ANALYSIS OF PACKHOUSE LIBRARY TRAY DATA FROM 2001/2002 SEASON

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ABSTRACT

Fruit quality in the 2001/2002 export season from the onshore packshed library tray programme was similar to that found in the USA Outturn monitoring programme with about 75% of ripe fruit having no defects greater than 5% severity. The fruit age of avocados has a major influence on quality with avocados older than 39 days exhibiting an exponential increase in incidence and severity of rots. The major quality problems onshore were found to be the same as those in the Outturn monitoring programme. These were rots (both stem-end and body), vascular browning and fuzzy spotting of the peel. The quality of avocados packed by different packhouses varied on average by as much as 40%. Delaying packing longer than 2 days after picking reduced avocado quality by about 10%. Quality changed from month to month with October harvested fruit having the best quality. The severity and incidence of body rot increased each month after October while stem-end rots were relatively constant from month to month. Quality for fruit from each grower was set by their level of rots, month of harvest and handling of fruit after harvest.
Keywords: avocados, rots, fruit age, packhouses, harvest month

INTRODUCTION

Measuring the quality of New Zealand avocado fruit is essential if the quality problems associated with them are to be understood and managed. In the past New Zealand avocado growers have received very little information about the quality of their own fruit. By not knowing what fruit quality issues they face within their own orchard, avocado growers are unable to make informed management decisions that would lead to improved avocado fruit quality. The quality of avocado fruit exported to California has been extensively surveyed over the past two seasons (Dixon, 2001). While valuable information has been gathered and there has been an increased understanding of what leads to quality problems, the Californian quality survey has been limited. The Outturn programme represents a big picture snapshot only and is limited by the relatively small numbers of fruit being examined. As a consequence only a small number of growers have had fruit examined and each packhouse has had only a very small sample of fruit assessed. In addition the fruit are examined only once they have passed through the post harvest handling chain. All of this has meant that the results of the quality survey in California are of limited value in evaluating specific growers' management practices or even for a reliable basis for packhouse comparisons.

The most common disorders found with New Zealand avocado fruit in California have been rots in ripe fruit and chilling injury of green fruit (Dixon, 2001). Chilling injury is a disorder that appears on the fruit after harvest while fruit can be infected with rots while growing on the tree, during harvest and when handled for packing. By having packhouses hold back fruit from the packing lines for later examination it is possible to identify where in the production chain problems are occurring. As an example identifying the points along the handling chain when chilling injury occurs is very valuable for determining what is causing chilling injury and what steps can be taken to ameliorate the damage. By comparing avocado fruit quality for fruit that have been harvested and packed but not exported with the same line of fruit that

has been exported it is possible to identify points in the postharvest handling chain where chilling damage can occur.

Rots in avocado fruit in New Zealand are known to develop from both latent and opportunistic infections (Everett and Pak, 2001). In order for an avocado grower to evaluate how successful their fungicide program is, a measure of rots in the fruit is required. By keeping back a sample of fruit from the packing line and storing that fruit for a number of weeks before ripening the inherent tendency of the fruit to rot can be measured. This then sets as a baseline the quality for a line of fruit from a specific harvest for a particular grower. For the rest of the fruit that has been exported the difference in quality between the fruit examined in California and the fruit held back in New Zealand could be attributed to the extra handling and different storage conditions that fruit experiences. By following changes in fruit quality as the avocado season progresses fruit quality could be tracked over time. This would serve as an early warning system of when fruit quality may deteriorate and highlight if weather conditions at harvest have an effect on fruit quality. Avocado growers would be able to evaluate how much rot their fruit has and compare their quality results to other growers in the same area. Additionally packhouses will be able to critically examine their performance with respect to fruit quality.

Due to the reasons outlined above avocado growers in New Zealand are encouraged through their packhouse to have samples of fruit held back from the packing lines to be evaluated for their quality. The fruit held back are part of what is collectively known as the 'Shed library tray program'. The purpose of the program is to provide New Zealand avocado growers with evaluations of avocado fruit quality using a consistent comparative format. This paper reports the results of the first two years of the "Shed library tray program" and compares the results with the quality assurance programme conducted in California.

MATERIALS AND METHODS

Fruit quality of avocados was surveyed after harvest and packing at individual packhouses during the 2001-2002 export season. The fruit were taken as single tray samples from a line after the completion of grading and packing. Where possible, samples were collected at each harvest for each grower. The number of times fruit were sampled for a particular grower depended on the number of harvests each individual grower made. For some growers this meant that only one sample of fruit was taken to be evaluated for fruit quality. Each individual packhouse conducted the sampling and evaluation of fruit quality using staff trained in the AIC standard assessment method. Fruit samples were taken at the beginning of the export season in August and continued until the end of the export season in February the following year.

The fruit taken for quality evaluation were class I export grade, typically count 20 to 25, and were stored in single layer trays at about 5 °C for 4 weeks before ripening at ambient conditions (about 15 to 23 °C). Immediately on removal from storage the fruit were given a detailed green fruit examination. Once the same fruit had ripened, to a firmness of at least 85 as determined by a firmometer with a 300g weight, the fruit were cut longitudinally and examined for internal disorders. Softness was determined by hand.

Disorders and defects considered commercially important were rated according to the AIC fruit quality assessment manual (AIC, 2001) using the same system as used for evaluating avocado fruit quality in the Californian export market (Dixon, 2001).

Results are reported as a percentage of fruit affected (incidence) and the average area of a fruit affected by a disorder (severity). The overall quality of the fruit was given a rating as the percentage of sound fruit by rejecting a fruit once the disorders: external rot, stem-end rot, vascular browning, brown patches, flesh bruising and flesh discolouration exceeded a

minimum threshold level and peel damage was in excess of 20% severity. The average severity and incidence of disorders have been tabulated and graphed for this report. Results have also been compared to the results from the Outturn monitoring programme reported previously (Dixon, 2001).

RESULTS AND DISCUSSION

Quality assessments were made on 29,869 fruit pieces sourced from 14 packhouses, 513 growers and 134 pick dates. About 95% of the fruit were count sizes 20 to 24. The major disorders found were the same as those found in the Outturn monitoring. The disorders were: rots visible fungal bodies on the outside of the fruit, undeveloped rots as fuzzy patches, body rots, stem-end rot and vascular browning. Minor disorders were bruising, mechanical damage, chilling injury on the skin and flesh discolouration. The incidence and severity of the major disorders are presented in Table 1.

Table 1. Average incidence and severity of disorders for all fruit evaluated in the Shed library tray and Outturn monitoring programme (Dixon, 2001) in 2001-2002.

Green fruit	Incidence (%)		Severity (%)		Ripe fruit	Incidence (%)		Severity (%)	
Disorder	Library	Outturn	Library	Outturn	Disorder	Library	Outturn	Library	Outturn
Discrete patches	14.3	0.6	0.6	0.1	External rot	0.3	0.4	0.5	0.1
Fuzzy patches	13.0	4.4	1.4	0.4	Stem-end rot	16.1	21.3	1.6	0.5
Peel Damage	68.1	83.6	11.5	16.2	Vascular browning	18.5	10.8	4.7	3.1
External rot	0.0	0.0	0.0	0.0	Brown patches	30.9	55.5	3.4	3.3
					Flesh adhesion	15.2	5.8	N/A[1]	N/A

[1]N/A = not applicable

The incidence and severity of quality disorders in fruit from the Shed library tray programme were similar to the incidence and severity of disorders found in the Outturn monitoring programme (Table 1). These results indicate that the disorders found in the fruit held back in New Zealand are a fair reflection of the quality of avocados exported from New Zealand. Samples of avocado fruit held back for the Shed library trays are exposed to what may be considered ideal post harvest handling while exported fruit are subjected to extra handling and periods of temperature fluctuation. It would be anticipated that the fruit examined in the Outturn monitoring should be of slightly lesser quality than the fruit from the Shed library trays. This was generally not the case except for a greater incidence of brown patches (the symptom of body rots). The Shed library trays had greater incidence of discrete and fuzzy patches than was observed in the Outturn monitoring but the severity of these disorders were very low and unlikely to be commercially important.

The numbers of sound fruit were similar for the Shed library trays and Outturn monitoring differing by 6 to 8% (Table 2). Such a result suggests that the Shed library trays are a good reflection of fruit quality in overseas markets despite differences that may be due to the large number of assessors of the Shed library trays and a lack of standardization of disorder rating with the Outturn assessors. It further suggests that the methodology of evaluating disorders is sufficiently robust to allow the Shed library trays to provide a comprehensive view of avocado fruit quality during the harvest season.

Table 2. Incidence of avocados from the Shed library trays and Outturn monitoring (Dixon, 2001) with quality defects in 2001-2002 counting peel damage as a defect when greater than 20% of fruit surface was affected. Other defects were counted once their severity exceeded the threshold value in the table.

Green fruit	Threshold value	Sound fruit (%)	
		Library	Outturn
	0%	63.4	85.0
	1%	74.4	87.4
	5%	81.0	88.6
	10%	82.7	88.6

Ripe fruit	Threshold value	Fruit without defects (%)	
		Library	Outturn
	0%	54.8	37.1
	1%	63.5	63.5
	5%	75.5	81.1
	10%	82.9	88.6

FRUIT AGE

Fruit age had a major influence on avocado fruit quality with the incidence and severity of rots having an extended lag phase until about 39 days after picking and an exponential increase thereafter (Figure 1). This is a similar pattern to that found in the Outturn monitoring (Dixon, 2001) but with a delay of about 5 days before rots increased exponentially. This delay may be due to packshed library tray fruit not being exposed to the extra handling required to load the fruit onto ships, storage in a hold and distribution to importers when fruit is exported to California. This finding further emphasises the importance of managing fruit age for best fruit quality.

Packhouses

There was considerable variation in quality of fruit from different packhouses (Figure 2). The reasons for the differences are not known but may be related amongst other factors to the pick to pack times achieved by each packhouse (Figure 3). Delaying packing after harvest longer than 2 days increases the number of unsound fruit by about 10%. Other factors may be how the fruit are handled and also include the inherent quality of fruit sourced from the growers that supply the packhouse.

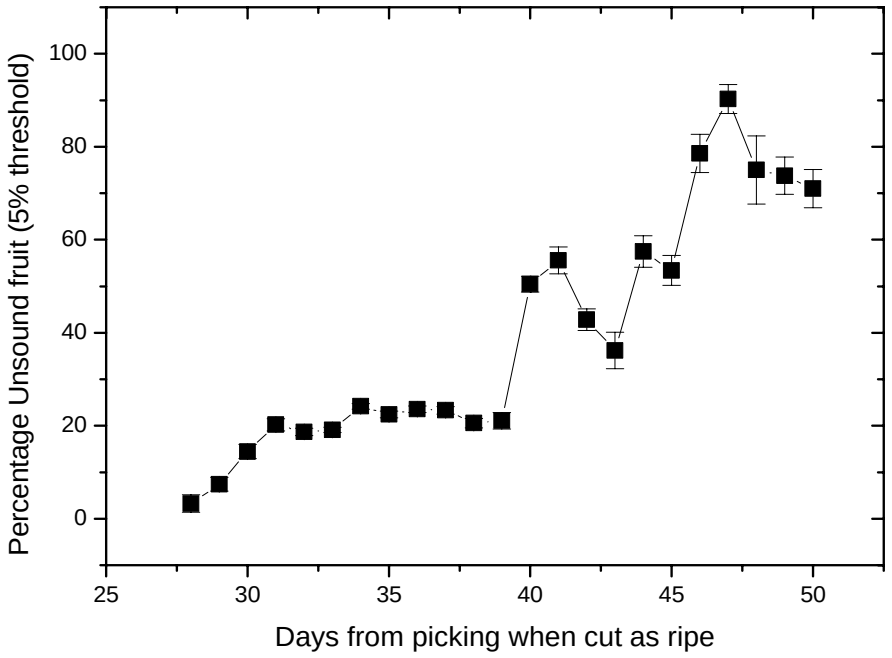

Figure 1. Average incidence of unsound avocados, using a 5% disorder threshold, at different fruit ages. Vertical bars represent the standard error of the mean at each fruit age.

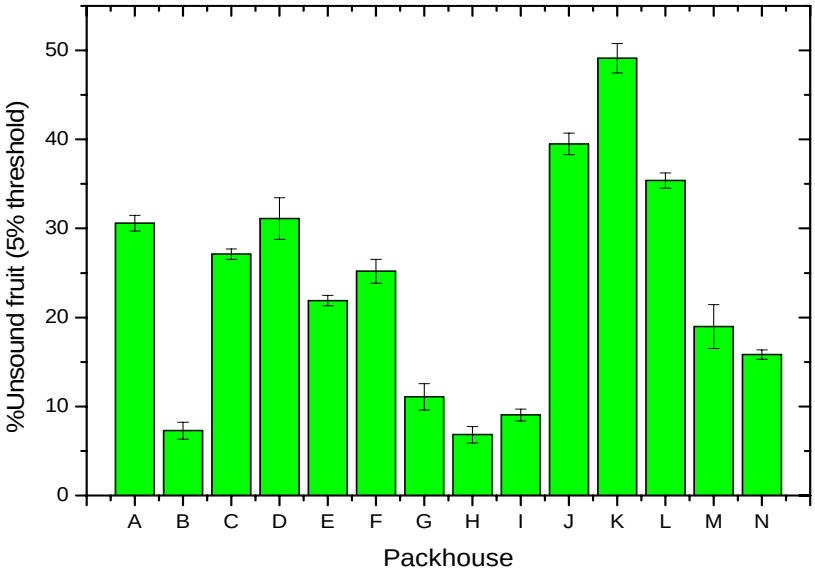

Figure 2. Average incidence of unsound fruit, using a 5% disorder threshold, for each packhouse. Vertical bars represent the standard error of the mean for each packhouse average.

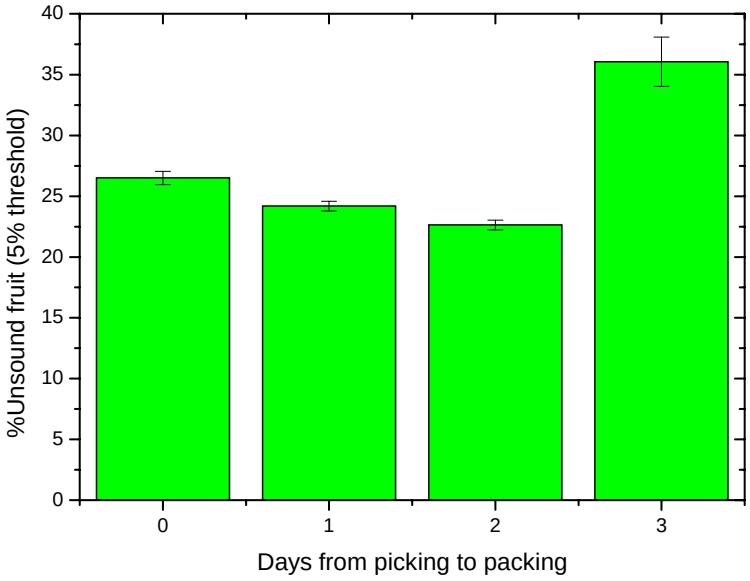

Figure 3. Average incidence of unsound fruit, using a 5% disorder threshold, for fruit packed immediately after picking or delayed up to 3 days after picking. Vertical bars represent the standard error of the mean.

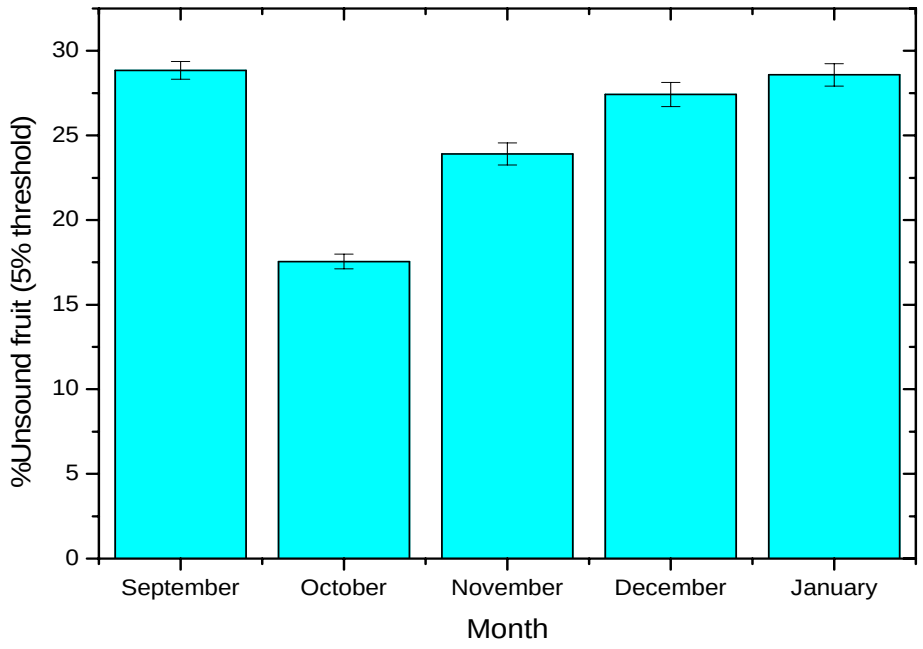

Figure 4. Average incidence of unsound fruit, using a 5% disorder threshold, each month of the harvest season. Vertical bars represent the standard error of the mean.

Harvest month

Avocado quality changes from month to month (Figure 4). Quality improved in October compared to September but then steadily declined up to January which had a similar incidence of unsound fruit as in September. This result suggests that there may be an influence of maturity on avocado fruit quality with a period where fruit quality is optimal in October. The incidence and severity of body rots had the same pattern (Figure 5) as the incidence of unsound fruit (Figure 4). Stem-end rots and vascular browning incidence and severity was similar in September, November, December and January but was very low in October. This would suggest that there are different conditions influencing the incidence and expression of each type of rot. Stem-end rots are an opportunistic infection (Everett and Pak, 2001) and are most likely to be influenced by weather conditions at harvest where body rots are latent infections that occur during the fruit growth and development. Each of the rot types requires different control strategies. Body rots require application of fungicides as the fruit are growing whereas stem-end rots require control measures at harvest and packing.

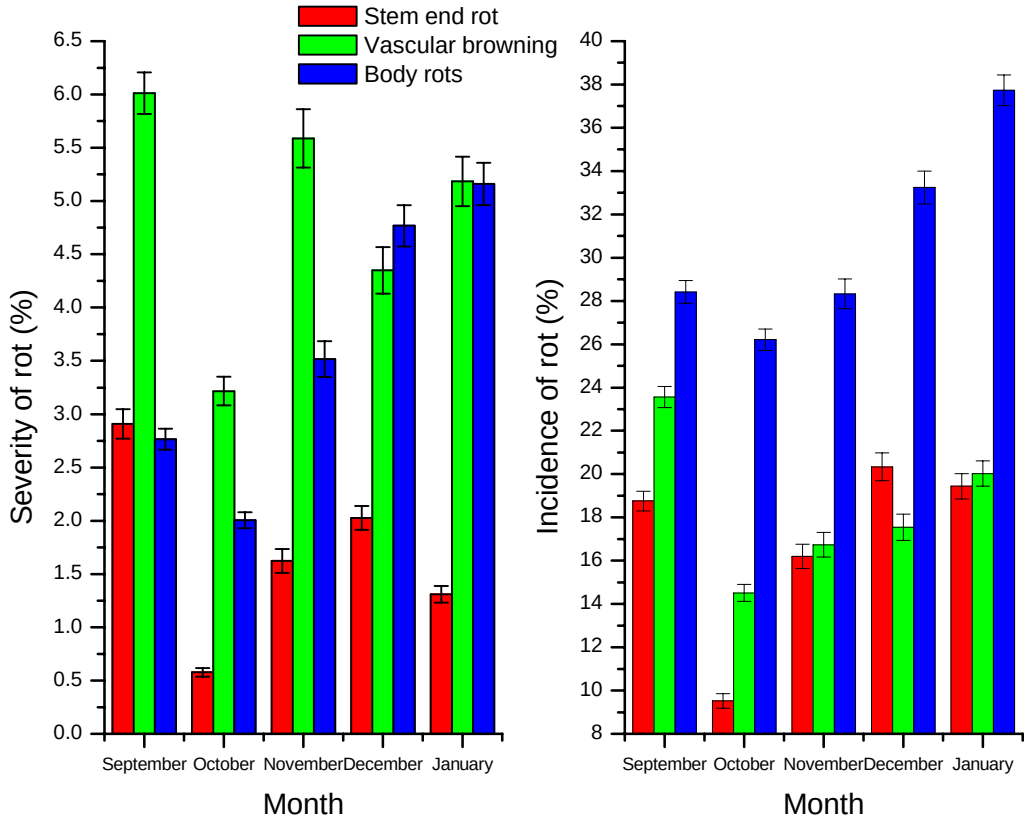

Figure 5. Average severity and incidence of stem end rot, vascular browning and body rot for each month of the harvest season. Vertical bars represent the standard error of the mean.

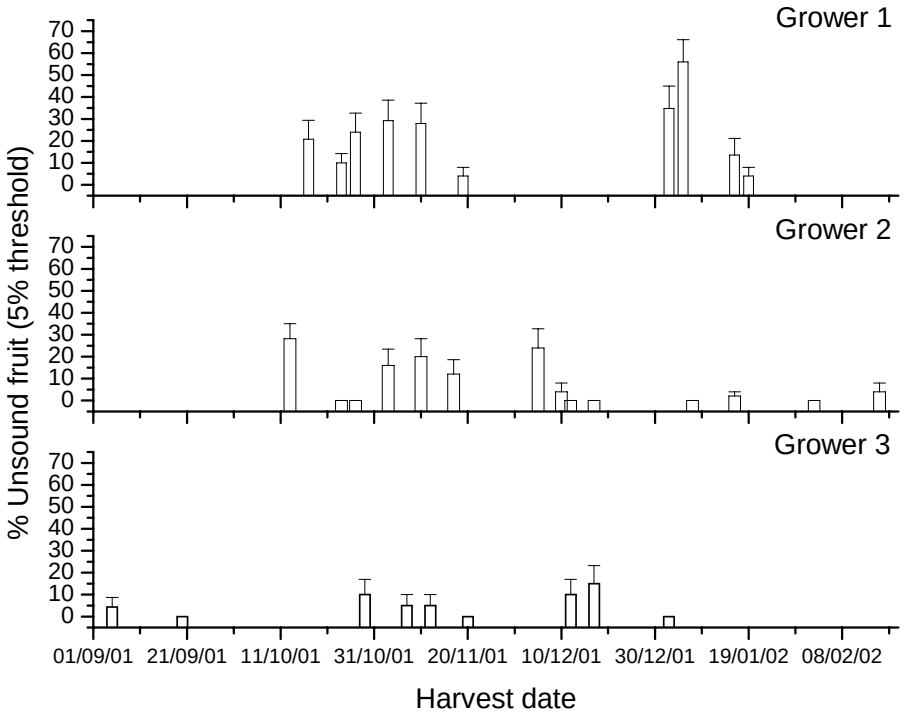

Figure 6. Average incidence of unsound fruit in library trays, using a 5% disorder threshold, for avocados harvested at times during the harvest season. Each graph represents the quality of avocados at each harvest for 3 growers fruit selected as being evaluated at the same fruit age. Vertical bars represent standard errors of the mean. Bars with no standard errors represent harvests where there was no unsound fruit.

Orchard differences

Incidence and severity of rots vary considerably in avocados harvested from different orchards. Each orchard has different growing conditions and cultural management; therefore caution must be exercised when comparing the average incidence of unsound fruit in library trays between orchards. Quality can also vary from harvest to harvest (Figure 6). The variable pattern of quality changes from one harvest to the next may be related to weather conditions promoting infection by stem-end rots and the changing maturity of the fruit. The overall incidence of unsound fruit from each orchard may also be influenced by their preventative fungicidal spray programme.

SUMMARY

The packshed library tray quality survey has highlighted and confirmed quality issues first identified by the Outturn monitoring programme. The major quality issue for New Zealand avocados after harvest and packing is rots. Stem-end rot and body rots were both prevalent and were observed to have different behaviours according to their mode of infection and action. This will lead to a better understanding of what effect different fungal management strategies will have on controlling the incidence and severity of rots. The packshed library tray results can be analysed for individual orchards to identify what the principal fungal issues are and what may be the most appropriate fungal control strategies. For example, if body rots are the primary rots in fruit from an orchard the grower may wish to put most effort

into ensuring their preventative fungicide programme is effective and to measure the effectiveness by the performance of their Shed library trays. Conversely if stem-end rots are their major issue, the harvesting strategy may need to be related to weather conditions at harvest.

Fruit age has been confirmed as a fundamental principle that can be used to manage the expression of rots in avocado fruit after harvest and during storage. By characterising the fruit age relationship and defining the influence of fruit age it should be possible to remove the influence of fruit age from further analysis. The relationship of quality with avocado fruit age emphasises that fruit age management is an effective quality management tool.

The packshed library tray results accurately reflected the results from the Outturn monitoring and provide confidence that quality issues that appear onshore in New Zealand will also be reflected in the export markets. There is also now a mechanism to identify quality problems as arising from the orchard or from the packing and shipping process enhancing the ability of exporters and packhouses to solve quality problems as the export season progresses.

Avocado growers in New Zealand now have a unique tool that allows them to evaluate their success in controlling avocado fruit quality by measuring the rots that occur in their fruit after storage. The challenge remains as to how best to use the information being gathered for controlling avocado fruit quality and to relate this information to orchard activities such as the fungicidal spray programme.

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