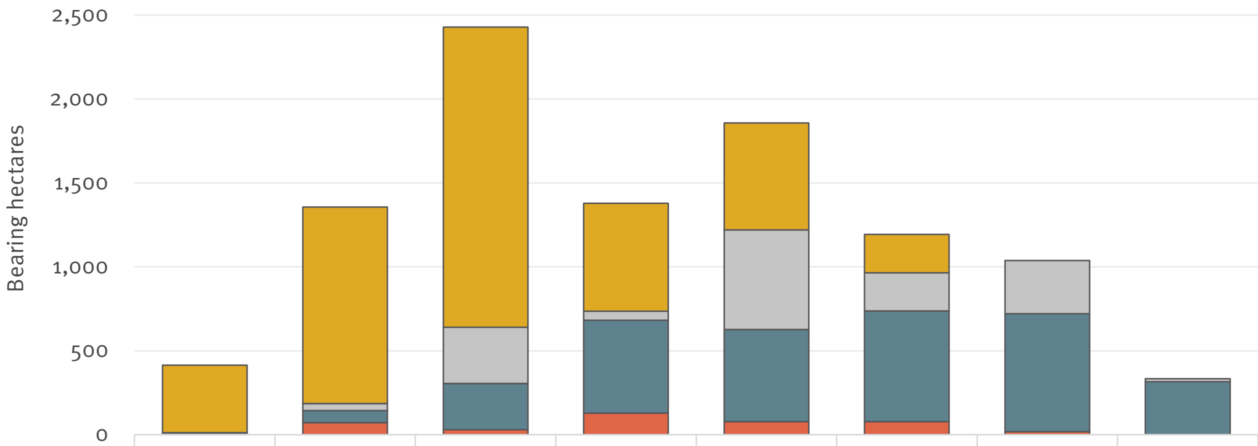


Figure 4 shows a breakdown of bearing hectares by region and tree age within the 2016 benchmark sample. Plantings less than five years of age are not considered bearing and are therefore excluded. Some farms, particularly in the CQ region, harvest nuts from four year old trees but these are usually small volumes. As tree ages vary between plantings on many farms, tree age categories shown in the chart are based on the weighted average tree age for each farm.

Farms with an average tree age between 10 and 14 years comprised the largest number of bearing hectares in the 2016 benchmark sample. This corresponds with trees planted between 2002 and 2006. Most of these farms are located in the CQ region. By comparison, the largest proportion of trees planted in other regions were aged 15 to 19 in the Mid North Coast of NSW (MNNSW), 20 to 24 years for SEQ and 30 to 34 years for NRNSW.

Total bearing hectares by tree age category and region

(2016 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	402	1,171	1,790	642	637	228	0	0
SEQ	0	43	334	54	594	228	317	18
NRNSW	12	72	275	554	548	659	703	316
MNNSW	0	71	29	128	78	77	18	0

Figure 4: Total bearing hectares by tree age category and region (2016)

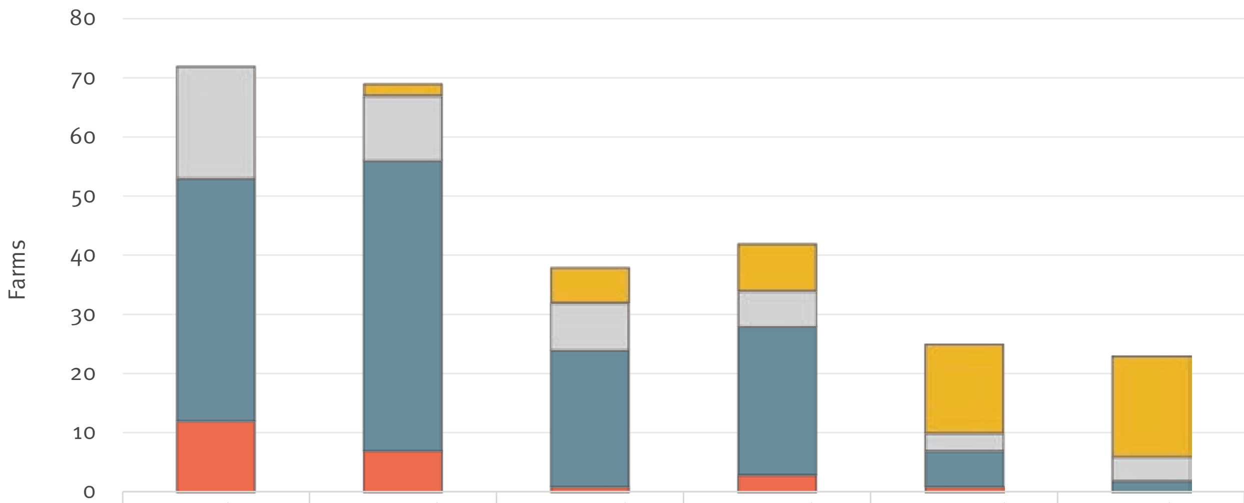
Figure 5 shows a breakdown of farms in the 2016 benchmark sample according to their size. The chart shows the number of farms within each major production region for size categories ranging from less than 10 hectares to more than 100 hectares.

Most farms in the 2016 sample had less than 10 hectares of bearing trees (72 farms) or between 10 and 20 hectares (69 farms). The majority of these farms are located in the MNNSW, NRNSW and SEQ regions. By comparison, the majority of larger farms (> 50 hectares) were located in the CQ region.

In 2016 the median size of farms in the benchmark sample was 18.8 bearing hectares and 19.2 total hectares. Average farm size was significantly higher at 36.3 bearing hectares and 37.2 total hectares. This is due to the inclusion of some very large farms in the benchmark sample.

Total bearing farms by farm size category and region

(2016 season)



	< 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	> 100 ha
CQ	0	2	6	8	15	17
SEQ	19	11	8	6	3	4
NRNSW	41	49	23	25	6	2
MNNSW	12	7	1	3	1	0

Figure 5: Total bearing farms by farm size category and region (2016)

Summary of the 2016 season

Figure 6 shows average yield and quality measures for all 269 bearing farms in the benchmark sample in 2016. This includes some young farms that are yet to reach full maturity. Corresponding averages for all seasons from 2009 to 2016 are shown in brackets.

Average productivity per hectare was generally higher in 2016 (2.92 t/ha NIS) than the long-term average for the last eight seasons (2.51 t/ha NIS). Average saleable kernel recovery was also slightly higher in 2016 (34.2%) than the average for the last eight seasons (33.7%).

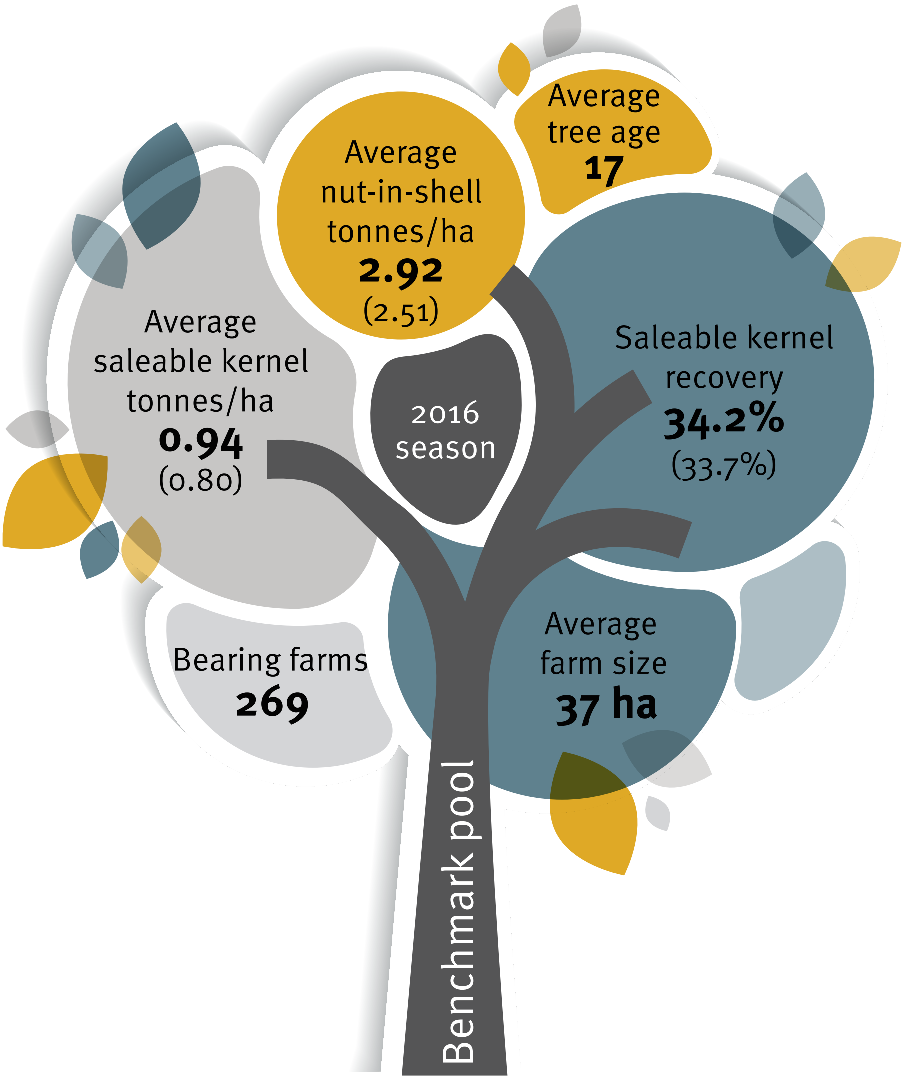


Figure 6: Summary of results from the 2016 benchmark sample

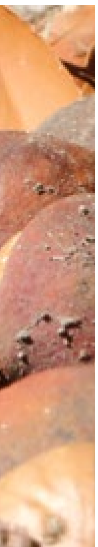


Table 2 shows differences in average yield and quality between the 2015 and 2016 seasons for mature farms (10+ years old) in the benchmark sample. Younger farms have been excluded to ensure a representative analysis of mature farm performance. Favourable seasonal changes are shown in gold and unfavourable changes are shown in red.

In 2016 both average saleable kernel yield per hectare and average saleable kernel recovery increased in Central Queensland (CQ), South East Queensland (SEQ) and the Mid North Coast of NSW (MNNSW) compared with 2015. In the Northern Rivers of NSW (NRNSW) average yield and saleable kernel recovery decreased in 2016. Average reject kernel recovery increased in SEQ, NRNSW and CQ and decreased in MNNSW. Insect damage caused the highest percentage of reject kernel recovery in all regions.

2015 vs 2016 comparison of mature farms				
	Saleable kernel per hectare	**Saleable kernel recovery %**	**Reject kernel recovery %**	**Leading cause of reject KR% in 2016**
CQ	Increase 13%	Increase 1.3%	Increase 0.4%	Insect damage
SEQ	Increase 35%	Increase 0.4%	Increase 0.8%	Insect damage
NRNSW	Decrease 15%	Decrease 0.8%	Increase 0.2%	Insect damage
MNNSW	Increase 29%	Increase 0.8%	Decrease 0.6%	Insect damage

Table 2: Comparison of mature farm performance between the 2015 and 2016 seasons

Major factors affecting production in Queensland and New South Wales in 2016 are shown in figure 7. These results are based on responses from 66 growers who attended benchmark group meetings in each of the major production regions in 2016. These growers represented a total of 131 farms.

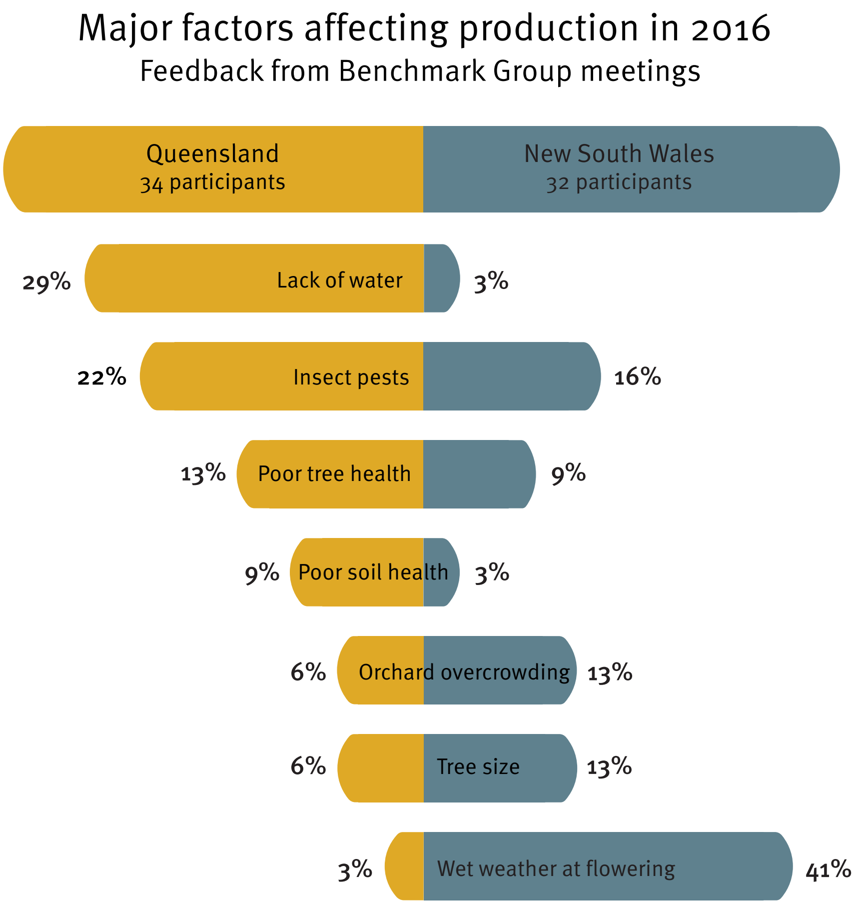


Figure 7: Major factors affecting production in Queensland and New South Wales in 2016

The most significant factors limiting production in 2016 included wet weather at flowering, insect pests and lack of water availability at key times. Wet weather at flowering mostly affected NSW farms while lack of water availability mainly affected SEQ farms.

Queensland participants nominated poor tree health and poor soil health as factors limiting their production in 2016. By comparison, orchard overcrowding and tree size were identified as significant limiting factors for NSW participants. All NSW participants indicated plans to manage their canopies in the next three years through a combination of limb removal, row removal and light hedging.

Insect damage was the major cause of factory reject among benchmark participants in all regions in 2016. More than 1% of reject kernel recovery was due to insect damage. Fruitspotting bug was reported as the primary cause of this reject.

Losses due to rat damage were also identified in all regions in the 2016 season with some participants reporting significant activity. Negligible losses due to husk diseases were reported in most regions.

The weight and value of total factory reject kernel was estimated for all farms in the benchmark sample in 2016. Figure 8 shows a breakdown of total reject into the major factory reject categories. The weight of reject was derived from individual farm reject kernel recovery percentages adjusted to equivalent nut-in-shell (NIS) weights. The value of those rejects was derived using the 2016 published price of $5.20 per kilogram of NIS. It is important to note that the averages shown in figure 8 are weighted according to NIS production, which means larger farms exert more influence on the average than smaller farms. This provides the most accurate estimate of the total weight of rejects across the benchmark sample.

The total value of factory losses due to reject kernel for all farms participating in benchmarking in 2016 was approximately $12.8 million. It is also important to note that this estimate is based only on factory reject kernel and therefore excludes additional processing or handling costs associated with that reject.

Insect damage accounted for more than one third of those rejects at a value of $4.46 million, followed by brown centres ($2.77 million) then immaturity ($2.59 million). Assuming similar average reject kernel recoveries among farms not participating in benchmarking, the estimated value of factory reject losses across industry is estimated to be more than $22 million in 2016.

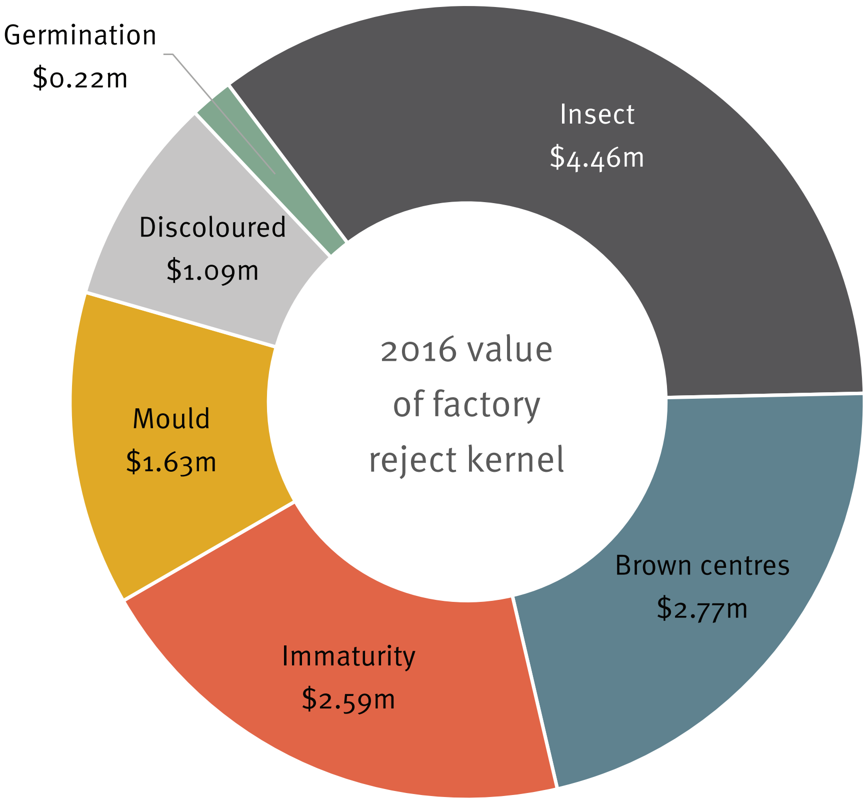


Figure 8: Estimated value of factory reject kernel for all farms in the benchmark sample (2016)

Average reject weights per hectare were also derived from reject kernel percentages and planting data for each farm in the benchmark sample in 2016. Table 3 shows the estimated average value of these losses per hectare based on the published 2016 price of $5.20 per kilogram of NIS.

In this case the values shown are based on unweighted averages, which means that each farm in the benchmark sample has equal influence on the average. These averages are therefore independent of production, locality, farm size or tree age. The relative proportions of each category of reject are therefore different to the weighted averages shown in figure 8 above.

It is important to note that the reject figures presented in this report only include losses from nuts consigned to the factory. This excludes the weight of nuts lost or rejected prior to consignment, which may also significantly contribute to total farm rejects.

Value of losses per hectare from factory reject	
Insect damage	$472
Immaturity	$224
Brown centres	$160
Mould	$143
Discoloured	$90
Germination	$27

Table 3: Estimated value of factory reject kernel per hectare for all farms in the benchmark sample (2016)

Annual productivity and quality trends

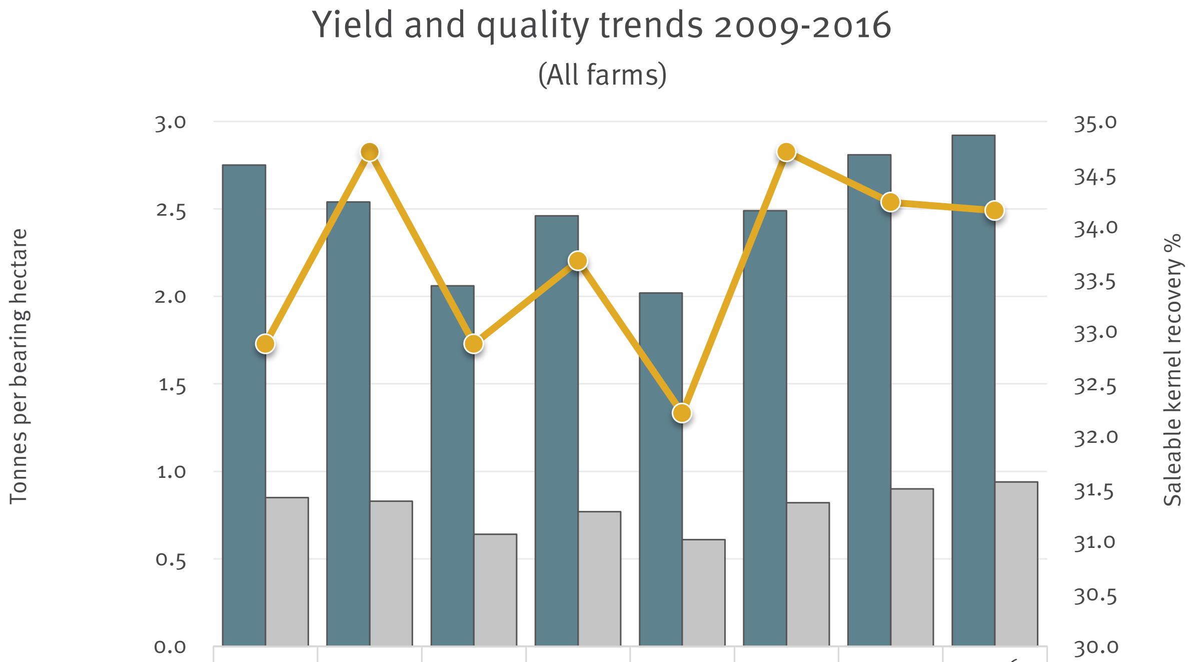
This section provides average performance for farms in the benchmark sample over multiple seasons. Yield data includes both nut-in-shell (NIS) and saleable kernel production per bearing hectare. Quality data includes premium kernel recovery (PKR), commercial kernel recovery (CKR), reject kernel recovery (RKR) and saleable kernel recovery (SKR). SKR is equal to the sum of PKR and CKR.

Figure 9 shows average yield as tonnes per hectare of NIS and saleable kernel and also SKR trends for all farms in the benchmark sample from 2009 to 2016. This includes young farms that are yet to reach full maturity.

Average productivity for this period was 2.51 t/ha (NIS) and 0.8 t/ha saleable kernel. Average saleable kernel recovery for all farms during this period was 33.71%.

The lowest average yield per hectare (both NIS and saleable kernel) was recorded in 2013. Average yield has increased since then across the benchmark sample. Average NIS and saleable kernel yield per hectare was higher in 2016 than in all other years from 2009 to 2015.

Average SKR in 2016 was slightly lower than 2015. As with yield, average SKR was lowest in 2013.



	2009	2010	2011	2012	2013	2014	2015	2016
NIS yield	2.75	2.54	2.06	2.46	2.02	2.49	2.81	2.92
Saleable kernel yield	0.85	0.83	0.64	0.77	0.61	0.82	0.90	0.94
Saleable KR %	32.88	34.71	32.88	33.67	32.22	34.71	34.23	34.15

Figure 9: Average yield and quality trends for all farms in the benchmark sample (2009 to 2016)

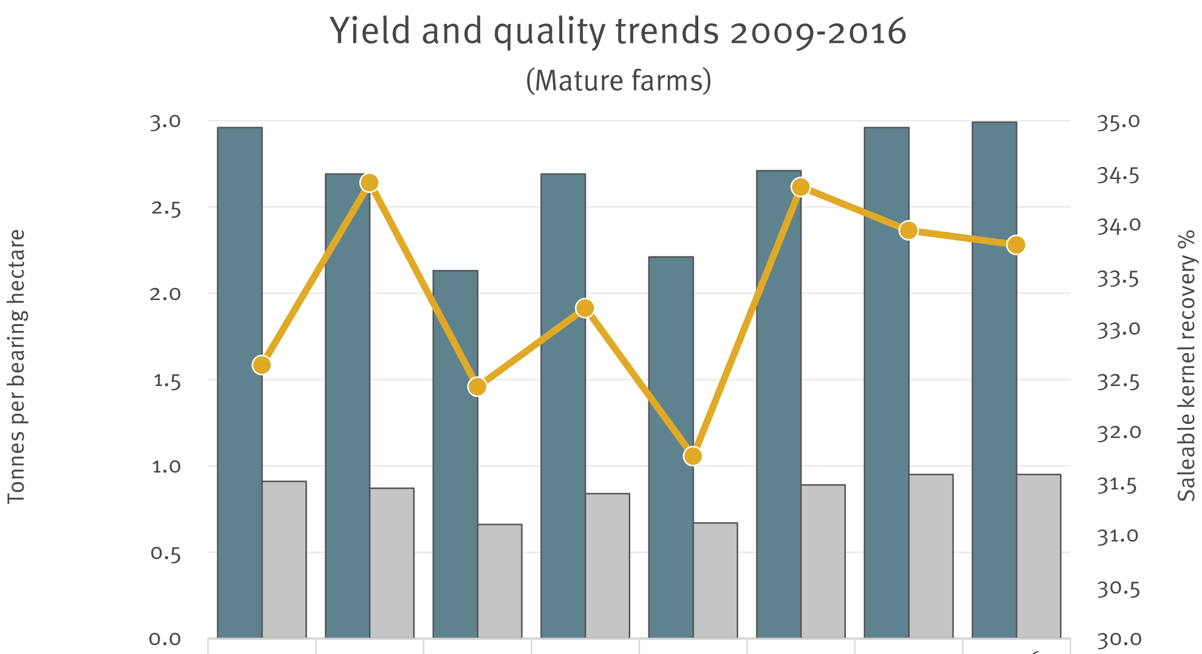
Average nut-in-shell and saleable kernel yields per hectare increased three years in a row from 2013 to 2016. Both nut-in-shell and saleable kernel yields per hectare were higher in 2016 than in any other year since the benchmarking began in 2009.

Figure 10 shows similar average yield and kernel recovery trends for mature farms (10+ years old) in the benchmark sample from 2009 to 2016. By excluding young farms that are yet to reach their full bearing potential this provides a more representative picture of seasonal variation in yield and kernel recovery.

Although similar seasonal variation in yield and quality is evident among mature farms, average NIS and saleable kernel yield is typically higher than the full sample due to exclusion of the young farms. Average productivity for mature farms from 2009 to 2016 was 2.68 t/ha (NIS) and 0.85 t/ha saleable kernel. Average saleable kernel recovery for all farms during this period was 33.36%.

Based on these yield values 2010, 2012 and 2014 were consistent with average productivity, 2011 and 2013 were below average productivity and 2009, 2015 and 2016 were above average productivity.

Average kernel recovery for mature farms was lower than the whole benchmark sample. Differences in saleable kernel productivity between mature farms and the whole sample were therefore less pronounced than NIS.



	2009	2010	2011	2012	2013	2014	2015	2016
NIS yield	2.96	2.69	2.13	2.69	2.21	2.71	2.96	2.99
Saleable kernel yield	0.91	0.87	0.66	0.84	0.67	0.89	0.95	0.95
Saleable KR %	32.64	34.40	32.43	33.19	31.76	34.36	33.94	33.80

Figure 10: Average yield and quality trends for mature farms in the benchmark sample (2009 to 2016)

High production variability is evident between seasons and farms within the benchmark sample. Figure 11 shows the distribution of productivity for 155 mature farms (10+ years old) that have participated in benchmarking for more than four seasons, including 2016.

The chart compares NIS productivity of these farms in the 2016 season (gold) with the average for those same farms from 2009-2015 (dark grey). The 2016 curve is biased towards the right side of the chart compared with the 2009-2015 curve. This reflects the higher median productivity in 2016 (3.13 t/ha) compared with 2009-2015 (2.65 t/ha). The lower peak of the 2016 curve compared with the 2009-2015 curve also shows that there was a wider distribution in NIS productivity in 2016 compared with the average of the 09-15 seasons. A similar distribution pattern was observed for saleable kernel production per hectare.

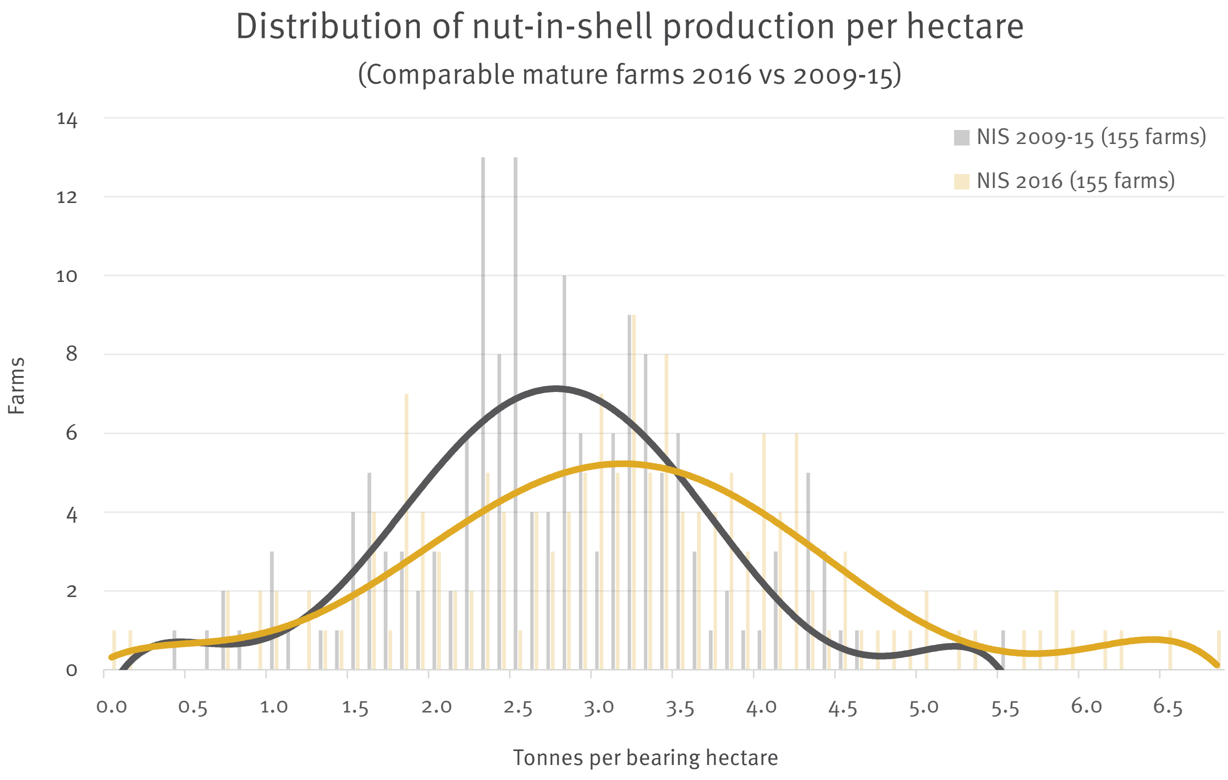


Figure 11: Distribution of nut-in-shell production for comparable mature farms (2016 vs 2009 to 2015)

Analysis of annual productivity between 2009 and 2016 reveals substantial seasonal variation in the distribution of productivity. Figure 12 compares NIS distribution for mature farms in the benchmark sample for two different seasons. The 2016 season (shown in gold) had the highest productivity during this period whereas the 2011 season (shown in dark grey) had the lowest average productivity during that same period.

Average NIS productivity per bearing hectare for these farms was 3.1 t/ha in 2016 and 2.1 t/ha in 2011. The rightward shift of the 2016 curve compared with the 2011 curve shows that more farms had higher average productivity in the 2016 season than in the 2011 season. There was also a wider distribution of that productivity in 2016 than in 2011. This is reflected by a higher standard deviation in NIS productivity in 2016 (1.26 t/ha) compared with 2011 (1.11 t/ha). The standard deviation in NIS productivity in 2016 was consistent with the long term average for 2009-2016 (1.26 t/ha).

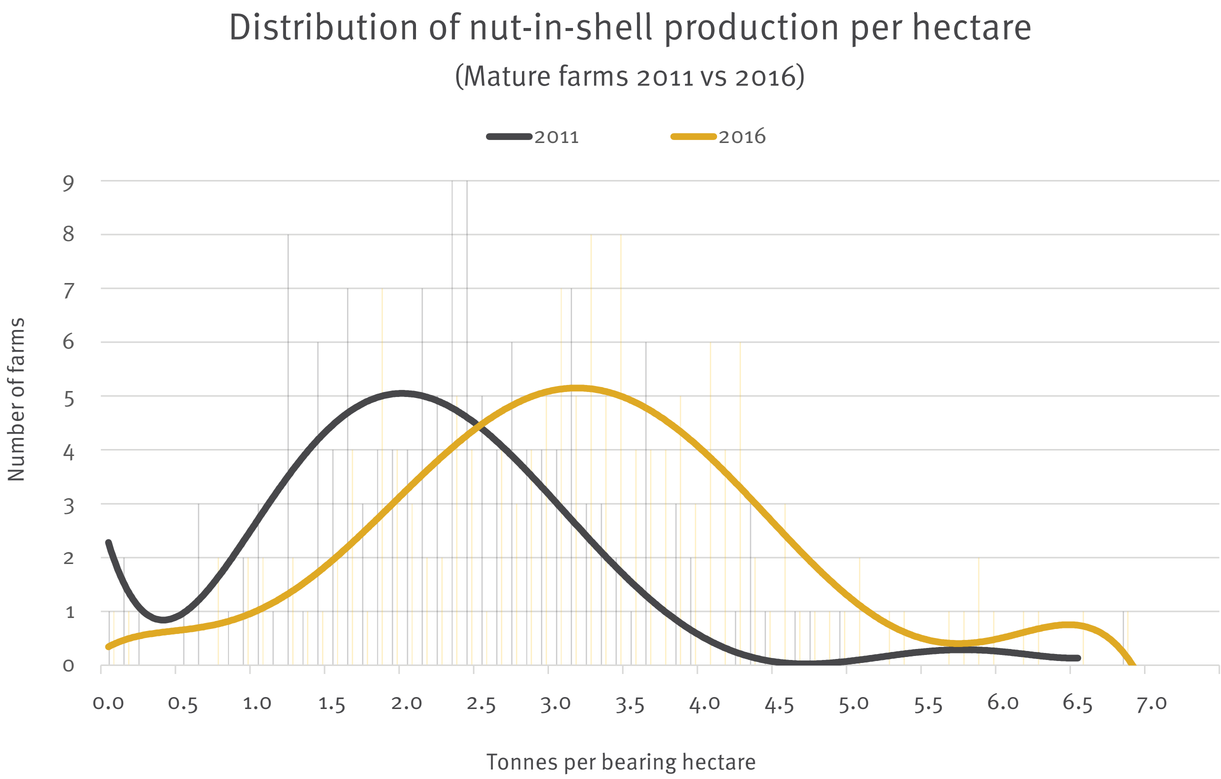
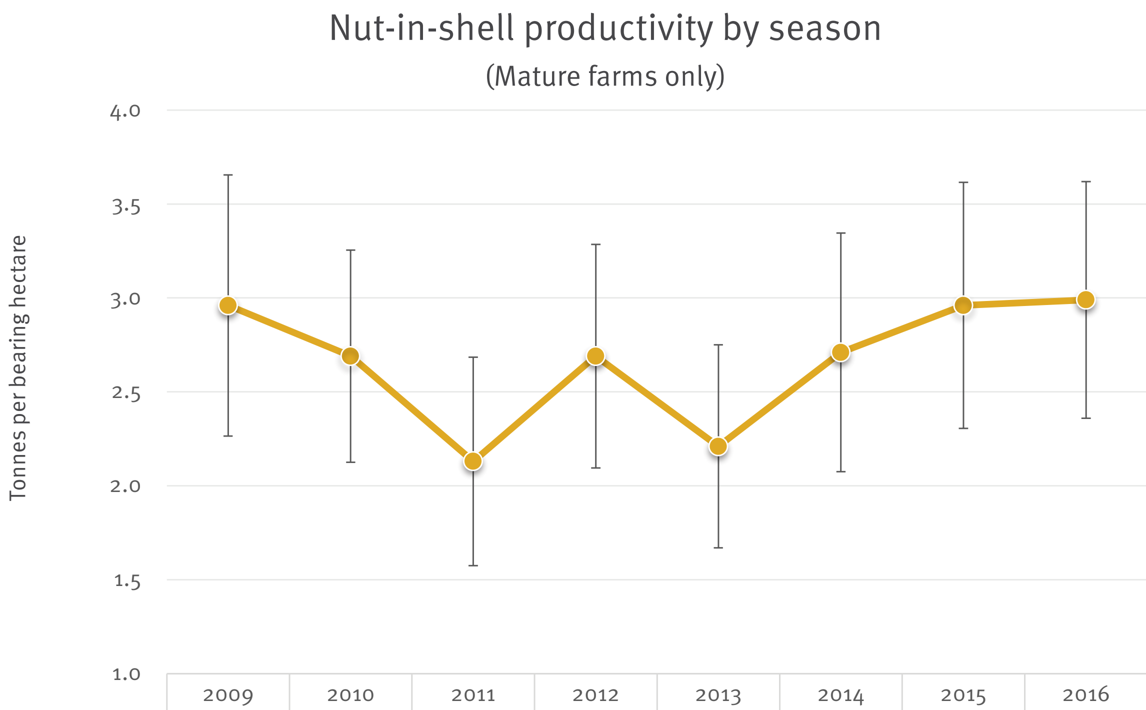


Figure 12: Distribution of nut-in-shell production for mature farms (2011 vs 2016)

Figure 13 shows the production variability between farms for each season since 2009. The chart shows average NIS productivity per bearing hectare for mature farms (10+ years old). The vertical error bars show the standard deviation for each season. Larger vertical bars indicate higher variability in NIS productivity.

The standard deviation of NIS productivity averaged 1.26 tonnes per bearing hectare from 2009 to 2016, or approximately 46% of average NIS productivity. There has been no significant reduction in this variation between mature farms over these eight seasons with annual standard deviation ranging between 42% and 52% of average NIS productivity during this period.

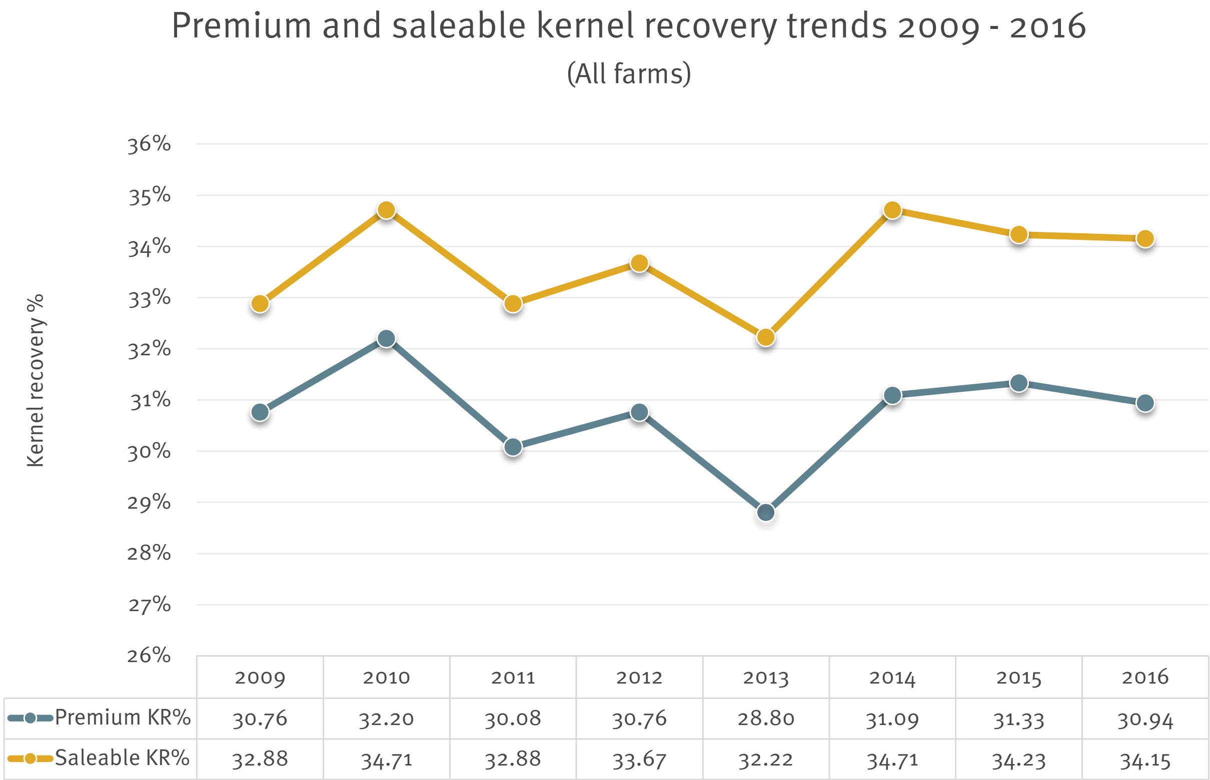


	2009	2010	2011	2012	2013	2014	2015	2016
NIS productivity	2.96	2.69	2.13	2.69	2.21	2.71	2.96	2.99
Standard deviation	1.39	1.13	1.11	1.19	1.08	1.27	1.31	1.26

Figure 13: Average and standard deviation of nut-in-shell productivity by season for mature farms (2009 to 2016)

Figure 14 shows average premium (PKR) and saleable (SKR) kernel recovery trends for all farms in the benchmark sample from 2009 to 2016. Figure 15 shows the corresponding commercial (CKR) and reject (RKR) kernel recovery for these seasons.

Average PKR fell slightly in 2016 compared with 2015. A comparable increase in CKR in 2016 meant that average saleable kernel recovery in 2016 was similar to that of 2015. 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.

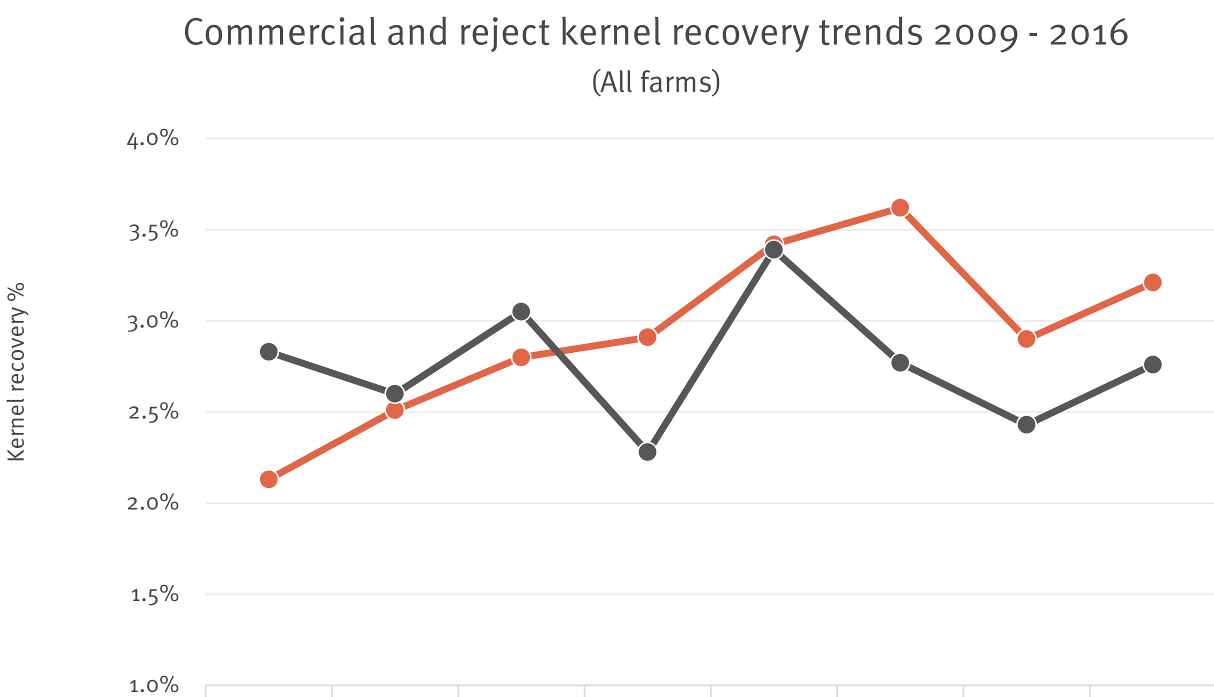


	2009	2010	2011	2012	2013	2014	2015	2016
Premium KR%	30.76	32.20	30.08	30.76	28.80	31.09	31.33	30.94
Saleable KR%	32.88	34.71	32.88	33.67	32.22	34.71	34.23	34.15

Figure 14: Average premium and saleable kernel recovery for the whole benchmark sample (2009 to 2016)

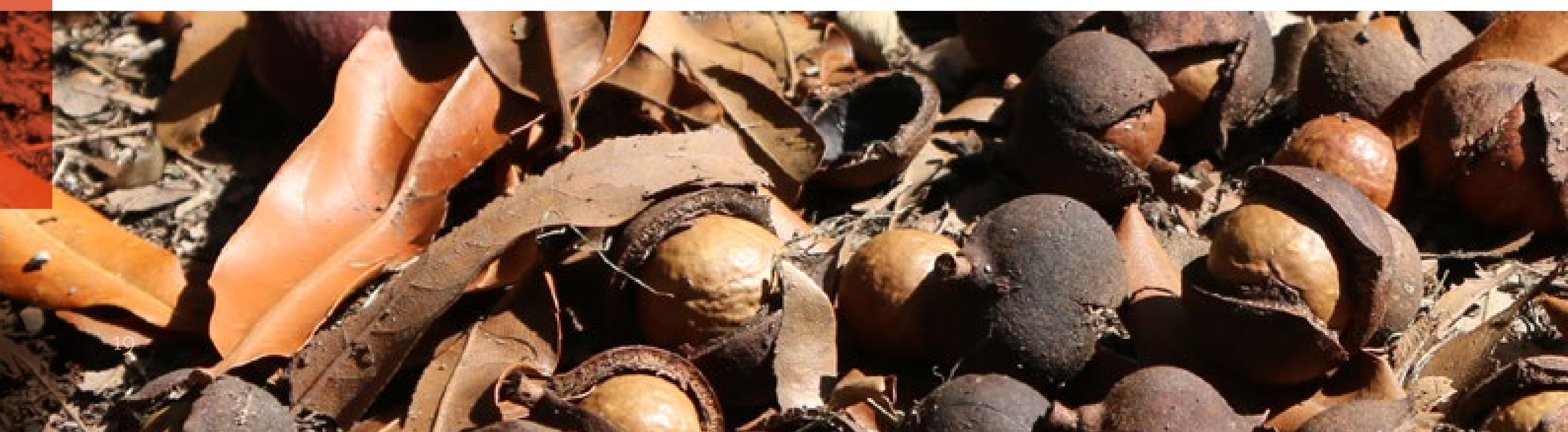
Average RKR increased by 0.4% in 2016 to 2.76%. Insect damage caused most of this reject in all production regions (average 1.15%). Average RKR was higher in 2013 than in each of the other years. This was largely due to high levels of immaturity (particularly in South East Queensland), insect damage (particularly in New South Wales) and brown centres (particularly in Central Queensland) during that year.

Productivity varies significantly between farms in the benchmark sample. Average nut-in-shell productivity for mature farms over the last eight seasons was 2.68 t/ha with a standard deviation of 1.26 t/ha or 47% of the average.



	2009	2010	2011	2012	2013	2014	2015	2016
Commercial KR%	2.13	2.51	2.80	2.91	3.42	3.62	2.90	3.21
Reject KR%	2.83	2.60	3.05	2.28	3.39	2.77	2.43	2.76

Figure 15: Average commercial and reject kernel recovery for the whole benchmark sample (2009 to 2016)



Analysis of reject categories provides insight into the specific causes of reject in any season. Figure 16 shows the average percentage of rejects for all major reject categories for the whole benchmark sample from 2009 to 2016. It is important to note that these percentages are unweighted averages. This means that each farm in the benchmark sample exerts equal influence on the average regardless of its size or level of production.

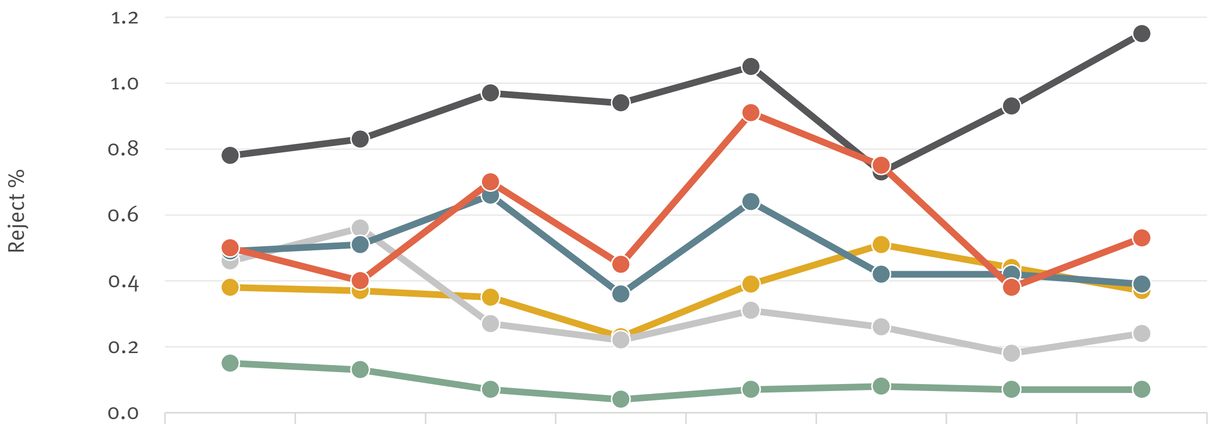
Insect damage has caused the highest average percentage of reject across the benchmark sample in all years except 2014. In 2016 insect damage was the leading cause of factory reject in every production region, reaching its highest average level since benchmarking began in 2009.

Immaturity reject levels also increased in 2016 to become the next most significant cause of factory rejects. Immaturity levels in 2016 were still well below the record high levels in 2013 and 2014, which were largely due to very dry conditions during key nut development and oil accumulation stages, particularly in South East Queensland (SEQ). These conditions resulted in moisture stress in the latter parts of 2012 and 2013.

The only other category of reject to increase in 2016 was discolouration, which was still well below average levels in 2009 and 2010.

Reject trends by percentage 2009 - 2016

(All farms)



	2009	2010	2011	2012	2013	2014	2015	2016
Insect	0.78	0.83	0.97	0.94	1.05	0.73	0.93	1.15
Mould	0.38	0.37	0.35	0.23	0.39	0.51	0.44	0.37
Discoloured	0.46	0.56	0.27	0.22	0.31	0.26	0.18	0.24
Brown centres	0.49	0.51	0.66	0.36	0.64	0.42	0.42	0.39
Immature	0.50	0.40	0.70	0.45	0.91	0.75	0.38	0.53
Germinated	0.15	0.13	0.07	0.04	0.07	0.08	0.07	0.07

Figure 16: Seasonal comparison of reject percentages for the whole benchmark sample (2009 to 2016)

The average weight of rejects was measured for all categories across the benchmark sample to quantify factory reject losses. Figure 17 shows the average annual kilograms of NIS per bearing hectare by reject category for all farms in the benchmark sample from 2009 to 2016. It is important to note that these are weighted averages so both production and reject levels impact on the average calculation. This means farms with larger yields or reject levels will exert more influence (weight) on the average than farms with smaller yields or reject levels.

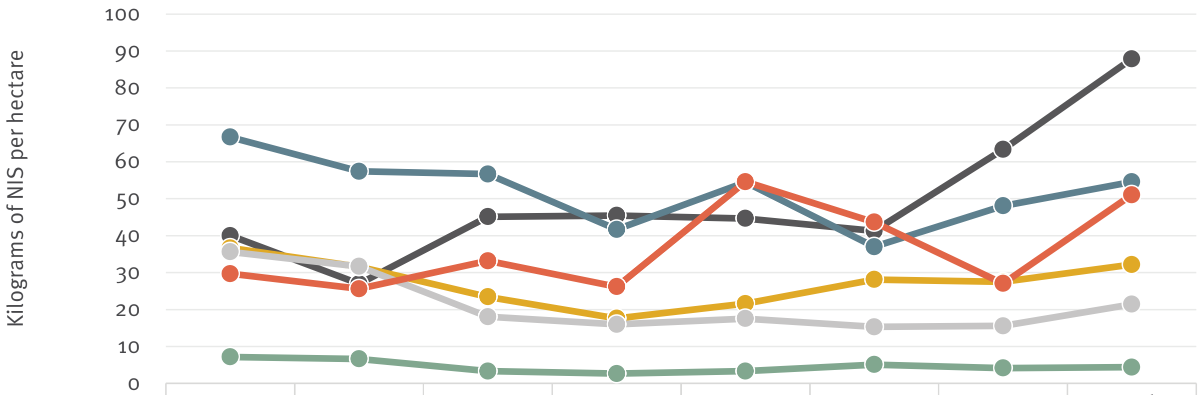
Average reject weights increased across all categories in 2016. Insect damage caused the largest average weight of reject kernel per bearing hectare, followed by brown centres and immaturity. Average reject weights due to insect damage were higher in 2015 and 2016 than in any other year since 2009 and substantially higher than the long-term average of 51.4 kg of NIS per bearing hectare.

In 2016 the average weight of rejects due to brown centres was slightly higher than the long-term average of 51 kg per hectare. Brown centres caused the highest average weight of reject kernel in the benchmark sample from 2009 to 2011.

In 2016 immaturity reject weights increased from their relatively low 2015 levels due to less favourable rainfall patterns, particularly in SEQ. Average rejects due to immaturity in 2016 were well above the long-term average of 37.5 kg per hectare.

Average reject weights per hectare 2009 - 2016

(all farms, weighted average kilograms of nut-in-shell)



	2009	2010	2011	2012	2013	2014	2015	2016
Insect	40.01	26.97	45.13	45.45	44.65	41.29	63.32	87.85
Mould	36.65	31.60	23.42	17.63	21.61	28.12	27.48	32.16
Discoloured	35.62	31.68	18.04	15.97	17.56	15.31	15.58	21.43
Brown centres	66.67	57.41	56.66	41.67	54.50	37.00	48.06	54.56
Immature	29.68	25.61	33.17	26.19	54.62	43.66	27.05	51.06
Germinated	7.18	6.64	3.32	2.66	3.33	5.09	4.16	4.41

Figure 17: Seasonal comparison of reject weights of nut-in-shell per bearing hectare for the benchmark sample (2009 to 2016)

Top performing farms

The benchmarking study has revealed high variability in productivity between farms and also between seasons for individual farms. 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, including 2016, 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. Only farms that fall within the top 25% of this group are regarded as top performing farms. As inclusion in this group is based on average performance over multiple seasons it is possible that some top performing farms may not have been among the most productive farms in a particular season.

Figure 18 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).

Most top performing farms had between 10 and 19 planted hectares with an average tree age of between 25 and 29 years.

The Northern Rivers of New South Wales (NRNSW) region represents 54% of farms in the whole benchmark sample and 58% of top performing farms. The Central Queensland (CQ) region was less represented among top performing farms, however it's important to remember that farms in this region are younger on average than other regions, with an average tree age of 13 years. This is compared to an average tree of 24 years for NRNSW and 22 years for South East Queensland (SEQ).

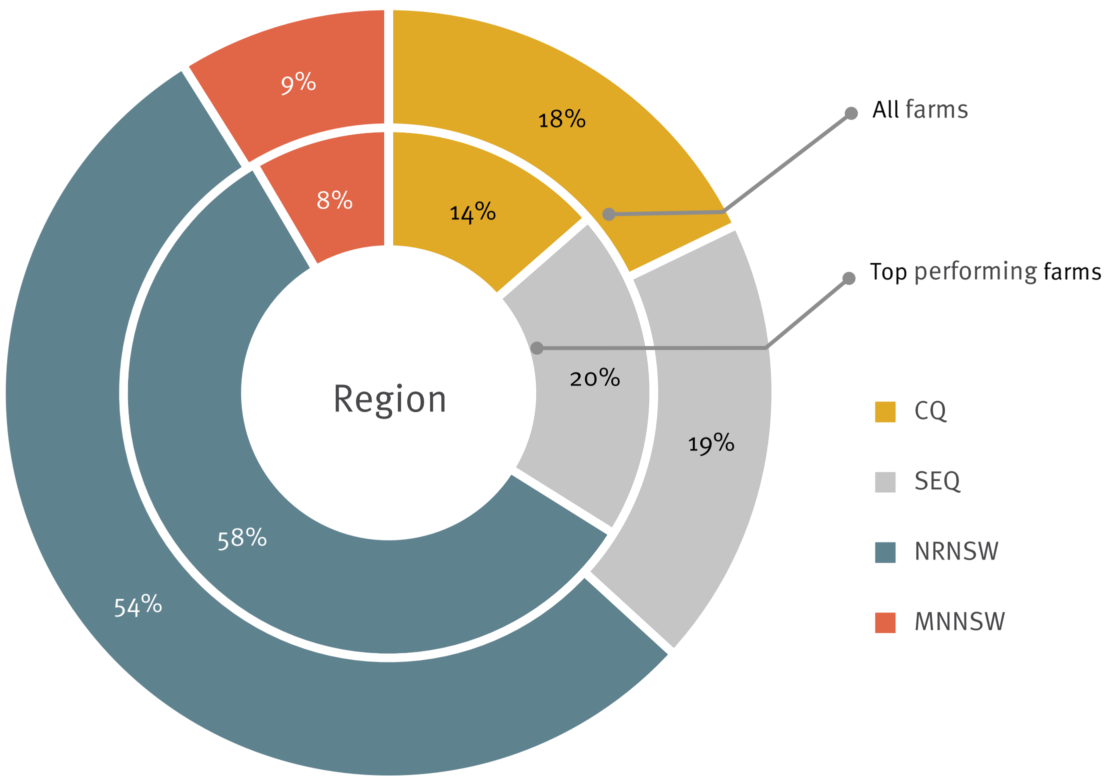


Figure 18: Regions of top performing farms vs the whole benchmark sample (2009 to 2016)

Figure 19 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. A total of 64% of the top performing farms were less than 20 hectares in size compared with 53% for the whole benchmark sample. Farms less than 30 hectares represented 81% of top performing farms compared with 67% 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.

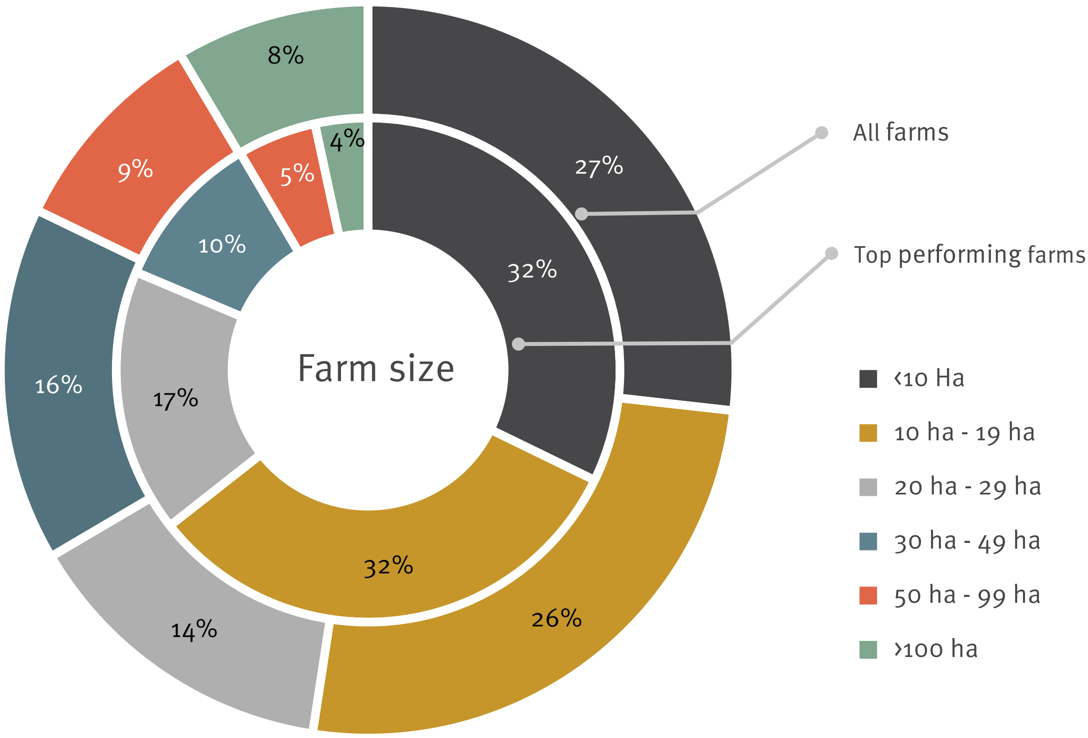


Figure 19: Farm size categories of top performing farms vs the whole benchmark sample (2009 to 2016)

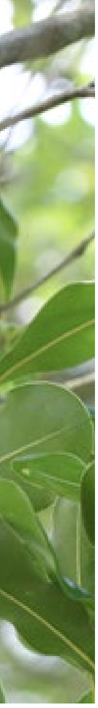


Figure 20 shows the breakdown of the top performing farms by tree age and compares this with the whole benchmark sample.

Farms with an average tree age of 25 to 29 years were the most strongly represented among the top performing farms (36%) compared with the wider benchmark sample (19%).

The top performing farms included four farms (7%) with an average tree age of less than 15 years, including one highly productive farm in the 8 to 9 year old age group. By comparison, 25% of the whole benchmark sample had an average tree age of less than 15 years.

The top performing farms also included three farms with an average tree age in excess of 30 years. This is important to note as it demonstrates that productivity can be maintained in older orchards.

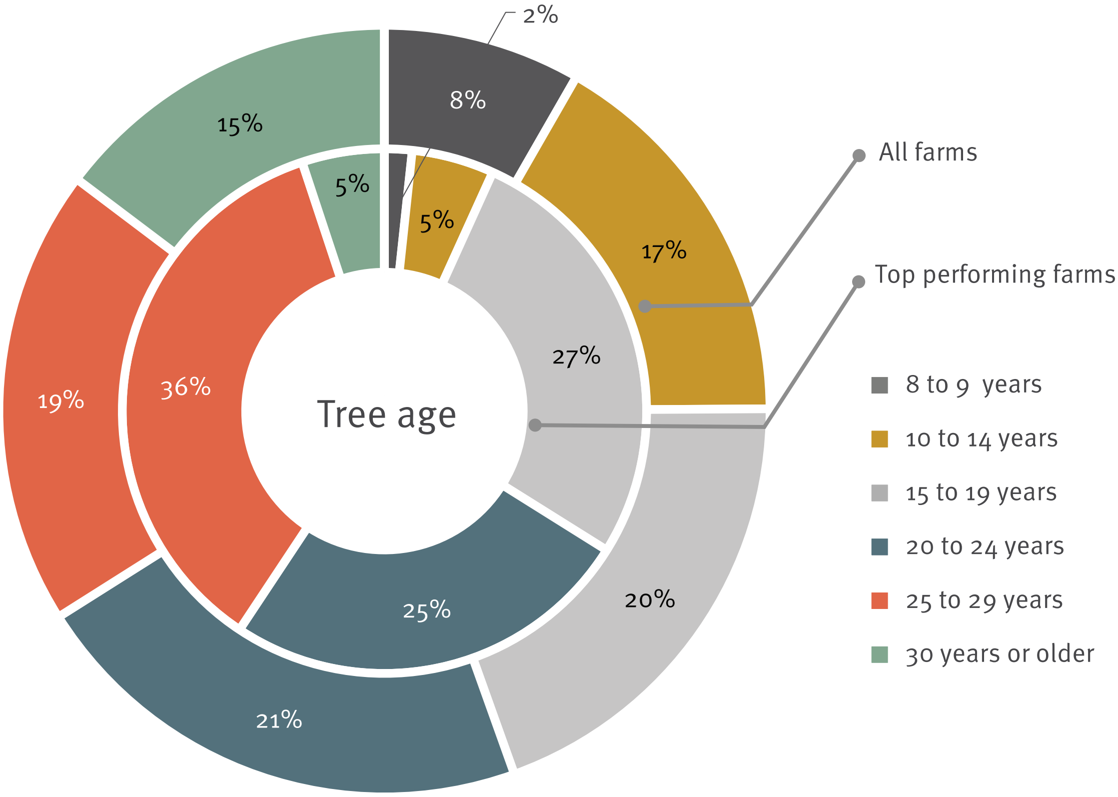


Figure 20: Average tree age of top performing farms vs the whole benchmark sample (2009 to 2016)

Figure 21 shows the average saleable tonnes per bearing hectare and saleable kernel recovery (SKR) for 2009 to 2016 for the top performing farms and compares these with all mature farms in the benchmark sample. Farms aged less than 10 years were excluded to ensure a fair comparison with the top 25%.

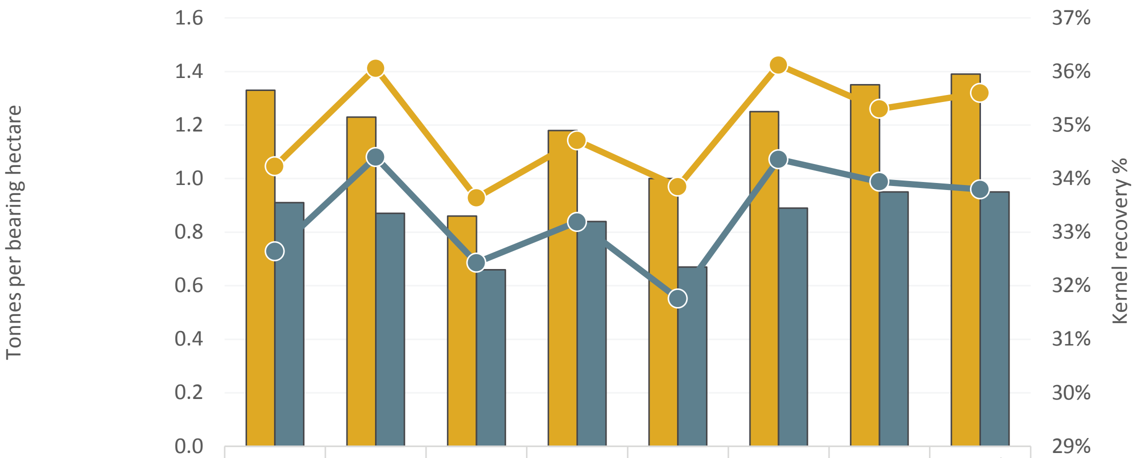
It is important to remember that top performing farms must have provided data for at least four years, including 2016, to be considered for inclusion within this group.

This chart confirms that top performing farms, like the broader benchmark sample, experience seasonal fluctuations in both yield and quality. It also shows that the pattern of this fluctuation is reasonably consistent between the two groups from season to season. The 2016 season showed a slight variation to this pattern between the two groups. Comparison with the 2015 season showed a small increase (0.3%) of saleable kernel recovery for the top performing farms, while all mature farms in the benchmark sample showed a slight decrease (0.14%).

Yield and quality trends 2009 - 2016

(Top performing farms vs all mature farms)

Saleable kernel production (bars) and saleable kernel recovery (lines)



	2009	2010	2011	2012	2013	2014	2015	2016
Yield - Top performing farms	1.33	1.23	0.86	1.18	1.00	1.25	1.35	1.39
Yield - All mature farms	0.91	0.87	0.66	0.84	0.67	0.89	0.95	0.95
SKR% - Top performing farms	34.23	36.06	33.64	34.71	33.85	36.12	35.30	35.60
SKR% - All mature farms	32.64	34.40	32.43	33.19	31.76	34.36	33.94	33.80

Figure 21: Yield and quality trends for top performing farms vs all mature farms in the whole benchmark sample (2009 to 2016)

The top performing farms also had a slight increase (3%) in average saleable kernel per bearing hectare compared to the previous 2015 season, while there was no yield increase for all mature farms in the benchmark sample, remaining the same at 0.95 tonnes of saleable kernel per bearing hectare.

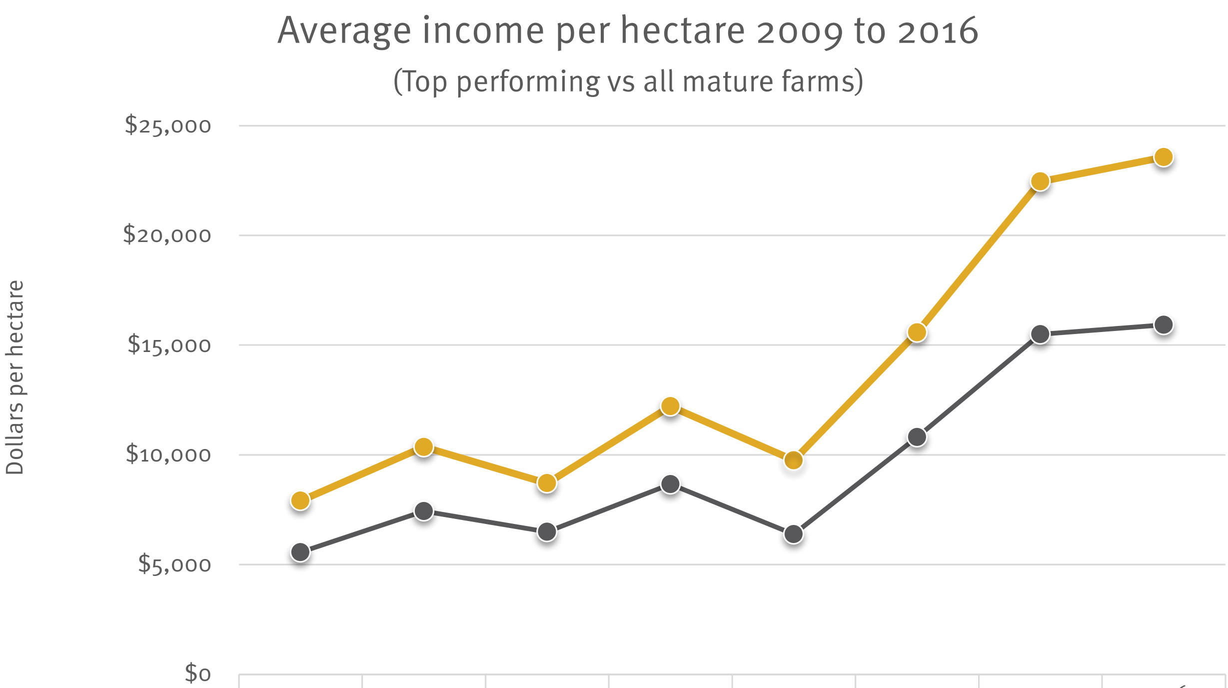
The lowest average annual yields per hectare for the top performing farms were 0.86 tonnes in 2011 and 1.00 tonnes in 2013. The highest average yields were 1.35 tonnes in 2015 and 1.39 tonnes in 2016. By comparison, the lowest average yields per hectare for all farms aged 10 years or older were 0.66 tonnes in 2011 and 0.67 tonnes in 2013 and the highest average yield was 0.95 tonnes in both 2015 and 2016. 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 2015 and 2016 for all mature farms in the benchmark sample.

The top performing farms averaged 1.20 tonnes of saleable kernel per bearing hectare over the eight years from 2009 to 2016 compared with 0.85 tonnes for all farms in the benchmark sample with an average tree age of 10 years or more. This is an increase of 41%, which is equivalent to an additional 350 kilograms of saleable kernel per bearing hectare amongst top performing farms.

The top performing farms (based on their average yield per hectare) also averaged 35.1% saleable kernel recovery (SKR) over the eight years compared with 33.4% for all mature farms. This is equivalent to a difference of 1.7% 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 1.2% in 2011 to 2.1% in 2013. The SKR difference means that the top performing farms also achieved a higher price per kilogram of nut-in-shell (NIS) each year than the average for mature farms in the benchmark sample.

Figure 22 compares average annual income per hectare for top performing farms vs the average of all mature farms in the benchmark sample. The table beneath the chart also shows the annual difference in estimated income per hectare between these groups.

Annual income estimates are based on average seasonal NIS production and base prices, adjusted for average saleable kernel recovery for each group. These income estimates exclude levies and production costs.

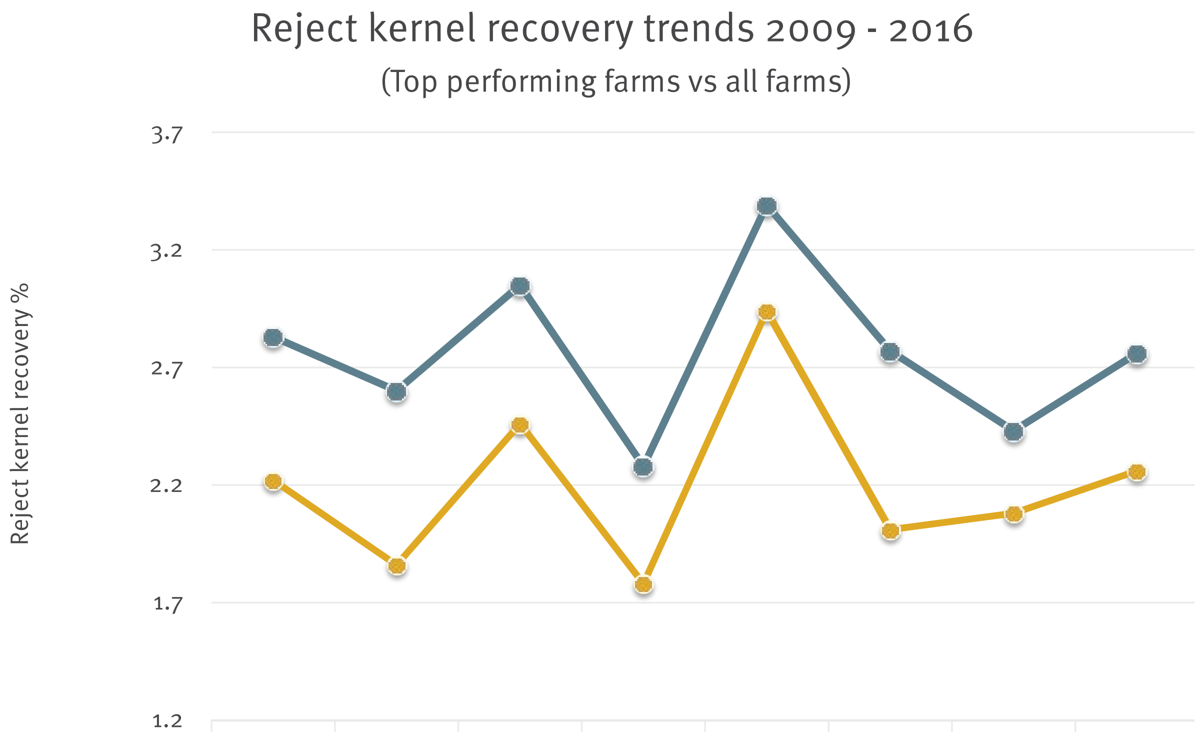


	2009	2010	2011	2012	2013	2014	2015	2016
Top performing farms	$7,909	$10,361	$8,708	$12,210	$9,748	$15,575	$22,454	$23,564
All mature farms	$5,563	$7,431	$6,489	$8,658	$6,381	$10,807	$15,496	$15,925
Difference	$2,346	$2,930	$2,219	$3,553	$3,367	$4,768	$6,958	$7,639

Figure 22: Average annual income per hectare for top performing farms vs mature farms in the benchmark sample (2009 to 2016)

Over the last eight seasons the average income per hectare for top performing farms has been more than $4200 higher than the average for all mature farms.

Figure 23 compares average reject kernel recovery (RKR) from 2009 to 2016 for the top performing farms with all farms in the benchmark sample. The top performing farms consistently achieved lower average RKR over the eight seasons compared with the benchmark average (2.21% vs 2.76%). The difference in average RKR between the two groups ranged from 0.35% to up to 0.76% over the eight seasons.



	2009	2010	2011	2012	2013	2014	2015	2016
Top performing farms	2.22	1.86	2.46	1.78	2.94	2.01	2.08	2.26

Figure 23: Average reject kernel recovery for the top performing farms vs all farms in the benchmark sample (2009 to 2016)

Figure 24 shows the average percentage of rejects by reject category for the top performing farms compared with all farms in the benchmark sample from 2009 to 2016. 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 with lower average rejects in each category compared with all farms in the benchmark sample over the eight seasons. The top performing farms for orchard productivity averaged 2.21% of reject kernel recovery over the eight seasons from 2009 to 2016 compared to 2.76% for all farms in the benchmark sample

Insect damage was the dominant reject category for most seasons from 2009 to 2016 for both top performing farms (average 0.82%) and all farms in the benchmark sample (average 0.93%).

Top performing farms averaged 0.13% lower immaturity rejects than the benchmark average over the eight seasons. Favourable rainfall patterns (particularly in South East Queensland) for the second consecutive year have led to a significant reduction in average rejects due to immaturity in 2015 and 2016 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 and immaturity were the two reject categories that showed the greatest average difference (both 0.13%) between the top performing farms and all farms in the benchmark sample over the eight seasons. Although immaturity levels increased in 2016 compared to the previous season for both sample groups, the levels were substantially less than the peak levels reached in 2013.

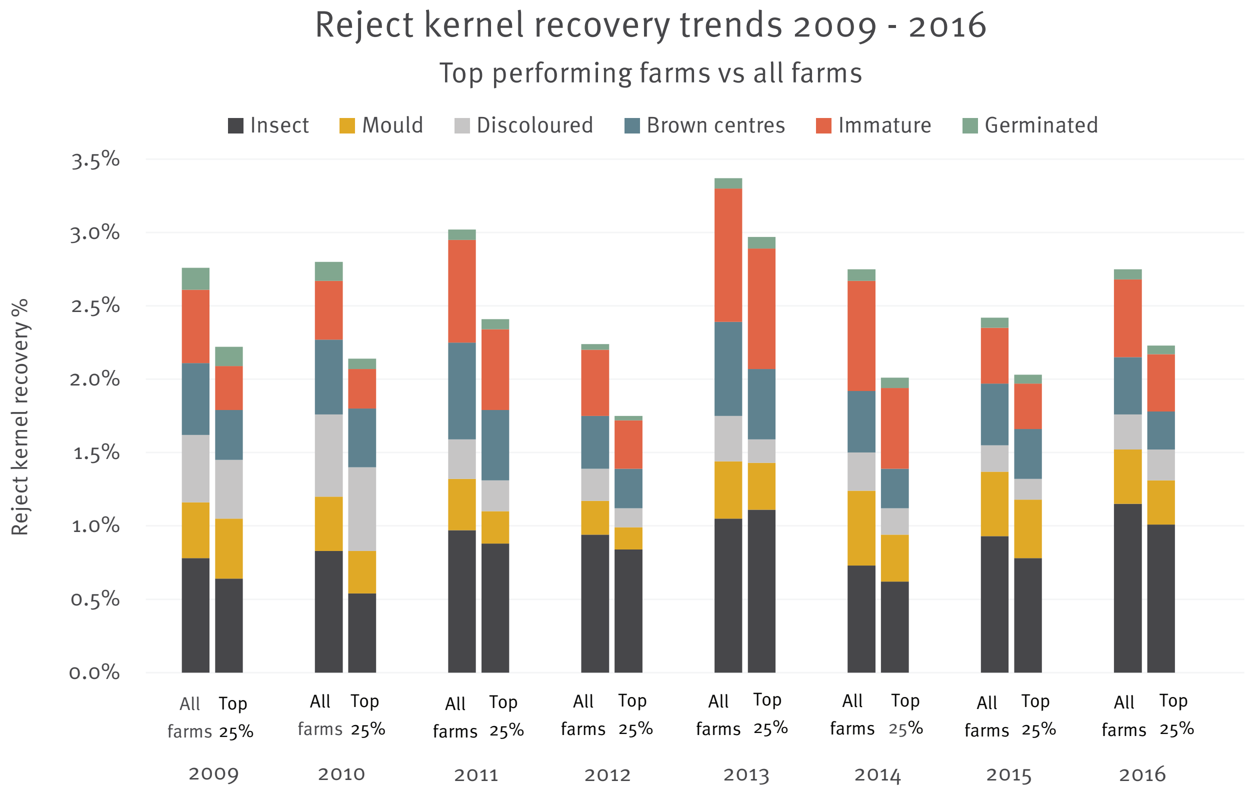
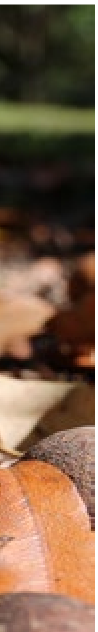


Figure 24: Seasonal comparison of reject categories for the top performing farms vs all farms (2009 to 2016)

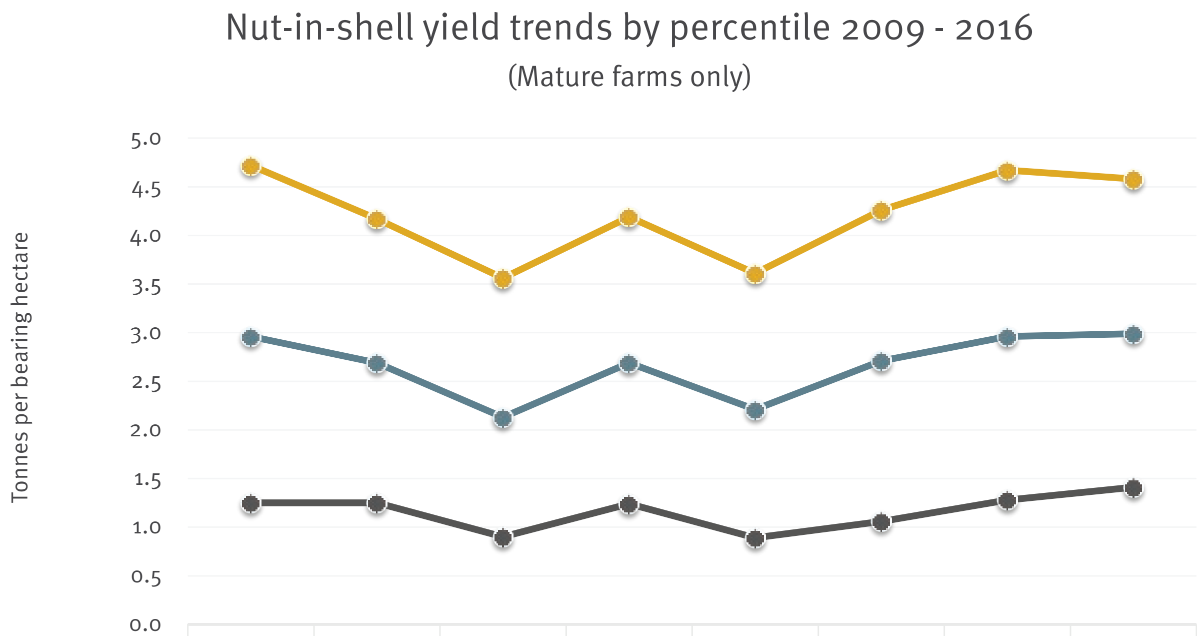


Productivity and quality percentiles

Averages for the top 25% and bottom 25% of the benchmark sample are compared with the sample average. It is important to note that the farms included in percentile averages are different for each yield or quality 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. 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.

Significant variability in both yield and quality was evident within the benchmark sample. Percentiles demonstrate the extent of this variability for various yield and quality attributes. Yield percentiles are based on mature farms to avoid the influence of young farms that are yet to reach full production. Quality percentiles are based on all farms in the benchmark sample.

Figure 25 compares the average tonnes of NIS per bearing hectare for the top 25%, bottom 25% and all mature farms in the benchmark sample for each year from 2009 to 2016. Average NIS yield increased within each of these groups from 2013 to 2015. It increased again from 2015 to 2016 for both the bottom 25% and the sample average, peaking in 2016. The top 25% showed the opposite trend with a slight decrease in NIS yield compared to the 2015 season.

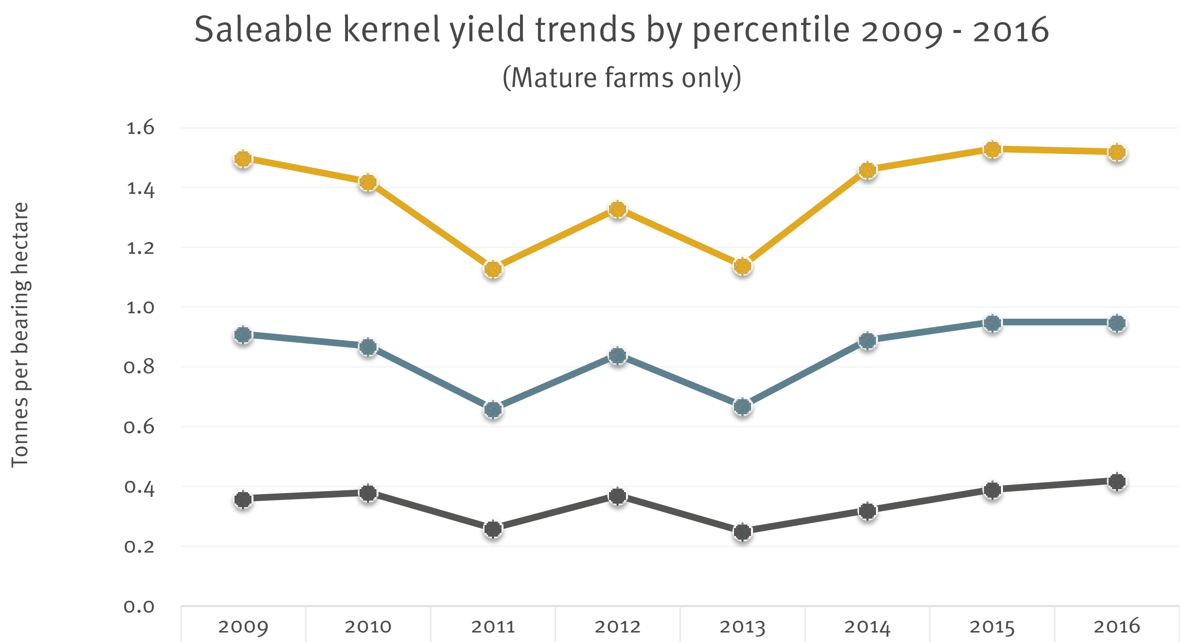


	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	4.72	4.17	3.56	4.19	3.61	4.26	4.67	4.58
All mature farms	2.96	2.69	2.13	2.69	2.21	2.71	2.96	2.99
Bottom 25%	1.25	1.25	0.90	1.24	0.89	1.06	1.28	1.41

Figure 25: Comparison of average mature farm yields of tonnes of nut-in-shell per bearing hectare (2009 to 2016)

Figure 26 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 2016. Saleable kernel peaked for each group in 2015 following increases over two consecutive seasons. It remained similar in 2016 for all percentile groups.

Analysis of data from 2009 to 2016 revealed substantial differences between the top and bottom 25% of mature farms for both nut-in-shell productivity (3.2 t/ha) and saleable kernel recovery (9.2%)

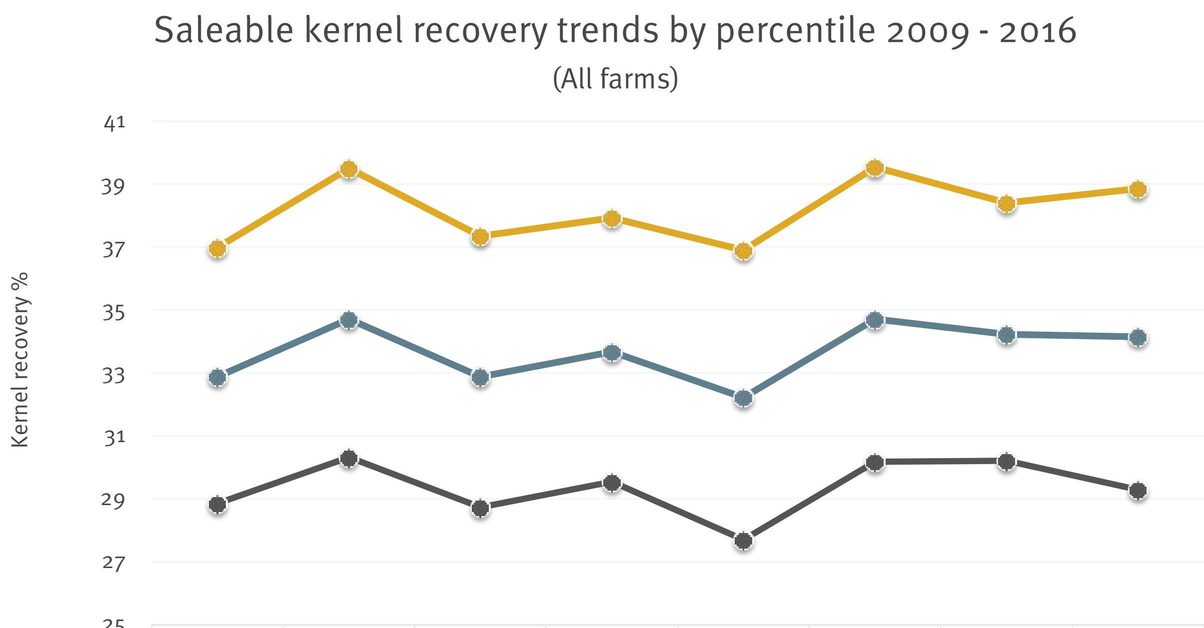


	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	1.50	1.42	1.13	1.33	1.14	1.46	1.53	1.52
All mature farms	0.91	0.87	0.66	0.84	0.67	0.89	0.95	0.95
Bottom 25%	0.36	0.38	0.26	0.37	0.25	0.32	0.39	0.42

Figure 26: Comparison of average mature farm yields of tonnes of saleable kernel per bearing hectare (2009 to 2016)

Figure 27 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 2016. SKR is equivalent to the sum of premium kernel recovery (PKR) and commercial kernel recovery (CKR).

Average SKR was higher in 2016 for the top 25% compared with 2015 but decreased slightly for the sample average and bottom 25%. The highest SKR for the top 25% was achieved in 2014 (39.54%). Average SKR was higher for all groups in the last three consecutive years (2014 to 2016) compared to the preceding three years (2011 to 2013).



	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	36.98	39.50	37.35	37.93	36.90	39.54	38.40	38.86
All farms	32.88	34.71	32.88	33.67	32.22	34.71	34.23	34.15
Bottom 25%	28.85	30.32	28.73	29.54	27.70	30.18	30.21	29.29

Figure 27: Comparison of average farm saleable kernel recovery (2009 to 2016)

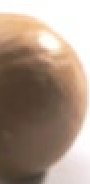
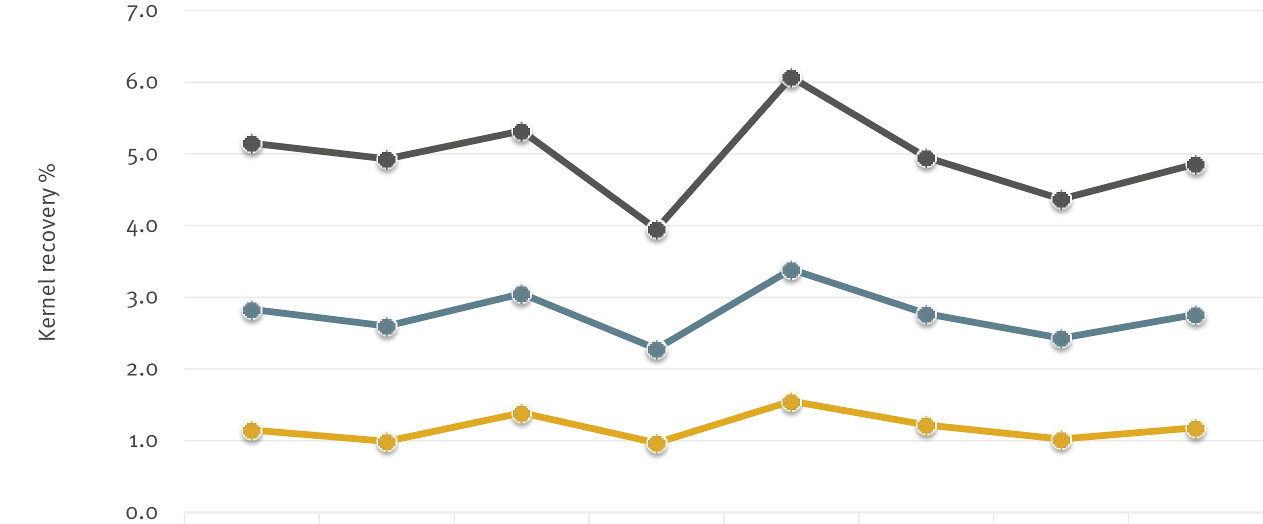


Figure 28 compares average reject kernel recovery (RKR) for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2016. RKR and associated reject category percentiles are inverted as low RKR and individual reject levels represent better quality.

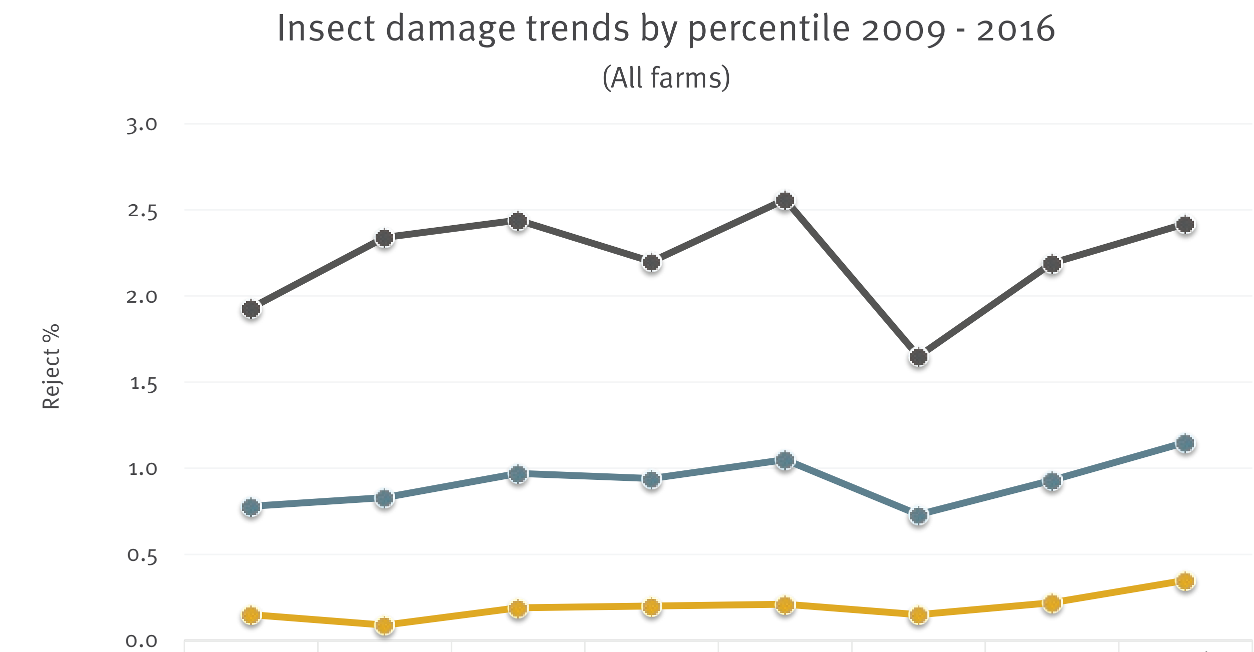
RKR increased across all groups from 2015 to 2016 following decreases from 2013 to 2015. Average RKR for the 2016 season was only marginally less than the 2014 season. Over the eight seasons average RKR levels were lowest in 2012 and peaked in 2013 across all percentile groups.



	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	1.15	0.99	1.39	0.97	1.55	1.22	1.02	1.18
All farms	2.83	2.60	3.05	2.28	3.39	2.77	2.43	2.76
Bottom 25%	5.15	4.93	5.32	3.95	6.07	4.95	4.37	4.86

Figure 28: Comparison of average farm reject kernel recovery (2009 to 2016)

Figure 29 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 2016. Average rejects due to insect damage decreased markedly from 2013 to 2014, then increased from 2014 to 2016 across all groups. Insect damage caused the highest percentage of rejects in 2016 across all regions and percentiles.



	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	0.15	0.09	0.19	0.20	0.21	0.15	0.22	0.35
All farms	0.78	0.83	0.97	0.94	1.05	0.73	0.93	1.15
Bottom 25%	1.93	2.34	2.44	2.20	2.56	1.65	2.19	2.42

Figure 29: Comparison of average insect damage reject levels (2009 to 2016)

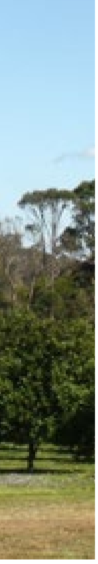
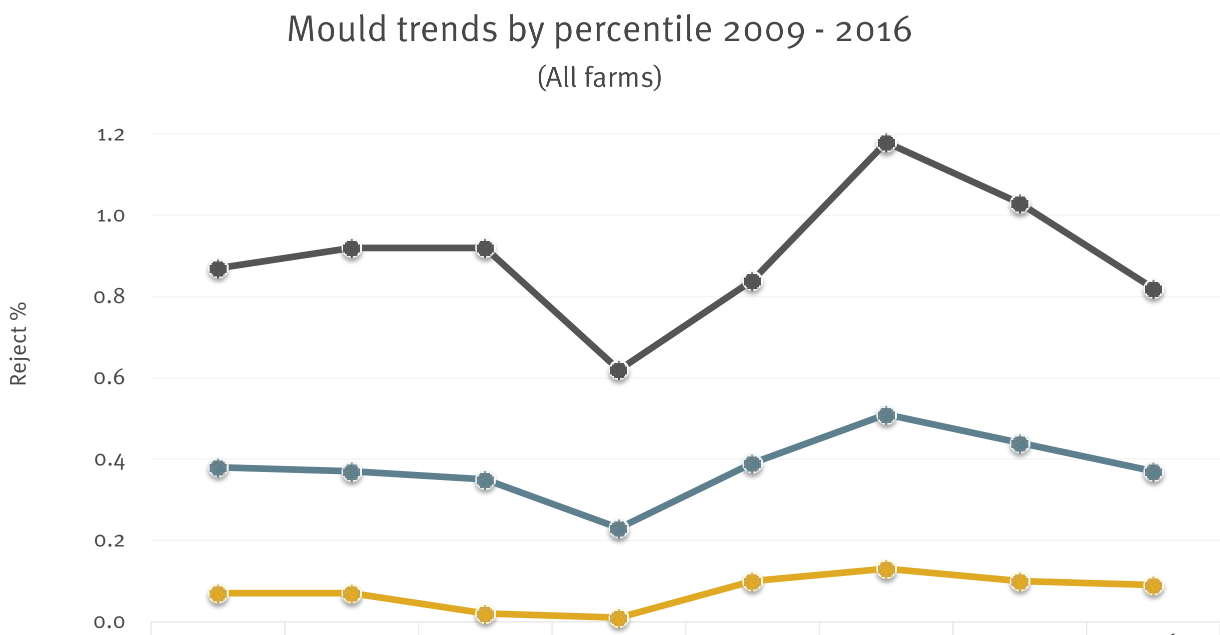


Figure 30 shows average rejects due to mould for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2016.

Average mould reject levels decreased for the second consecutive year across all groups following successive increases in the previous two seasons. Mould reject levels were the highest in 2014 for each percentile group.

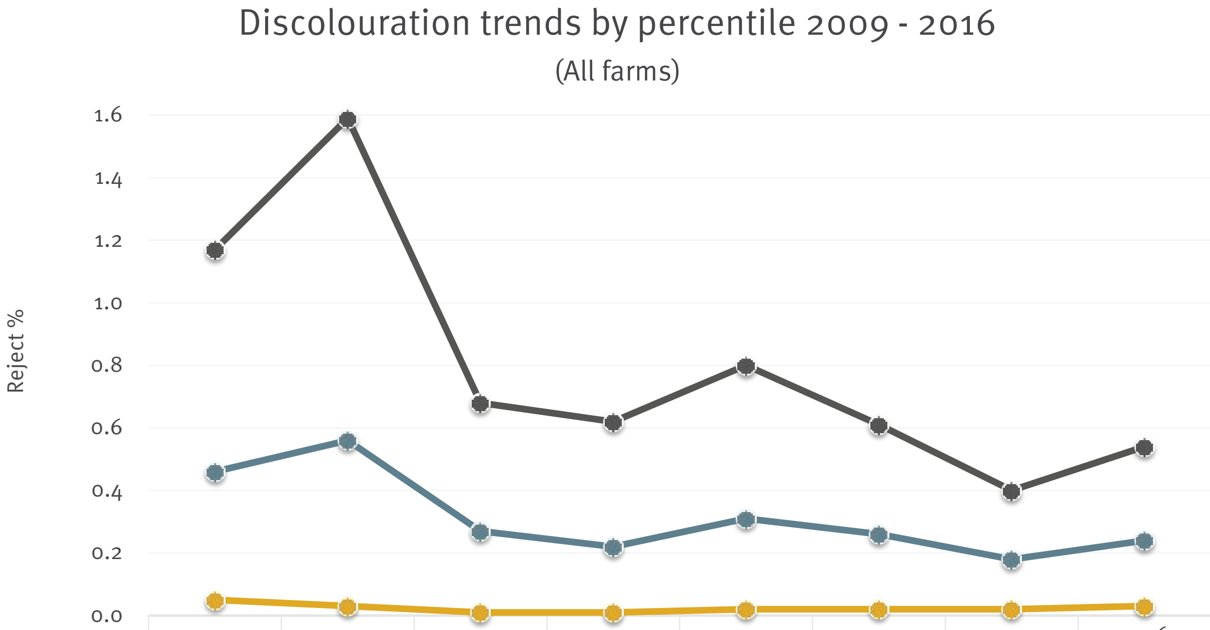


	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	0.07	0.07	0.02	0.01	0.10	0.13	0.10	0.09
All farms	0.38	0.37	0.35	0.23	0.39	0.51	0.44	0.37
Bottom 25%	0.87	0.92	0.92	0.62	0.84	1.18	1.03	0.82

Figure 30: Comparison of average mould reject levels (2009 to 2016)

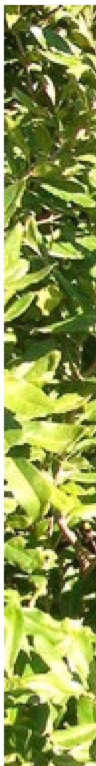
Figure 31 shows average rejects due to discolouration for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2016.

Average discolouration reject levels increased slightly from 2015 to 2016 across all percentile groups in the benchmark sample. The largest decrease across the eight seasons is shown in the bottom 25%, from a peak of 1.59% in 2010 down to a low of 0.40% in 2015.



	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	0.05	0.03	0.01	0.01	0.02	0.02	0.02	0.03
All farms	0.46	0.56	0.27	0.22	0.31	0.26	0.18	0.24
Bottom 25%	1.17	1.59	0.68	0.62	0.80	0.61	0.40	0.54

Figure 31: Comparison of average discolouration reject levels (2009 to 2016)



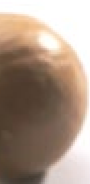
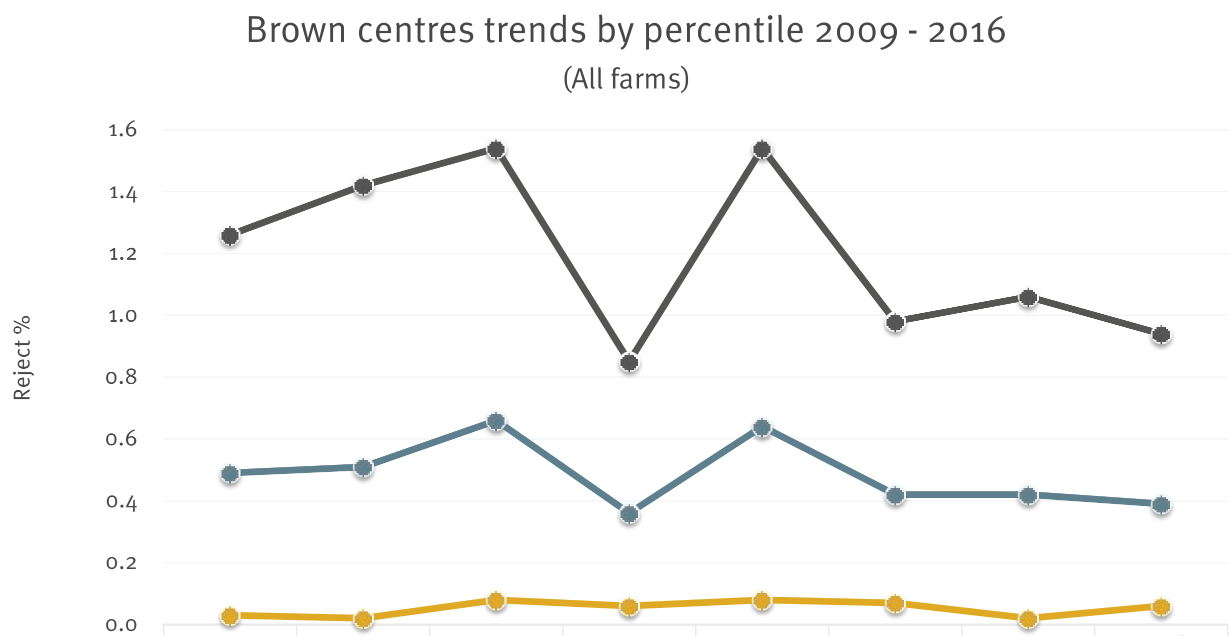


Figure 32 shows average rejects due to brown centres for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2016.

Average brown centre reject levels across all percentile groups were similar in 2014, 2015 and 2016 and significantly lower than in 2013 and from 2009 to 2011.

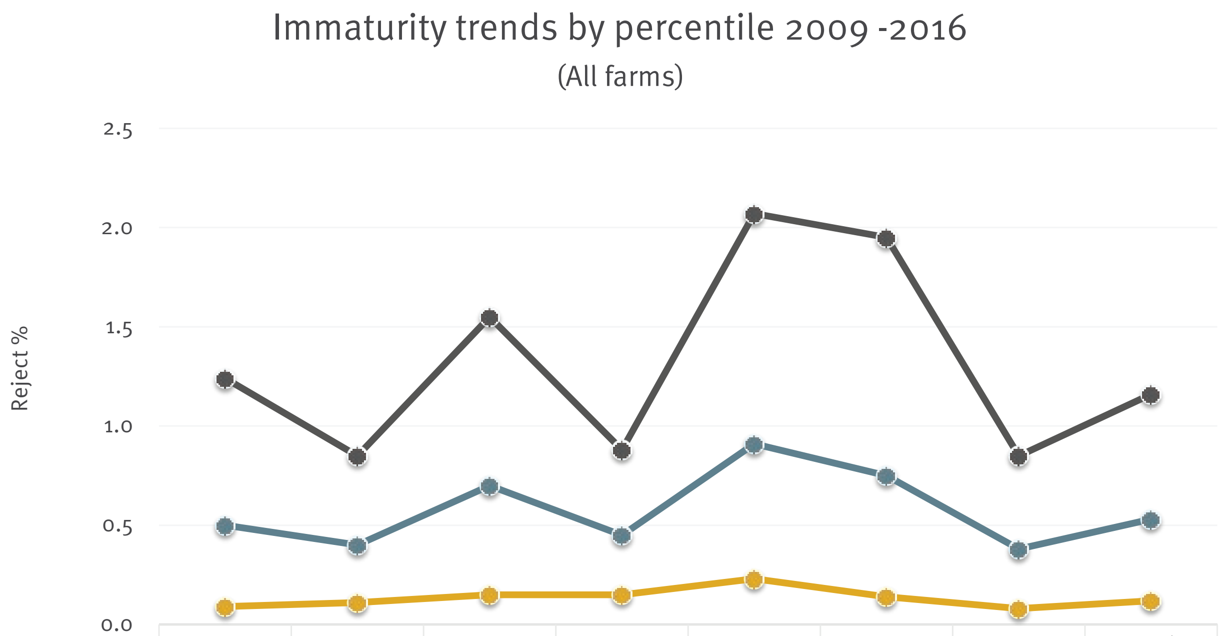


	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	0.03	0.02	0.08	0.06	0.08	0.07	0.02	0.06
All farms	0.49	0.51	0.66	0.36	0.64	0.42	0.42	0.39
Bottom 25%	1.26	1.42	1.54	0.85	1.54	0.98	1.06	0.94

Figure 32: Comparison of average brown centres reject levels (2009 to 2016)

Figure 33 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 2016.

Average immaturity reject levels reached their lowest level in 2015. This followed a major reduction from peak levels in 2013 and 2014 when immaturity was particularly prevalent in the South East Queensland (SEQ) region. In 2016 average immaturity levels rose across all groups. The bottom 25% recorded the largest percentage increase in 2016 of 0.31%.



	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	0.09	0.11	0.15	0.15	0.23	0.14	0.08	0.12
All farms	0.50	0.40	0.70	0.45	0.91	0.75	0.38	0.53
Bottom 25%	1.24	0.85	1.55	0.88	2.07	1.95	0.85	1.16

Figure 33: Comparison of average immaturity reject levels (2009 to 2016)

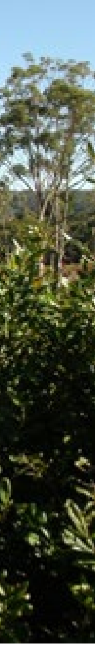
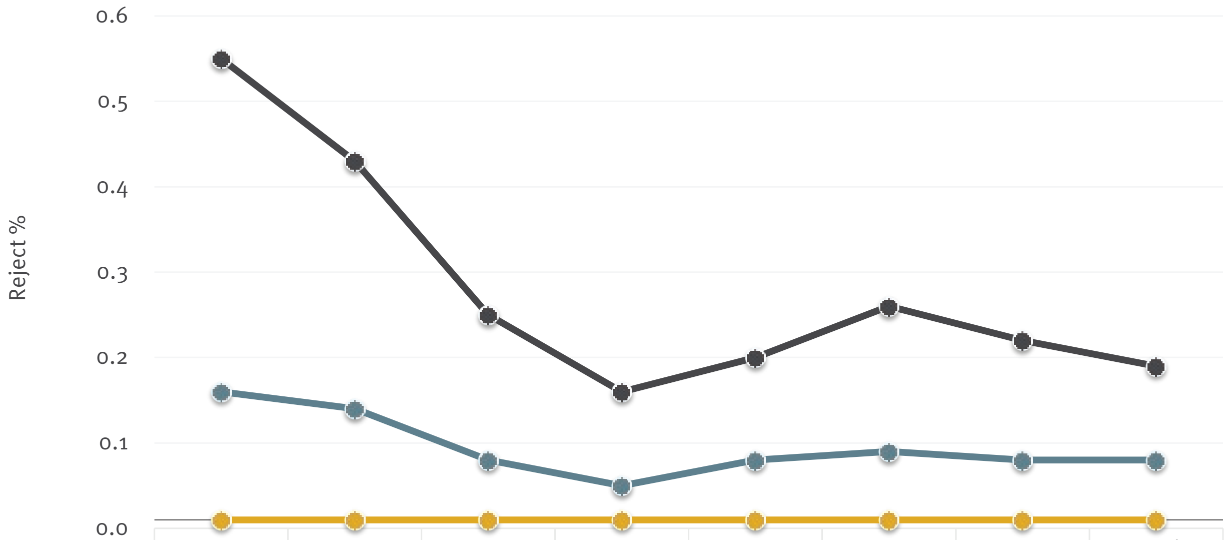


Figure 34 shows average rejects due to germination for the top 25%, bottom 25% and all farms in the benchmark sample for each year from 2009 to 2016. Germination represented the lowest of all reject categories for each group from 2009 to 2016.

There was a slight decrease in average germination reject levels amongst the bottom 25% of farms from 2015 to 2016. The top 25% of farms recorded no germination rejects from 2009 to 2016. Since 2011 germination levels amongst the bottom 25% have remained between 0.15% and 0.25%, following peak levels of 0.54% in 2009 and 0.42% in 2010.

Germination trends by percentile 2009 - 2016

(All farms)



	2009	2010	2011	2012	2013	2014	2015	2016
Top 25%	0.00	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	0.07
Bottom 25%	0.54	0.42	0.24	0.15	0.19	0.25	0.21	0.18

Figure 34: Comparison of average germination reject levels (2009 to 2016)

Productivity and quality by region

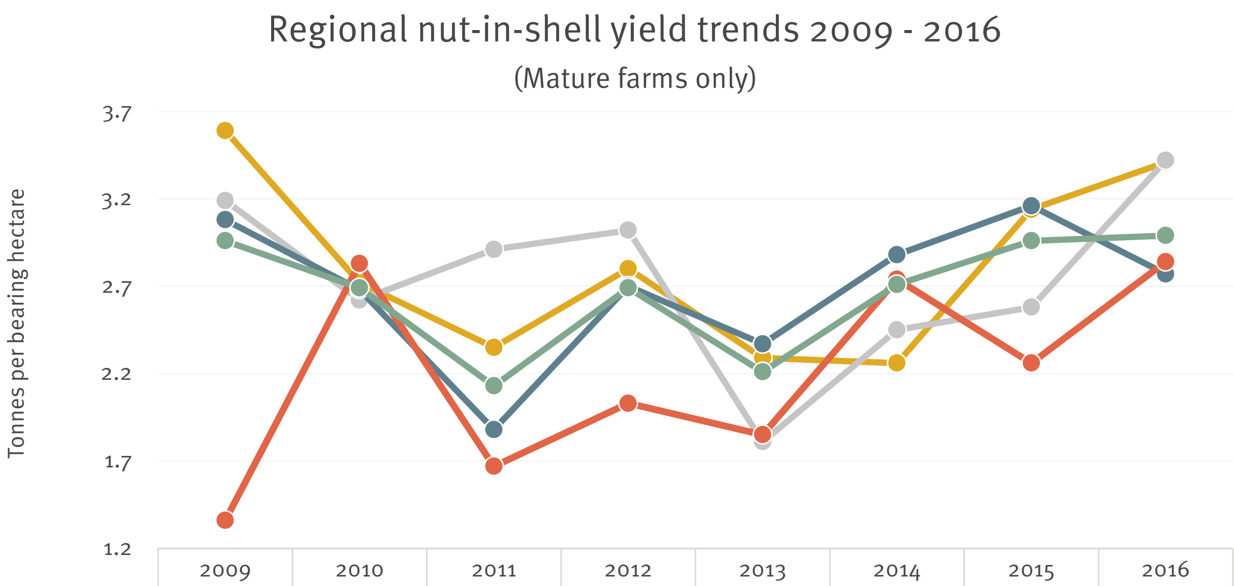
Yield and quality results were compared across four major production regions including Central Queensland (CQ), South East Queensland (SEQ), Northern Rivers of New South Wales (NRNSW) and the Mid North Coast of New South Wales (MNNSW). Figure 35 compares average annual nut-in-shell (NIS) yield per bearing hectare for mature farms (10 or more years old) in each of these regions. These averages are unweighted, so all farms exert equal influence regardless of their size.

The region with the highest average mature NIS yield over the last eight years was CQ (2.83 t/ha), followed by SEQ (2.74 t/ha), NRNSW (2.71 t/ha) then MNNSW (2.23 t/ha).

Farms in the SEQ and CQ regions showed the highest average NIS per hectare in 2016 (3.42 and 3.41 t/ha respectively) following consecutive increases in both of these regions over the last two seasons. SEQ farms had the largest average increase in NIS per hectare from 2015 to 2016 (0.84 t/ha). CQ farms had the largest increase in average NIS per hectare over the last two seasons (1.15 t/ha) followed by SEQ (0.97 t/ha).

In 2016 MNNSW farms achieved their highest average NIS yield per hectare since benchmarking began in 2009 (2.84 t/ha). This follows a decline from 2014 to 2015.

NRNSW average yield was the highest of all regions in 2015 (3.16 t/ha) but fell in 2016 to be the lowest of all regions (2.77 t/ha). This follows consecutive yield increases in the previous two seasons. Storms and wet weather at flowering affected yield within the NRNSW region in 2016.



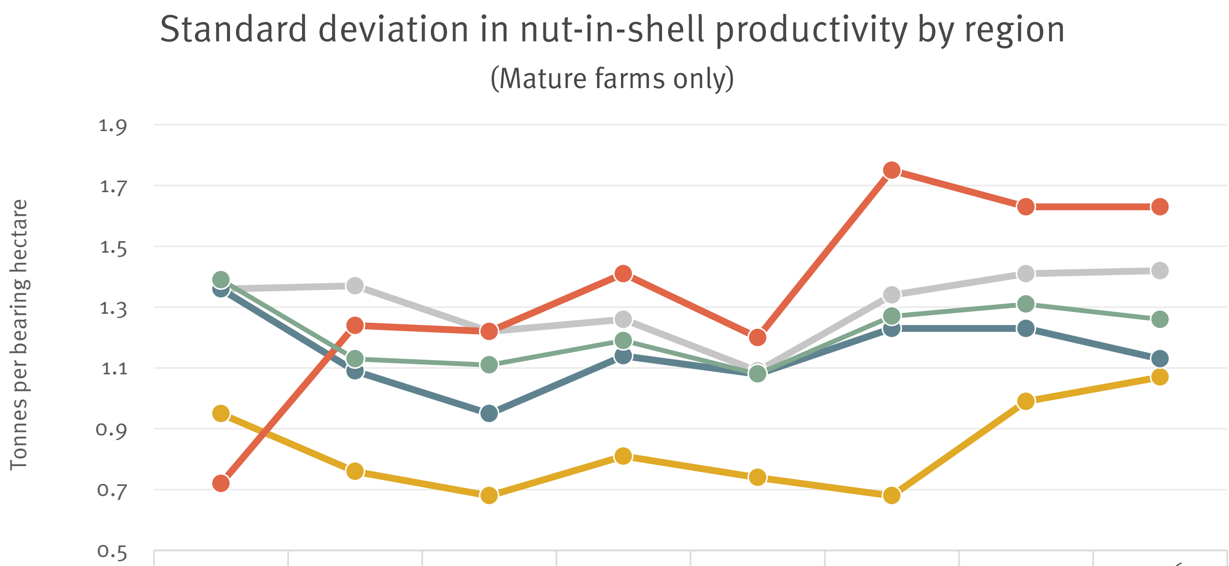
	2009	2010	2011	2012	2013	2014	2015	2016
CQ	3.59	2.72	2.35	2.80	2.29	2.26	3.14	3.41
SEQ	3.19	2.62	2.91	3.02	1.81	2.45	2.58	3.42
NRNSW	3.08	2.68	1.88	2.70	2.37	2.88	3.16	2.77
MNNSW	1.36	2.83	1.67	2.03	1.85	2.74	2.26	2.84
All regions	2.96	2.69	2.13	2.69	2.21	2.71	2.96	2.99

Figure 35: Comparison of average regional nut-in-shell yields per bearing hectare for mature farms (2009 to 2016)

There is high variability in yield between farms within the benchmark sample. Figure 36 shows the extent of this variability between regions and seasons. The figure shows annual standard deviation in NIS productivity for each of the major production regions.

The charts shows the extent to which farm productivity varies from the average, shown as tonnes of NIS per bearing hectare on the Y-axis. Lower points on these lines mean less variability between farms in any given season and region. It is important to view this chart in conjunction with figure 35 above as it describes the amount of variability around the NIS productivity averages shown in that chart.

Farms in the CQ region had the lowest average variability in NIS productivity from 2009 to 2016 (0.98 t/ha), followed by NRNSW (1.21 t/ha), SEQ (1.39 t/ha) and MNNSW (1.47 t/ha). There has been no significant reduction in this variability within any of these regions over that time. Variability among farms in MNNSW in particular has increased since benchmarking began in 2009.



	2009	2010	2011	2012	2013	2014	2015	2016
CQ	0.95	0.76	0.68	0.81	0.74	0.68	0.99	1.07
SEQ	1.36	1.37	1.22	1.26	1.09	1.34	1.41	1.42
NRNSW	1.36	1.09	0.95	1.14	1.08	1.23	1.23	1.13
MNNSW	0.72	1.24	1.22	1.41	1.20	1.75	1.63	1.63
All regions	1.39	1.13	1.11	1.19	1.08	1.27	1.31	1.26

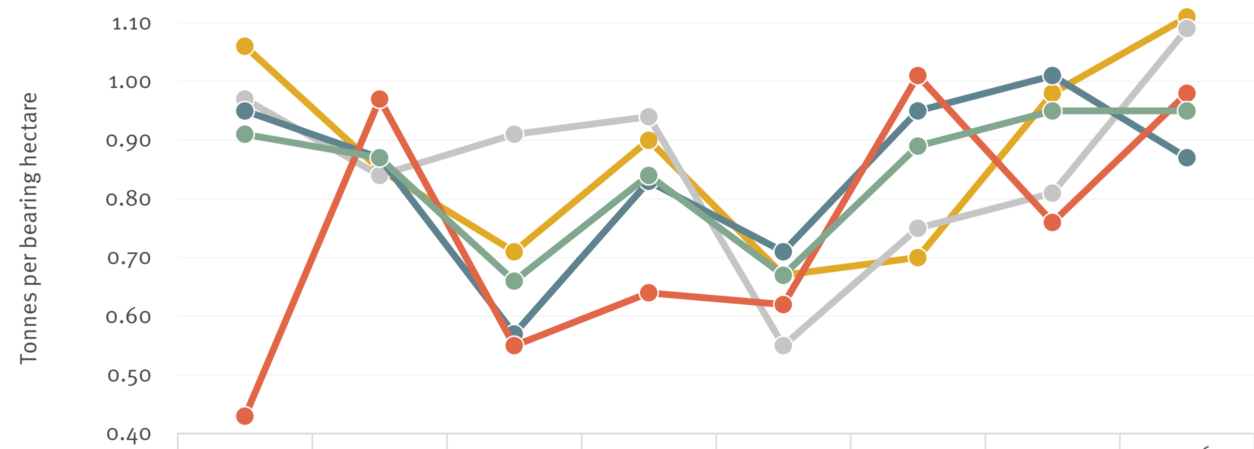
Figure 36: Standard deviation in annual regional nut-in-shell productivity per bearing hectare for mature farms (2009 to 2016)

Figure 37 compares average yields of saleable kernel per bearing hectare from 2009 to 2016 for mature farms in each of the four regions in the benchmark sample. This chart shows a similar general trend to NIS productivity for this period, with some variation in particular regions and seasons due to variation in saleable kernel recovery.

Farms in the CQ region achieved the highest average saleable kernel productivity from 2009 to 2016 (0.88 t/ha), followed by SEQ and NRNSW (each 0.85 t/ha) and MNNSW (0.76 t/ha). The NRNSW region had the lowest average saleable kernel yield per bearing hectare in 2016 after having the highest average yield in 2015.

Regional saleable kernel yield trends 2009 - 2016

(Mature farms only)



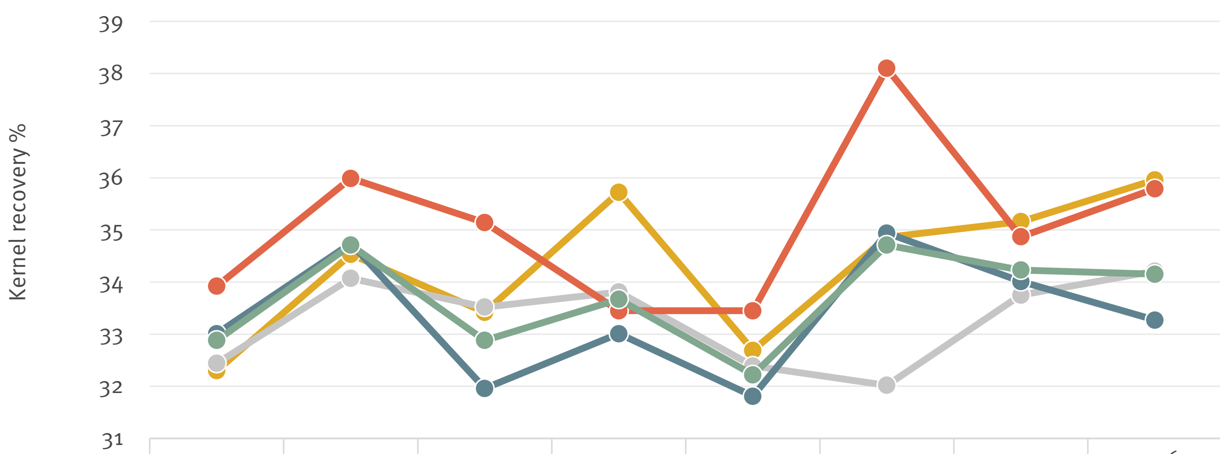
	2009	2010	2011	2012	2013	2014	2015	2016
CQ	1.06	0.85	0.71	0.90	0.67	0.70	0.98	1.11
SEQ	0.97	0.84	0.91	0.94	0.55	0.75	0.81	1.09
NRNSW	0.95	0.87	0.57	0.83	0.71	0.95	1.01	0.87
MNNSW	0.43	0.97	0.55	0.64	0.62	1.01	0.76	0.98
All regions	0.91	0.87	0.66	0.84	0.67	0.89	0.95	0.95

Figure 37: Comparison of average regional yields of tonnes of saleable kernel per bearing hectare (2009 to 2016)

Figure 38 compares average regional saleable kernel recovery (SKR) for farms in each major production region from 2009 to 2016. SKR is the sum of premium kernel recovery (PKR) and commercial kernel recovery (CKR).

Across the benchmark sample average SKR was slightly lower in 2016 (34.15%) than the previous season (34.23%). Increases in average SKR were evident in 2016 in MNNSW (up 0.92%), CQ (up 0.8%) and SEQ (up 0.46%). Average SKR fell by 0.74% in the NRNSW region.

The MNNSW region had the highest average SKR of all regions for the 2009 to 2016 period (35.1%) followed by CQ (34.5%), NRNSW (33.4%) and SEQ (33.3%). The high average SKR in the MNNSW region is influenced by the high percentage of "A" series cultivars grown in this region, which tend to have high kernel recoveries. Table 1 also shows that trees in CQ are, on average, younger than those in the other production regions. Analysis of productivity by tree age data shows farms with a younger average tree age tend to have higher SKR.



	2009	2010	2011	2012	2013	2014	2015	2016
CQ	32.30	34.53	33.42	35.72	32.69	34.86	35.16	35.96
SEQ	32.44	34.07	33.52	33.81	32.39	32.02	33.75	34.21
NRNSW	33.01	34.74	31.96	33.01	31.81	34.94	34.01	33.27
MNNSW	33.92	35.99	35.14	33.45	33.45	38.10	34.87	35.79
All regions	32.88	34.71	32.88	33.67	32.22	34.71	34.23	34.15

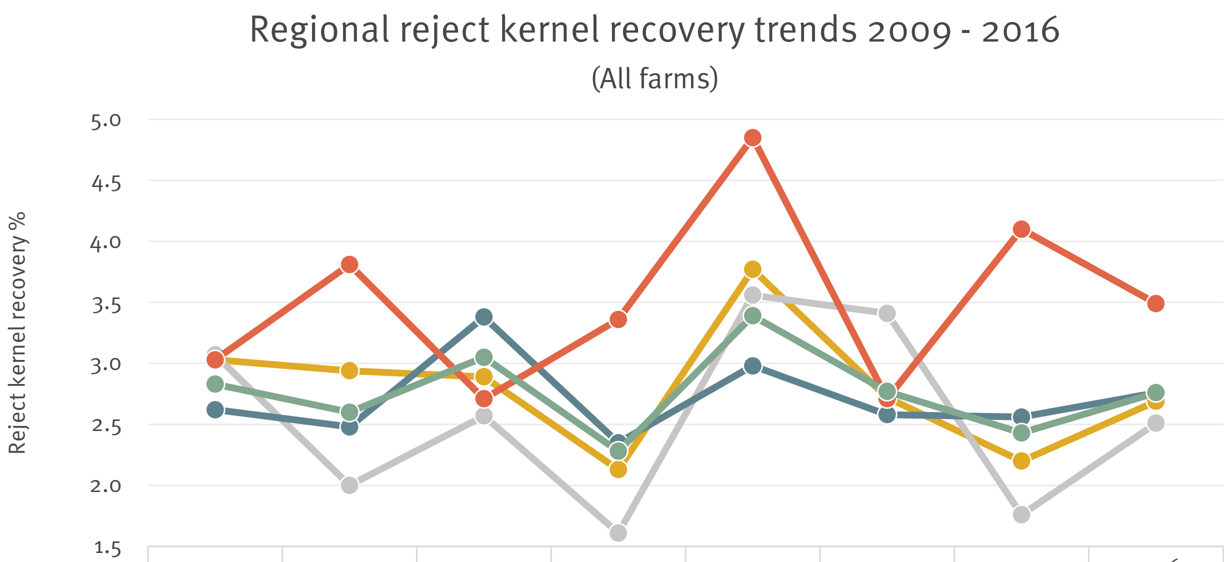
Figure 38: Comparison of average regional saleable kernel recoveries (2009 to 2016)

Figure 39 compares average reject kernel recovery (RKR) from 2009 to 2016 for each region.

Across the benchmark sample average RKR was higher in 2016 (2.76%) compared with the previous season (2.43%). Increases in average RKR were evident in 2016 in SEQ (up 0.75%), CQ (up 0.49%) and NRNSW (up 0.2%), largely due to increased insect damage, immaturity and discolouration.

In MNNSW average RKR fell by 0.61% in 2016 mainly due to reductions in insect damage, mould and brown centres.

The MNNSW region had the highest long-term average RKR of all regions for the 2009 to 2016 period (3.5%) followed by CQ (2.78%), NRNSW (2.7%) and SEQ (2.55%).



	2009	2010	2011	2012	2013	2014	2015	2016
CQ	3.03	2.94	2.89	2.13	3.77	2.72	2.20	2.69
SEQ	3.07	2.00	2.57	1.61	3.56	3.41	1.76	2.51
NRNSW	2.62	2.48	3.38	2.35	2.98	2.58	2.56	2.76
MNNSW	3.03	3.81	2.71	3.36	4.85	2.71	4.10	3.49
All regions	2.83	2.60	3.05	2.28	3.39	2.77	2.43	2.76

Figure 39: Comparison of average regional reject kernel recoveries (2009 to 2016)

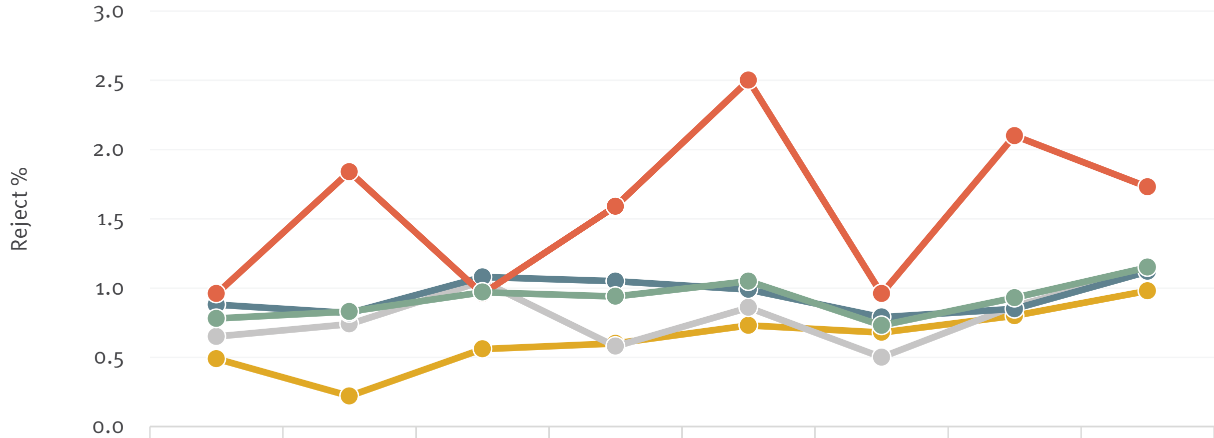
Figure 40 shows average rejects due to insect damage for participating farms in each of the four major production regions from 2009 to 2016.

In 2016 average insect damage reached its highest level (1.15%) since benchmarking began in 2009. Insect damage was the leading cause of factory reject kernel across all regions in 2016.

Despite reduced damage levels in 2016 in MNNSW, average insect damage (1.73%) remained higher than in all other regions.

Regional insect damage trends 2009 - 2016

(All farms)

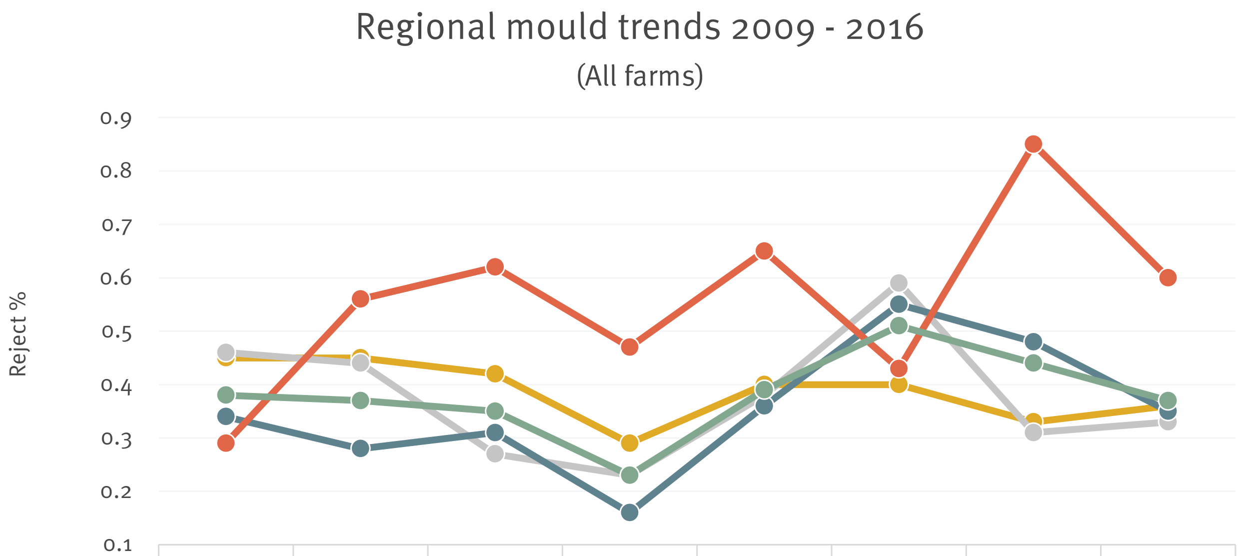


	2009	2010	2011	2012	2013	2014	2015	2016
CQ	0.49	0.22	0.56	0.60	0.73	0.68	0.80	0.98
SEQ	0.65	0.74	1.05	0.58	0.86	0.50	0.87	1.13
NRNSW	0.88	0.82	1.08	1.05	0.99	0.79	0.85	1.12
MNNSW	0.96	1.84	0.96	1.59	2.50	0.96	2.10	1.73
All regions	0.78	0.83	0.97	0.94	1.05	0.73	0.93	1.15

Figure 40: Comparison of average regional insect damage reject levels (2009 to 2016)

Figure 41 shows average rejects due to mould from 2009 to 2016 for each of the four regions in the benchmark sample.

From 2015 to 2016 average mould rejects decreased among NSW farms but increased slightly among Queensland farms. Average mould levels across all regions were similar to previous seasons. Mould rejects in MNNSW were substantially higher than in other regions in all seasons other than 2009 and 2014.



	2009	2010	2011	2012	2013	2014	2015	2016
CQ	0.45	0.45	0.42	0.29	0.40	0.40	0.33	0.36
SEQ	0.46	0.44	0.27	0.23	0.38	0.59	0.31	0.33
NRNSW	0.34	0.28	0.31	0.16	0.36	0.55	0.48	0.35
MNNSW	0.29	0.56	0.62	0.47	0.65	0.43	0.85	0.60
All regions	0.38	0.37	0.35	0.23	0.39	0.51	0.44	0.37

Figure 41: Comparison of average regional mould reject levels (2009 to 2016)

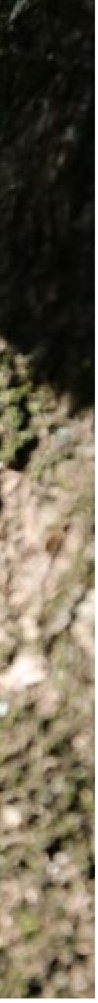
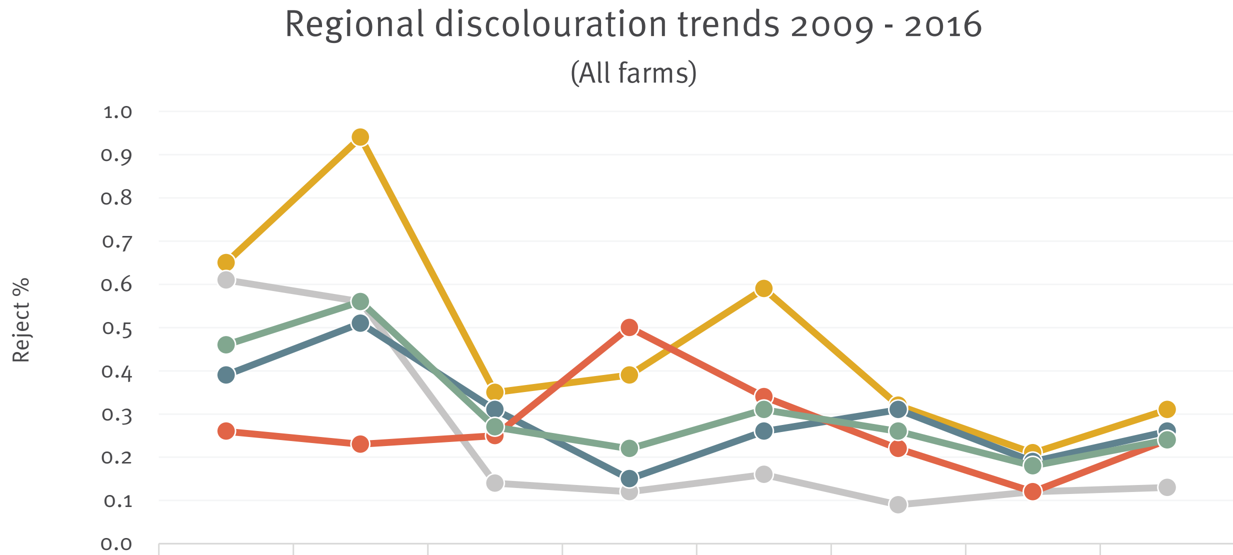


Figure 42 shows average rejects due to discolouration from 2009 to 2016 for each of the four regions in the benchmark sample.

Although average discolouration rejects increased across all regions in 2016 they remained lower than most other seasons since 2009. Discolouration was the reject category where average reject levels were the most uniform in 2016. SEQ farms had the lowest average rejects due to discolouration in each season from 2011 to 2016.



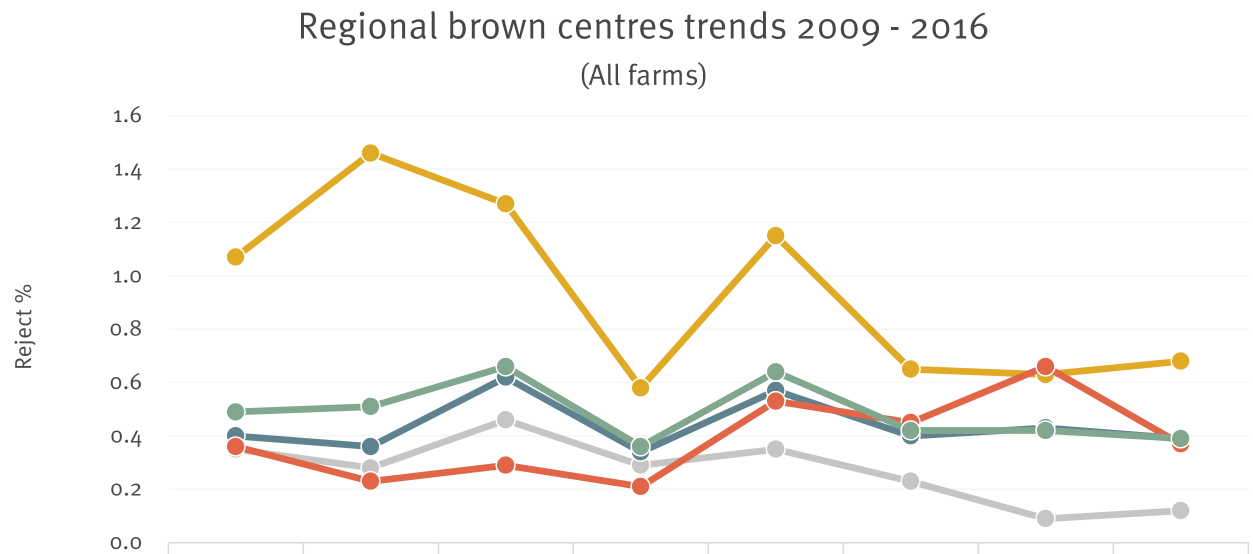
	2009	2010	2011	2012	2013	2014	2015	2016
CQ	0.65	0.94	0.35	0.39	0.59	0.32	0.21	0.31
SEQ	0.61	0.56	0.14	0.12	0.16	0.09	0.12	0.13
NRNSW	0.39	0.51	0.31	0.15	0.26	0.31	0.19	0.26
MNNSW	0.26	0.23	0.25	0.50	0.34	0.22	0.12	0.24
All regions	0.46	0.56	0.27	0.22	0.31	0.26	0.18	0.24

Figure 42: Comparison of average regional discolouration reject levels (2009 to 2016)

Figure 43 shows average rejects due to brown centres from 2009 to 2016 for each of the four regions in the benchmark sample.

In 2016 average rejects due to brown centres increased slightly among Queensland farms but decreased in NSW, particularly in the MNNSW region. The average for 2016 across all regions was slightly lower than for 2015 (0.39% vs 0.42%). Despite a slight increase among SEQ farms in 2016, brown centres reject levels in this region have remained lower than in any other region since 2013.

In 2016 and in most previous seasons, farms in the CQ region have had higher average rejects due to brown centres than those in other regions. 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. Despite CQ farms having the highest regional average in most seasons the average level of rejects due to brown centres was significantly lower from 2014 to 2016 than from 2009 to 2011 and in 2013.



	2009	2010	2011	2012	2013	2014	2015	2016
CQ	1.07	1.46	1.27	0.58	1.15	0.65	0.63	0.68
SEQ	0.35	0.28	0.46	0.29	0.35	0.23	0.09	0.12
NRNSW	0.40	0.36	0.62	0.34	0.57	0.40	0.43	0.39
MNNSW	0.36	0.23	0.29	0.21	0.53	0.45	0.66	0.37
All regions	0.49	0.51	0.66	0.36	0.64	0.42	0.42	0.39

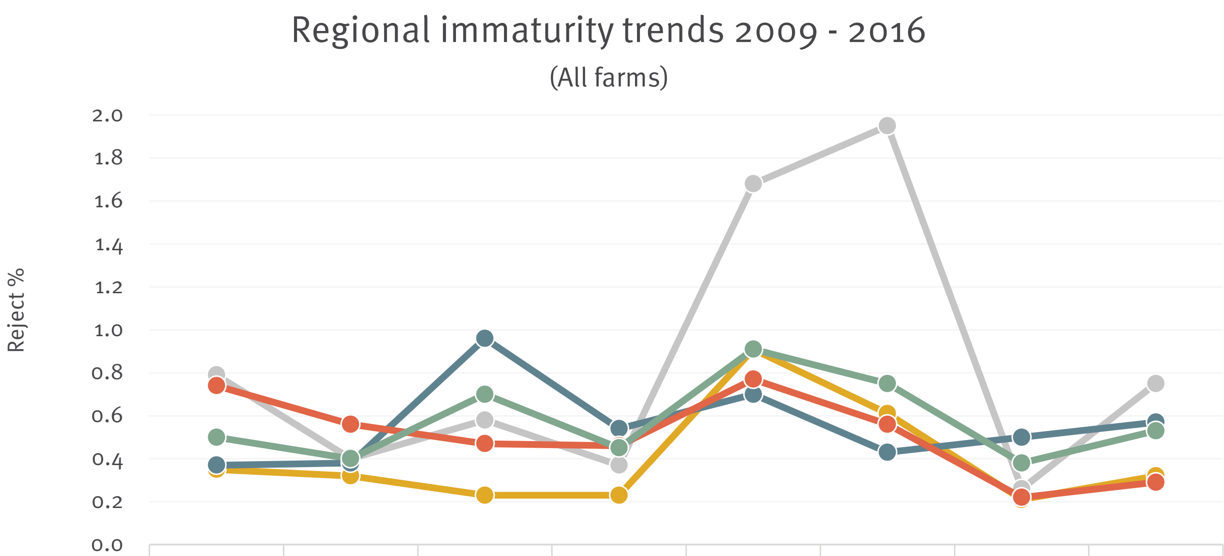
Figure 43: Comparison of average regional brown centres reject levels (2009 to 2016)

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

Figure 44 shows average rejects due to immaturity from 2009 to 2016 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 benchmarking began in 2009. Immaturity rejects increased again across all regions in 2016, especially in SEQ. Previous high immaturity levels in SEQ in 2013 and 2014 have largely been attributed to very dry conditions leading to moisture stress during nut growth and development and oil accumulation. 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 2016 and was not considered a major cause of immaturity in these seasons.

Farms in the CQ and MNNSW regions had the lowest average rejects due to immaturity in 2015 and 2016.

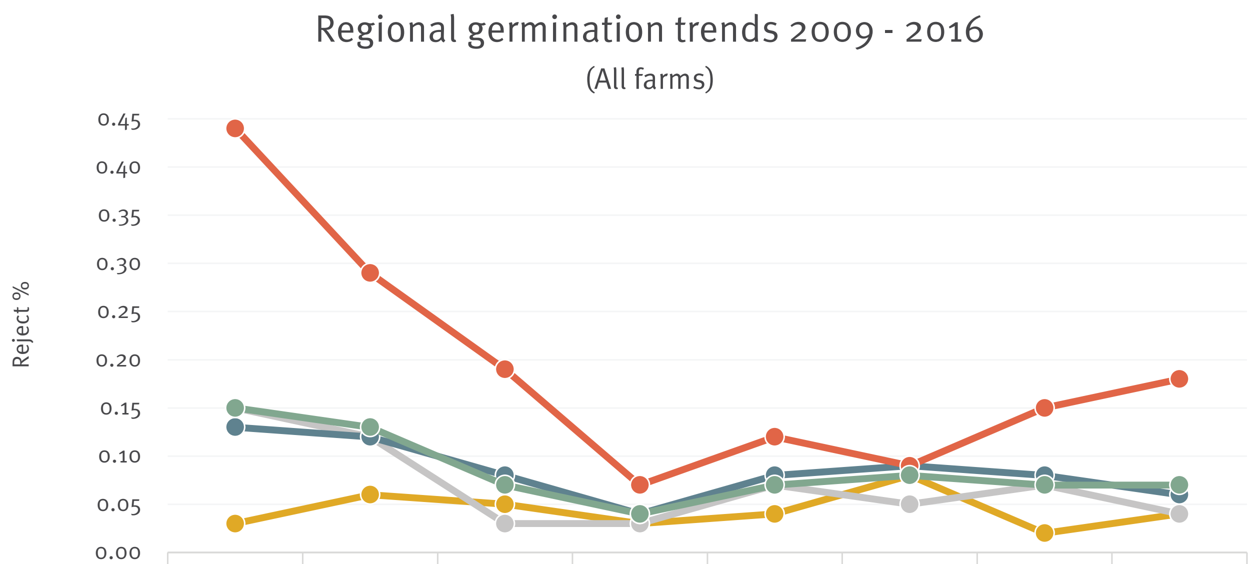


	2009	2010	2011	2012	2013	2014	2015	2016
CQ	0.35	0.32	0.23	0.23	0.91	0.61	0.21	0.32
SEQ	0.79	0.40	0.58	0.37	1.68	1.95	0.26	0.75
NRNSW	0.37	0.38	0.96	0.54	0.70	0.43	0.50	0.57
MNNSW	0.74	0.56	0.47	0.46	0.77	0.56	0.22	0.29
All regions	0.50	0.40	0.70	0.45	0.91	0.75	0.38	0.53

Figure 44: Comparison of average regional immaturity reject levels (2009 to 2016)

Figure 45 shows average rejects due to germination from 2009 to 2016 for each of the four regions in the benchmark sample.

Average germination rejects have remained low since 2012. The only region to show increases over the last two seasons has been MNNSW. Despite this, average losses due to germination remained the least significant cause of reject across the benchmark sample from 2009 to 2016.



	2009	2010	2011	2012	2013	2014	2015	2016
CQ	0.03	0.06	0.05	0.03	0.04	0.08	0.02	0.04
SEQ	0.15	0.12	0.03	0.03	0.07	0.05	0.07	0.04
NRNSW	0.13	0.12	0.08	0.04	0.08	0.09	0.08	0.06
MNNSW	0.44	0.29	0.19	0.07	0.12	0.09	0.15	0.18
All regions	0.15	0.13	0.07	0.04	0.07	0.08	0.07	0.07

Figure 45: Comparison of average regional germination reject levels (2009 to 2016)

Productivity and quality by tree age

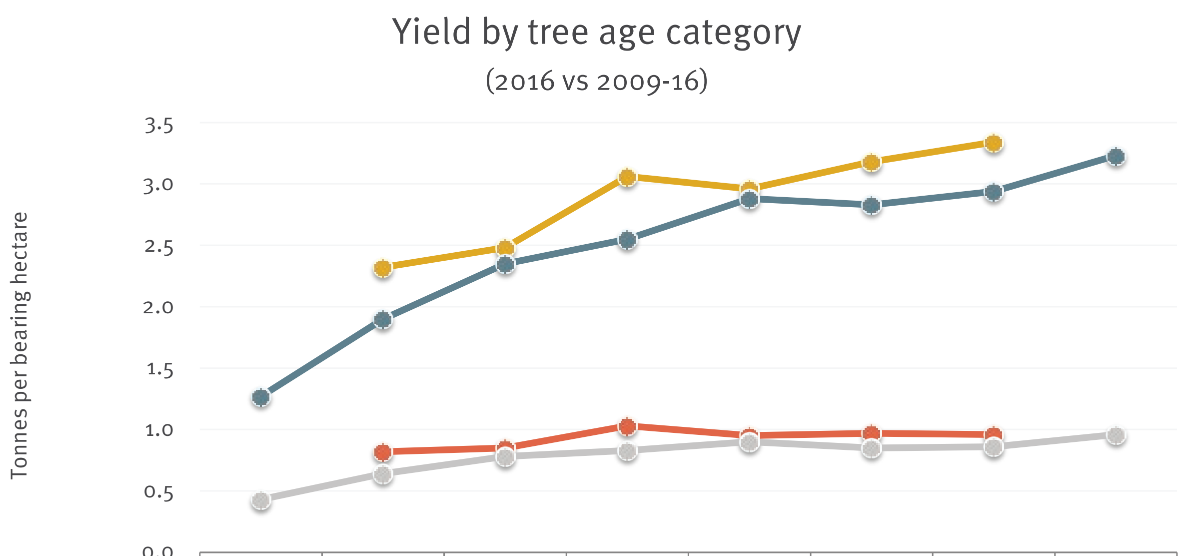
Yield and quality results were analysed according to tree age to identify age-related trends in orchard performance. It is important to note that all age-related analyses are based on weighted average tree age as very few farms record harvest results by individual block or tree age group. A weighted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

Tree ages may vary substantially both within and between production regions. Planting densities also vary between farms in various age categories and this may also impact on yields per hectare, particularly during the early bearing years before trees grow together within rows. Some farms also have plantings of various tree ages and this will impact on the weighted average tree age.

Figure 46 shows average yields of nut-in-shell (NIS) and saleable kernel per bearing hectare for 2016 and for all years from 2009 to 2016 for farms from various tree age categories. Results are presented only where sufficient data exists to maintain individual farm confidentiality (i.e. more than 10 data points).

Both NIS and saleable kernel yield per hectare were higher across all age groups in 2016 than the average for 2009 to 2016. In 2016 peak NIS yield was achieved among farms with an average tree age of 30 years or older. This was also the case for the 2009-2016 seasons.

Saleable kernel yield per hectare was more uniform amongst farms with an average tree age of 15 years or older. This is mainly due to a lower average saleable kernel recovery (SKR) among older farms, despite their higher average NIS yields. Higher average SKR amongst younger farms has compensated for their lower average NIS yield in reducing the difference in the average saleable kernel yield per hectare between the younger and older farms.



	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25 to 29 years	30-34 years	35+ years
Nut-in-shell 2016		2.32	2.48	3.06	2.96	3.18	3.34	
Nut-in-shell 09-16	1.27	1.90	2.35	2.55	2.88	2.83	2.94	3.23
Saleable kernel 2016		0.82	0.85	1.03	0.95	0.97	0.96	
Saleable kernel 09-16	0.43	0.64	0.78	0.83	0.90	0.85	0.86	0.96

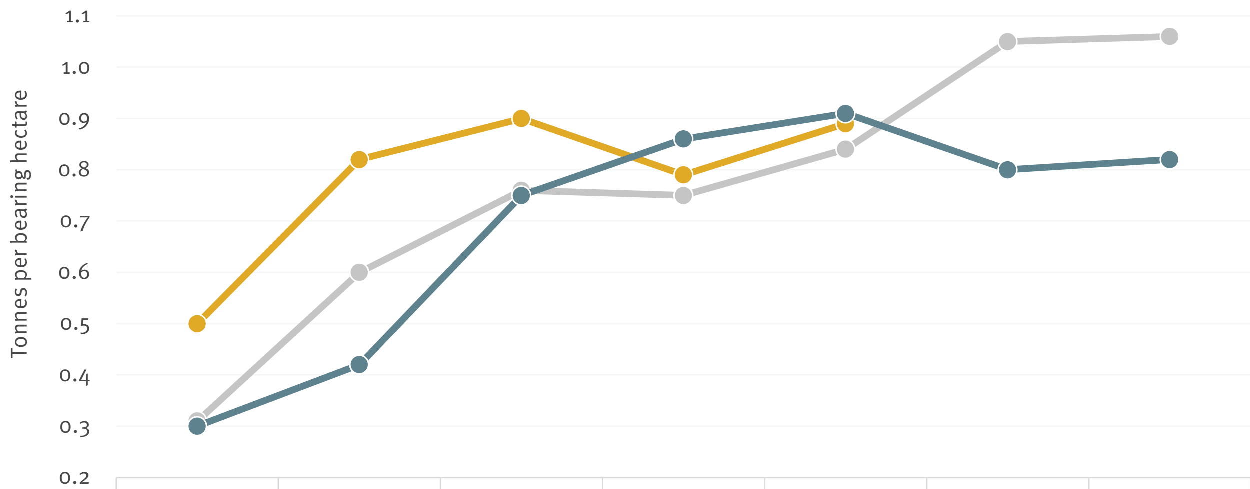
Figure 46: Comparison of yield per bearing hectare for farms by tree age category for 2016 and for all years (2009 to 2016)

Figure 47 shows the average yield of saleable kernel per bearing hectare by tree age category for 2009 to 2016 across the major production regions. As insufficient data was available for individual tree age categories in MNNSW, all NSW farms have been combined on this chart. Similarly there is currently insufficient data to plot yield by tree age beyond 20-24 years within the CQ region.

CQ farms with an average tree age 14 years or younger had a higher average yield of saleable kernel per hectare than farms of the same age in the other regions. Many of the younger CQ farms are managed through higher crop inputs to achieve higher yields earlier in the life of the orchard. In SEQ saleable kernel yields continue to increase as trees age to 25 years and older. By comparison, in NSW saleable kernel yield per hectare peaked at age 20 to 24 years then declined among older age groups.

Regional saleable kernel yield by tree age category

(2009 - 2016 seasons)



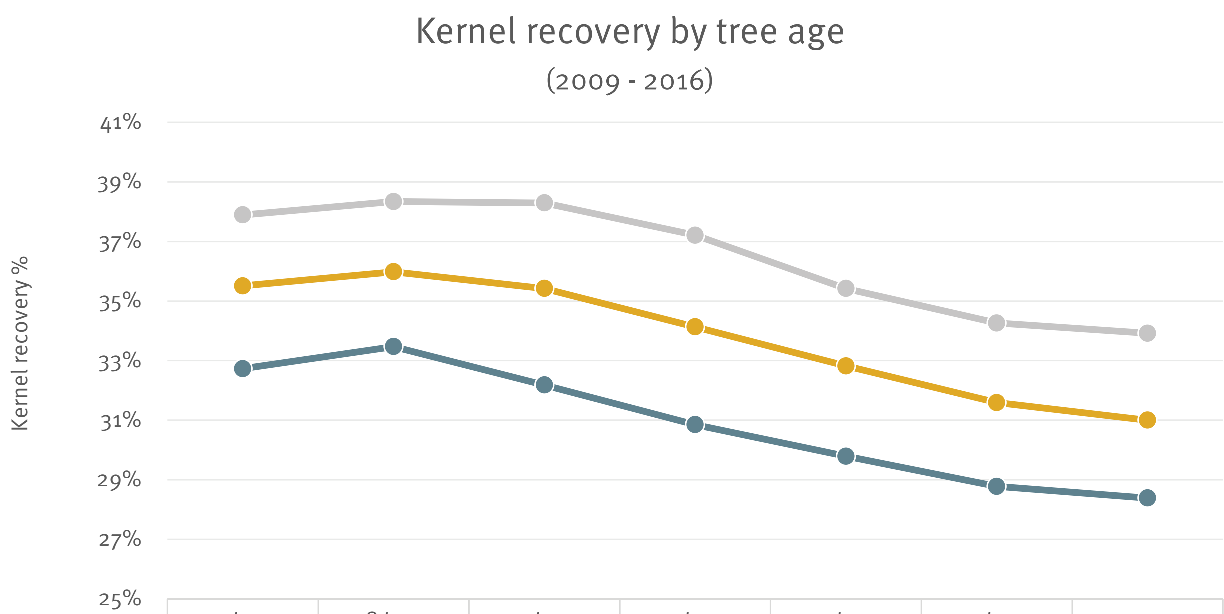
	5 to 7 years	8 to 9 years	10 to 14 years	15 to 19 years	20 to 24 years	25 to 29 years	30+ years
CQ	0.50	0.82	0.90	0.79	0.89		
SEQ	0.31	0.60	0.76	0.75	0.84	1.05	1.06
NSW	0.30	0.42	0.75	0.86	0.91	0.80	0.82

Figure 47: Saleable kernel production by tree age category and region for all years (2009 to 2016)

Figure 48 shows average total kernel recovery (TKR), saleable kernel recovery (SKR) and premium kernel recovery (PKR) by tree age category for all years from 2009 to 2016. TKR is the sum of premium, commercial and reject kernel recovery. SKR is the sum of premium and commercial kernel recovery.

Farms in the younger age categories achieved higher average TKR, SKR and PKR than farms in the older age categories. For farms aged more than 9 years, average TKR, SKR and PKR decreased with increasing tree age. Farms with an average tree age younger than 15 years achieved an average TKR of 38.3%. By comparison, farms older than 15 years achieved an average TKR of 35.6%. 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.

Average nut-in-shell yield generally increases with tree age. Lower average saleable kernel recovery among older farms means that saleable kernel production per hectare is less strongly linked to tree age among mature farms



	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
Total KR%	37.89	38.34	38.29	37.21	35.42	34.26	33.92
Saleable KR%	35.51	35.98	35.42	34.13	32.82	31.59	31.00
Premium KR%	32.73	33.47	32.18	30.85	29.79	28.78	28.39

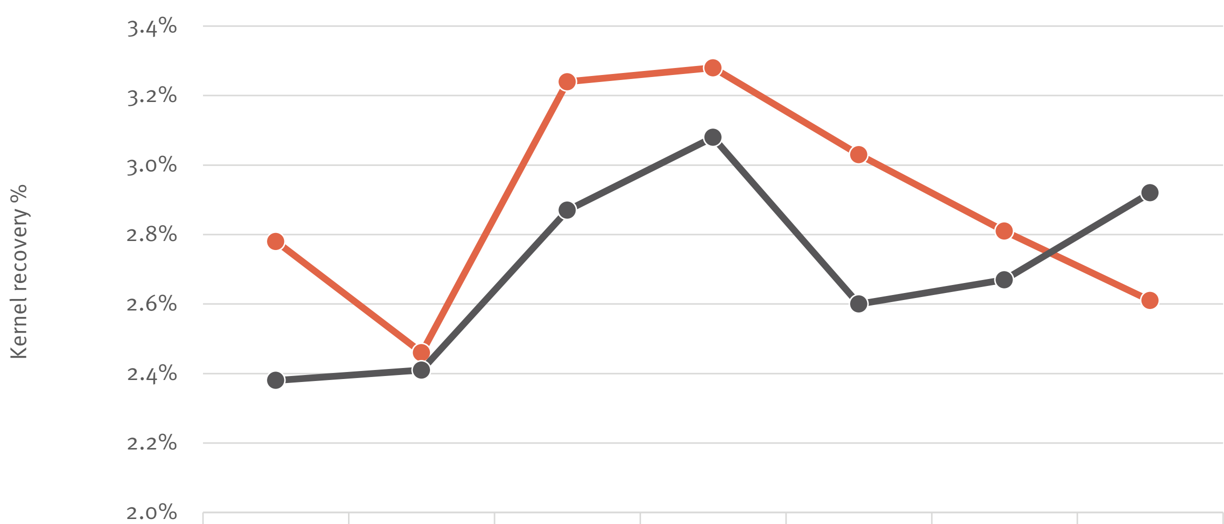
Figure 48: Premium, saleable and total kernel recovery by tree age category for all years (2009 to 2016)

Figure 49 shows average commercial kernel recovery (CKR) and reject kernel recovery (RKR) by tree age category for all years from 2009 to 2016.

Farms with an average tree age between 10 and 19 years had the highest average CKR (3.3%). The major component of CKR amongst farms in the benchmark sample is light discolouration. Farms aged 15-19 had the highest average RKR (3.1%), most of which was due to insect damage. It is important to note that most small farms fall within this age category so these reject levels may be related to other factors such as farm size.

Commercial and reject kernel recovery by tree age

(2009 - 2016)



	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
Commercial KR%	2.78	2.46	3.24	3.28	3.03	2.81	2.61
Reject KR%	2.38	2.41	2.87	3.08	2.60	2.67	2.92

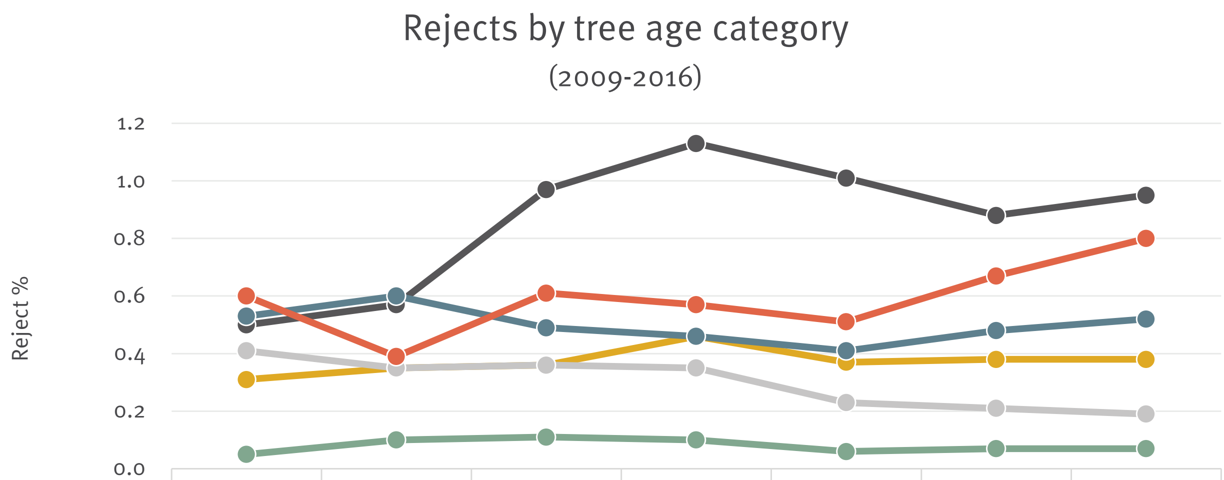
Figure 49: Commercial and reject kernel recovery by tree age category for all years (2009 to 2016)

Figure 50 shows a breakdown of factory rejects by category from 2009 to 2016 for farms of various average tree ages.

Insect damage was the major reject category for farms with an average tree age of 10 or more years. Average insect damage levels peaked among farms aged 15 to 19 years, although analysis of rejects by farm size revealed that most small farms fall within this age group, which may be a contributing factor to these high levels of damage. See the *Productivity and Quality by Farm Size* section within this report for more information.

Average immaturity levels were highest among farms aged 25+ years old. Some of this immaturity may be related to premature nut drop associated with husk spot damage. It is important however to note that in some seasons there have also been significant levels of immaturity in farms in this age group resulting from weather related moisture stress, such as farms in the SEQ region in 2013 and 2014.

Immaturity, brown centres and insect damage were the major reject categories amongst farms with an average tree age less than 8 years. Average rejects due to discolouration were also highest 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 CQ 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	0.50	0.57	0.97	1.13	1.01	0.88	0.95
Mould	0.31	0.35	0.36	0.46	0.37	0.38	0.38
Discolouration	0.41	0.35	0.36	0.35	0.23	0.21	0.19
Brown centres	0.53	0.60	0.49	0.46	0.41	0.48	0.52
Immaturity	0.60	0.39	0.61	0.57	0.51	0.67	0.80
Germination	0.05	0.10	0.11	0.10	0.06	0.07	0.07

Figure 50: Breakdown of reject kernel recovery by tree age category for all years (2009 to 2016)

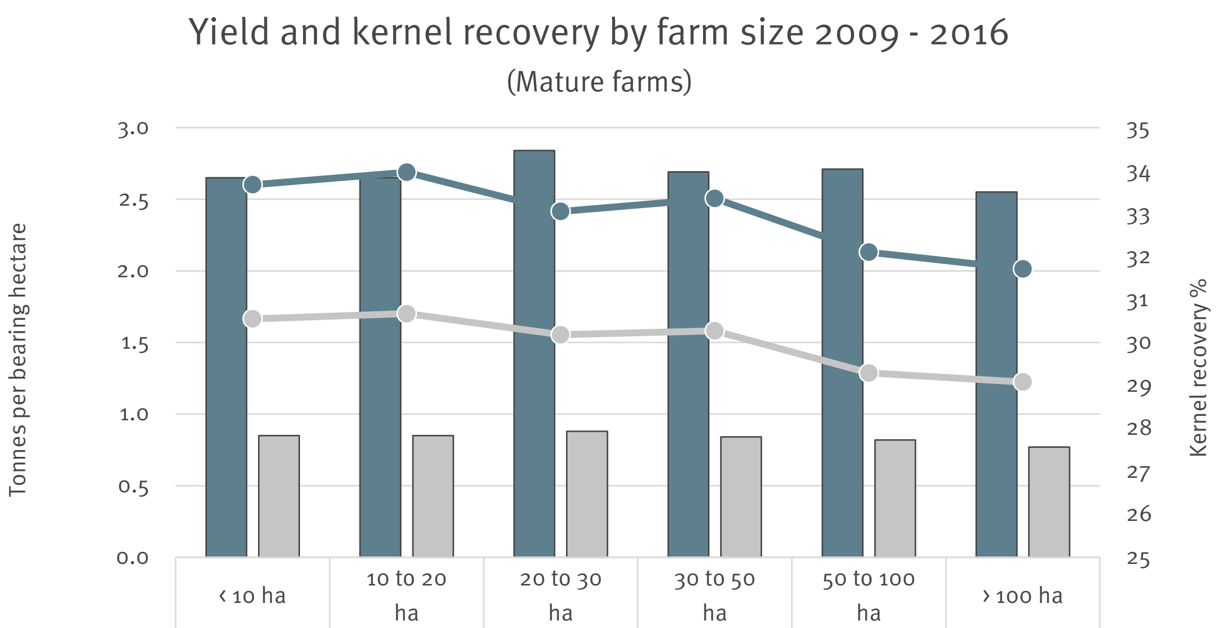
Productivity and quality by farm size

Analysis of yield and quality trends reveal some differences in kernel recovery related to farm size. It should be noted that certain farm sizes are more prevalent in particular regions. Larger farms within the benchmark sample also tend to be younger than smaller farms. Care must be taken when interpreting these results as regional or tree age factors may be involved.

Figure 51 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 for all years from 2009 to 2016. These averages are based on mature farms in the benchmark sample with an average tree age of 10 or more years.

Farms between 10 and 20 hectares had the highest average SKR (33.96%) and PKR (30.67%) of all the farm size categories. Farms 100 hectares or larger had the lowest average SKR (31.71%) and PKR (29.08%) of all the farm size categories.

The differences in both NIS and saleable kernel yield between small and large farms were not significant.

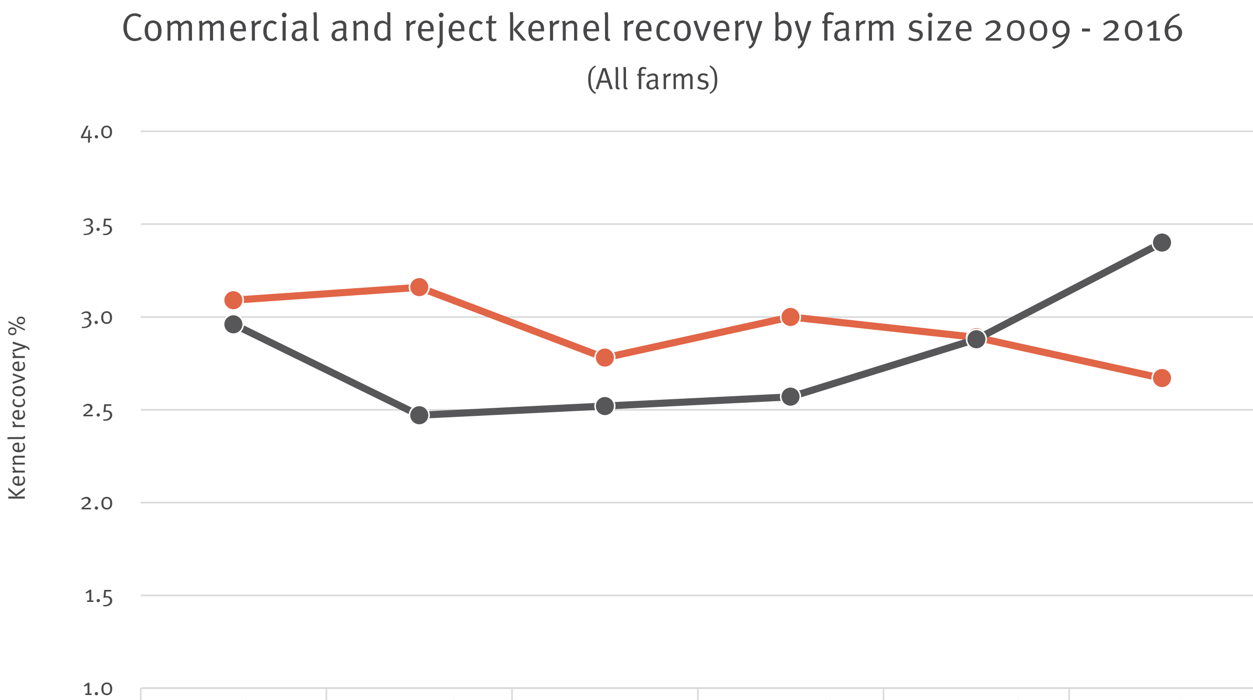


	‹ 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	› 100 ha
Nut-in-shell	2.65	2.65	2.84	2.69	2.71	2.55
Saleable kernel	0.85	0.85	0.88	0.84	0.82	0.77
SKR%	33.67	33.96	33.05	33.35	32.10	31.71
PKR%	30.55	30.67	30.18	30.27	29.29	29.08

Figure 51: Yield per bearing hectare and saleable and premium kernel recovery by farm size for all years (2009 to 2016)

Figure 52 shows average commercial kernel recovery (CKR) and reject kernel recovery (RKR) for different farm size categories in the benchmark sample for all years from 2009 to 2016. These kernel recovery trends are based all farms in the benchmark sample.

Farms smaller than 20 hectares had the highest average CKR (3.12%) of all the farm size categories. Farms between 10 and 50 hectares had lower RKR than both smaller and larger farms. Farms 100 hectares or larger had the lowest average CKR (2.67%) and highest average RKR (3.40%) of all the farm size categories.



	‹ 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	› 100 ha
CKR%	3.09	3.16	2.78	3.00	2.89	2.67
RKR%	2.96	2.47	2.52	2.57	2.88	3.40

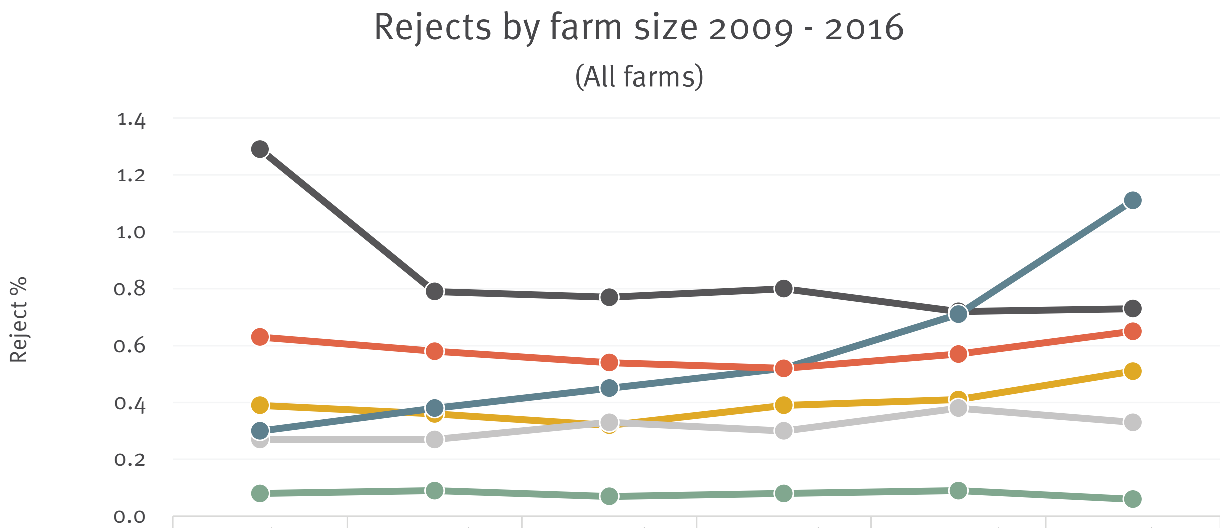
Figure 52: Yield per bearing hectare and commercial and reject kernel recovery by farm size for all years (2009 to 2016)

Figure 53 shows the average reject percentage and breakdown for the different farm size categories in the benchmark sample for all years from 2009 to 2016. These averages are again based on all farms in the benchmark sample.

Rejects due to brown centres increased with increasing average farm size. Farms less than 10 hectares had average brown centres rejects of 0.3% compared with 1.11% for farms 100 hectares or greater.

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 1.29% compared with other farm size categories that ranged from 0.72% to 0.80%. Immaturity, discolouration and germination rejects did not vary as much with farm size as insect damage, brown centres and mould.



	< 10 ha	10 to 20 ha	20 to 30 ha	30 to 50 ha	50 to 100 ha	> 100 ha
Insect	1.29	0.79	0.77	0.80	0.72	0.73
Mould	0.39	0.36	0.32	0.39	0.41	0.51
Discolouration	0.27	0.27	0.33	0.30	0.38	0.33
Brown centres	0.30	0.38	0.45	0.52	0.71	1.11
Immaturity	0.63	0.58	0.54	0.52	0.57	0.65
Germination	0.08	0.09	0.07	0.08	0.09	0.06

Figure 53: Yield per bearing hectare and consignment reject analysis by farm size for all years (2009 to 2016)

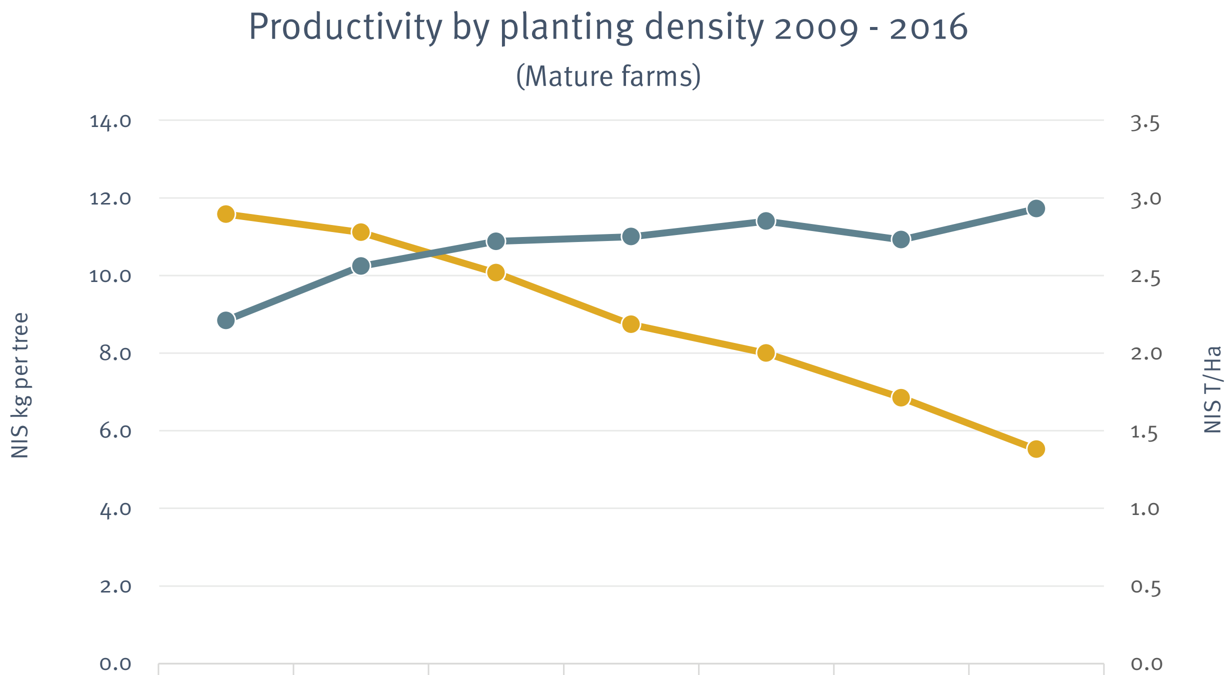
Rejects due to brown centres increased with increasing farm size. By comparison, rejects due to insect damage were highest amongst smaller farms, particularly those less than 10 hectares.

Productivity and quality by planting density

Figure 54 shows average nut-in-shell (NIS) productivity in tonnes per hectare and kilograms per tree for mature farms at a range of planting densities. Weighted average planting density is calculated for each farm from tree spacing information provided. NIS rather than saleable kernel productivity is shown to exclude the influence of variable kernel recoveries.

The chart shows that average NIS productivity per hectare is relatively stable apart from planting densities less than 250 trees per hectare. NIS productivity per tree declines markedly with increasing planting density, particularly at planting densities above 250 trees per hectare.

The weighted average planting density for mature farms in the benchmark sample is 333 trees per hectare.



	100-200	201-250	251-300	301-350	351-400	401-450	› 450
NIS Kg/Tree	11.58	11.11	10.07	8.74	8.00	6.85	5.52
NIS T/Ha	2.21	2.56	2.72	2.75	2.85	2.73	2.93

Figure 54: Productivity by planting density for all years (2009 to 2016)

Production costs

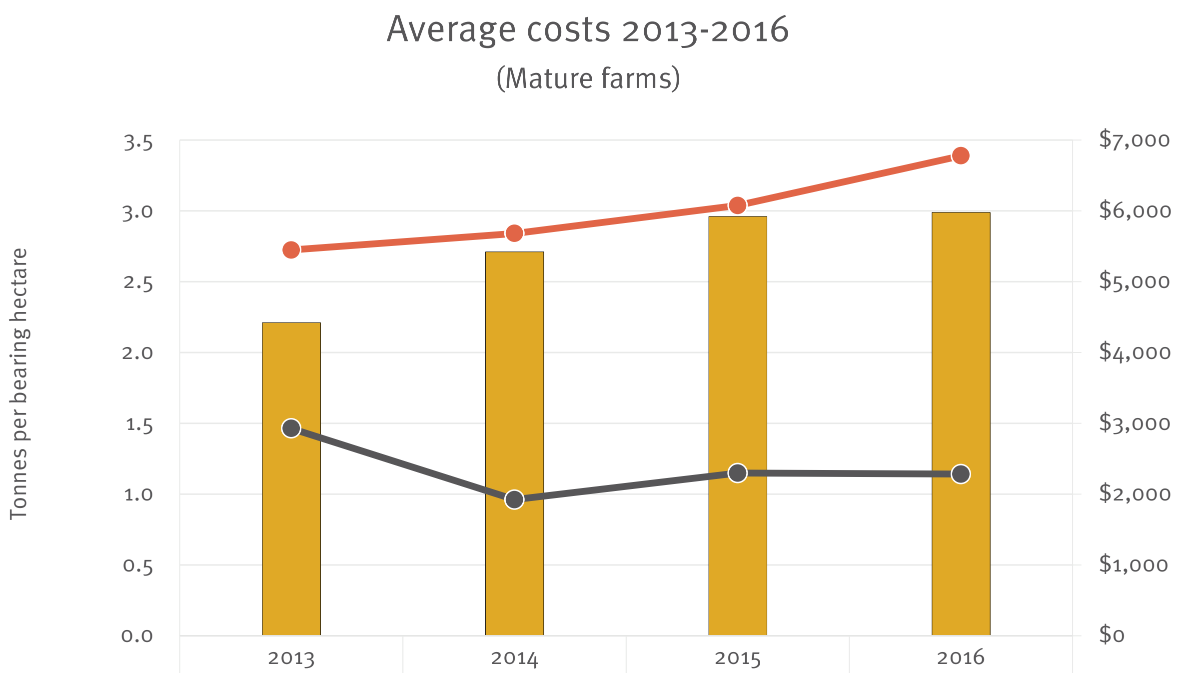
Cost of production data has been collected from a sub-sample of benchmark participants for the last four seasons (2013 to 2016). Data collected for each of these seasons includes all cash costs incurred in the preceding financial year (2012/13 to 2015/16). Similar data was previously collected in 2003 to 2006 as part of the *On-farm Economic Analysis* project (MC03023). This includes a breakdown of total costs according to standard financial heads of expenditure. Analysis of these data provides insight into seasonal orchard expenditure and profitability, as well as a breakdown of expenditure.

The term “farm year” is used in the benchmarking study to describe a record for an individual farm for a given year. A total of 191 farm-years of cost data has been collected from bearing farms for the four seasons from 2013 to 2016. It is important to note that this data and subsequent analyses focus only on cash costs. Other costs such as unpaid labour, capital expenditure, depreciation and taxation are therefore excluded.

Figure 55 shows nut-in-shell (NIS) productivity (t/ha), average costs per hectare and average costs per tonne of NIS for the four years from 2013 to 2016 for mature farms. Average costs per planted hectare increased by more than 11% from 2015 to 2016 to $6,777 per hectare, following smaller increases in the previous two seasons. The rise in costs per hectare may be attributed to increased levels of cash flow, allowing businesses to reinvest back into their macadamia orchards. This is supported by increased productivity and favourable NIS prices in recent years.

Average NIS production increased substantially in 2014, following a poor 2013 season in which average productivity was substantially lower than the long term average. The increased productivity in 2014 led to a 34% reduction in average costs per tonne of NIS.

Average productivity has increased steadily from 2014 to 2016. Despite annual increases in costs per hectare from 2014 to 2016, higher productivity has meant that average costs per tonne of NIS have remained stable.



	2013	2014	2015	2016
Nut-in-shell yield	2.21	2.71	2.96	2.99
Costs per hectare	$5,447	$5,681	$6,076	$6,777
Costs per tonne	$2,928	$1,922	$2,297	$2,283

Figure 55: Average costs per hectare and per tonne of nut-in-shell (2013 to 2016)

Figure 56 shows average expenditure from 2013 to 2016 broken down into various heads of expenditure for mature farms. Employment accounts for the largest proportion of costs (26%). This is consistent with the previous *On-farm Economic Analysis* study from 2003-2006, with employment costs accounting for 24% of total costs at that time. This expenditure 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. Crop nutrition was the next highest average cost (14%) followed by repairs and maintenance of plant (12%), crop protection (7%) and fuel and oil (7%).

There were significant differences between farms in both total costs and the breakdown of those costs. Wide variation between farms was also observed in the previous *On-farm Economic Analysis study*. This variation was related to individual farm characteristics, farm management and the stage of development within the orchard.

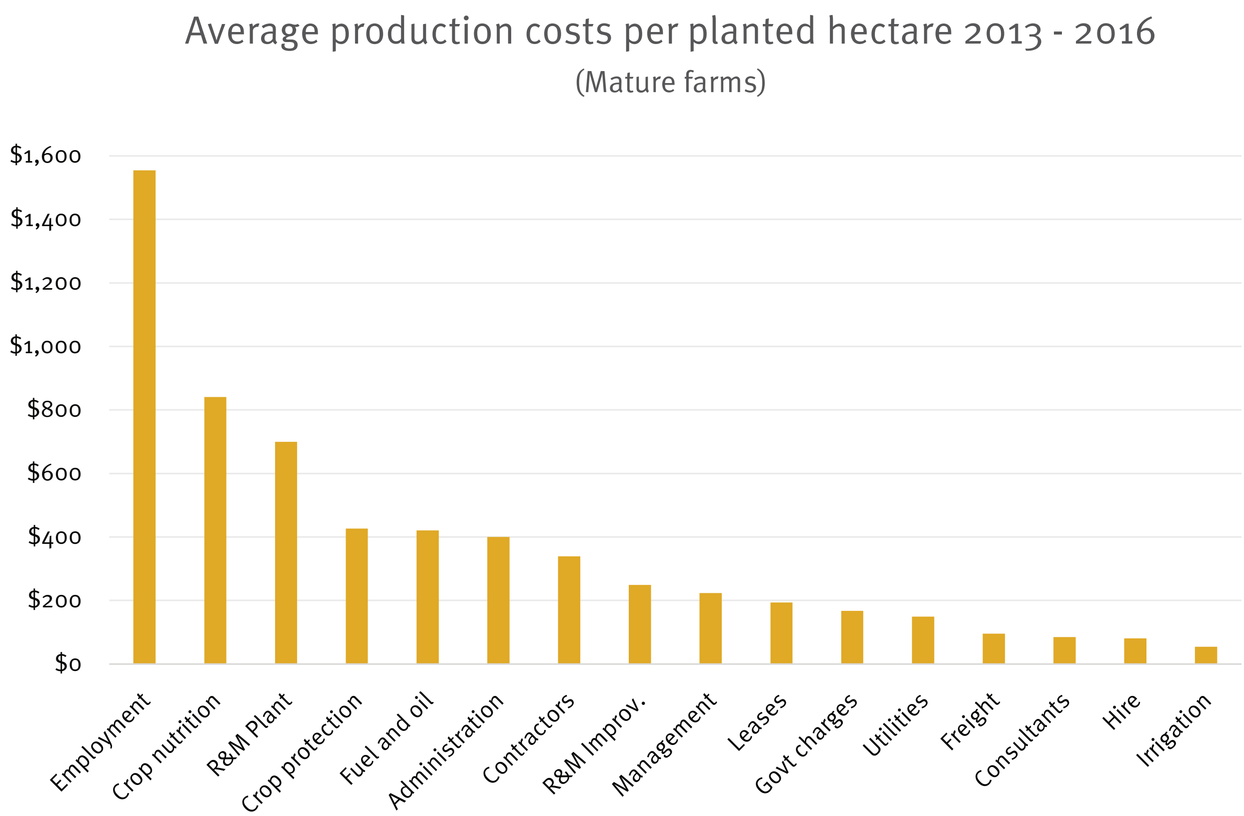


Figure 56: Production costs per hectare by head of expenditure (2013 to 2016)

Figure 57 shows the top five heads of expenditure per hectare from 2013 to 2016 and compares these with the same heads of expenditure in 2016. All remaining costs have been combined as "other" costs on the chart.

Most heads of expenditure were higher in 2016 compared with the 2013 to 2016 average. The largest difference was employment costs, which were up by $451, or 29% compared with the four-year average. Expenditure on crop nutrition was also up by $100 per hectare in 2016, which is 12% more than the four-year average.

Although average total costs per hectare have risen over the last few seasons, increased average productivity has meant that costs per tonne have remained relatively stable.

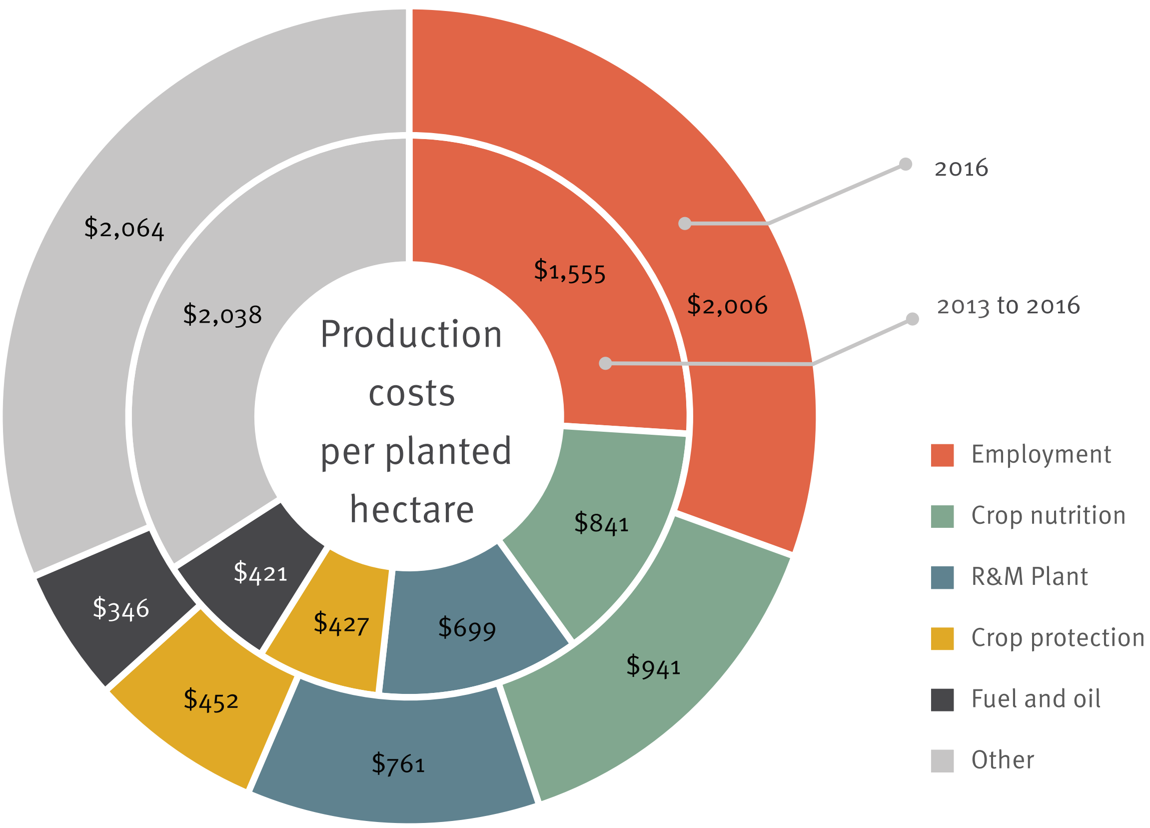
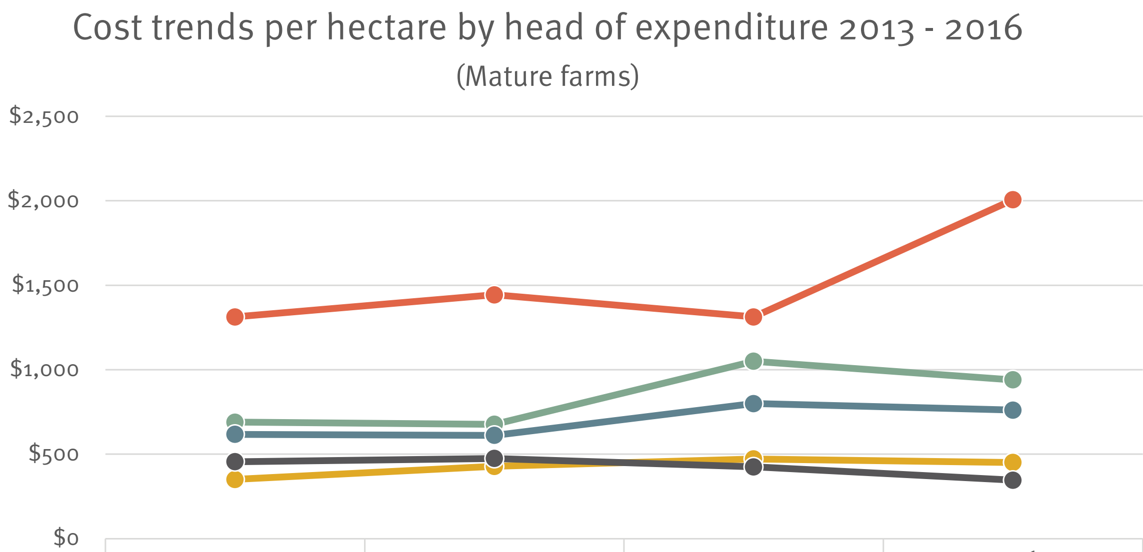


Figure 57: Annual production costs per hectare by head of expenditure for mature farms (2016 vs 2013 to 2016)

Figure 58 shows the yearly average of the top five heads of expenditure between 2013 and 2016. Employment costs increased considerably between 2015 and 2016.

Crop protection, crop nutrition, R&M plant and fuel and oil costs all decreased slightly in 2016. This follows more substantial increases in crop nutrition, R&M plant and crop protection costs from 2014 to 2015.



	2013	2014	2015	2016
Employment	$1,313	$1,444	$1,313	$2,006
Crop nutrition	$690	$677	$1,051	$941
R&M Plant	$618	$612	$800	$761
Crop protection	$351	$428	$472	$452
Fuel and oil	$456	$475	$425	$346

Figure 58: Annual cost trends per total hectare by head of expenditure for mature farms (2013 to 2016)

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.

Standard deviation

Standard deviation provides a measure of the amount of variation around the average or mean for a set of data. A low standard deviation means that most of the numbers in that set are very close to the average. A high standard deviation means that the numbers are spread out. Standard deviation provides an important measure of the amount of variability within the benchmark sample. For example, it is useful to know the average productivity for all farms in a given region or season, but the standard deviation of that average provides additional insight into how uniform productivity is among those farms.

Median

The median value of a data set represents the middle (or 50%) point in the data. In comparison the average, or mean is the sum of all values divided by the total number of data points. The average is very useful for understanding a given set of data when that data is normally distributed, however if data is skewed by extreme or outlying values these can influence the mean. For example, one very large farm in a region of otherwise small farms could raise the sample average above what is characteristic of most farms in that region. As the median comes from the middle point in a data set it is not influenced by such outlying or extreme data.

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