LIBRARY TRAYS – A VALUABLE TOOL FOR MANAGING FRUIT QUALITY

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SUMMARY

Collection of library trays from export lines of fruit is a cornerstone of the strategy to improve the quality of New Zealand avocados in our export markets. Fruit quality is generally perceived as being a post-harvest issue, despite the fact that the quality of the fruit is largely determined on orchard. In order to improve fruit quality it is essential to address this discontinuity between fruit quality and orchard influence, and to provide growers with feedback on the quality issues surrounding their fruit and how they can best address them. Library trays provide a valuable mechanism for achieving this. Another key function of library trays is to assist with determining the cause of any out-turn problems, particularly in relation as to whether the problems occurred as a result of offshore conditions or were inherent to the fruit. The library tray system which runs in parallel with the out-turn programme is critical in this regard. At an industry level the library trays provide an overview of the nature and extent of quality problems affecting New Zealand fruit, and trends in the development of these disorders within and between seasons. As a quality management tool library trays are used to determine the influence of key factors on fruit quality. Three factors that have been demonstrated to have a consistent impact on fruit quality are the time delay between picking and packing fruit, the duration of the coolstorage period (fruit age) and rainfall prior to harvest.

Keywords: stem-end rot, body rot, pick to pack time, flesh temperature

INTRODUCTION

The New Zealand avocado industry operates a database on fruit quality, receiving raw data on fruit assessments, processing the data and generating reports for the key stakeholders. The library trays provide information on fruit quality at industry, exporter, packer and grower levels. The information obtained is delivered to the industry stakeholders in a manner that is tailored to their requirements. Library trays were first introduced in New Zealand in the 2000/1 season as a recommended best practice. Since the 2003/4 season the collection of library trays from export lines of fruit has been compulsory.

The information on fruit quality that the system provides is limited by the quality of the data collected. The fruit quality assessment manual (AIC, 2001) is a key to ensuring that the data collected is in a standardized format. This allows comparison across growers, packers and seasons. It is the responsibility of the packer to collect the raw data.

Currently, all but one packer contracts this out to a central facility that stores and ripens the fruit under standard conditions.

MATERIAL AND METHODS

Fruit quality of avocados is assessed on library trays collected after harvest and packing at individual packhouses. A single tray of fruit is collected from a line of export fruit after the completion of grading and packing. Within each season fruit sampling commenced at the start of the export season in August/September and continued until the end of the export season in February/ March the following year. The number of times fruit were sampled from a particular grower depended on the number of harvests from each individual grower. During the 2001/2 and 2002/3 export seasons each individual packhouse conducted the sampling and evaluation of fruit quality using staff trained in the AIC standard assessment method. For the 2003/4 and 2004/5 seasons the fruit storage and assessment has been done at a centralized facility.

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). Ripening temperatures were maintained at 20 °C (± 1 °C) in the centralized facility for the 2003/4 and 2004/5 seasons. 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. Firmness was determined by hand. Disorders and defects present were rated according to the AIC fruit quality assessment manual (AIC, 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 unsound 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 of 5% severity.

Table 1. Numbers of library tray fruit collected for each of the past four seasons.

Season	No. of fruit
2001/2	30,023
2002/3	22,192
2003/4	23,882
2004/5	25,873

Additional information is collected on a range of uncontrolled variables. These include the property identifier, region, harvest date, count size, packer, and time delay from pick to pack. Growers are also encouraged to collect rainfall data in the 24 hour period preceding harvest.

RESULTS AND DISCUSSION

Information flows

Growers. Collection of library tray data provides a vital flow of information back to the grower on their ripe fruit quality. This can be a powerful impetus for the continued drive to deliver and sustain further improvements in quality. For most growers library tray information is the only feedback they receive of their fruit quality. For individual growers, information provided on their fruit quality can provide the stimulus to improve orchard management systems. Once changes have been implemented, the feedback on fruit quality allows growers to determine whether the additional expense has been warranted. This is especially true of preventative fungicide control programmes, where the benefit is not immediately obvious and cannot be determined from packout rates or reject analyses provided by the packer.

To assist this process growers are provided with detailed feedback on their fruit quality. This includes a graphical summary highlighting the growers results in relation to the rest of the industry. The results for each of the key disorders is presented in relation to the upper and lower thresholds based on the cumulative incidence of any particular disorder. The incidence of unsound fruit in the sample is also compared with the average for their packer and the overall industry average.

Exporters. Library trays reflect the quality problems inherent in the fruit or onshore handling systems before transport to export markets. Comparison of library samples with samples taken at out-turn, serves to identify any problems which may have arisen as a consequence of the shipping or handling system, once the fruit has left the packhouse. The combined information collected from the onshore library trays and the out-turn monitoring define the nature and extent of any quality problems afflicting New Zealand fruit. The stage in the production chain at which quality problems arise can also be determined.

Packers. There are major differences between some packers, which could be due either to differences in the way that various packers handle the fruit or in the quality of fruit supplied to them by their pool of growers. A project is underway attempting to relate differences in handling methods between packers to determine the extent that they may have contributed to quality differences.

Quality of New Zealand fruit

The key disorders affecting New Zealand 'Hass' fruit are primarily pathological. The most predominant disorder likely to be encountered on green fruit immediately on removal from coolstorage is fuzzy patches due to fungal rot. For ripe fruit the most prevalent disorders are body rots, stem-end rots, and vascular browning (Fig.1). In New Zealand 'Hass' the incidence of vascular browning is strongly correlated with the presence of a stem-end rot. Diffuse flesh discoloration in ripe fruit and discrete patches on green fruit are the most common physiological disorders.
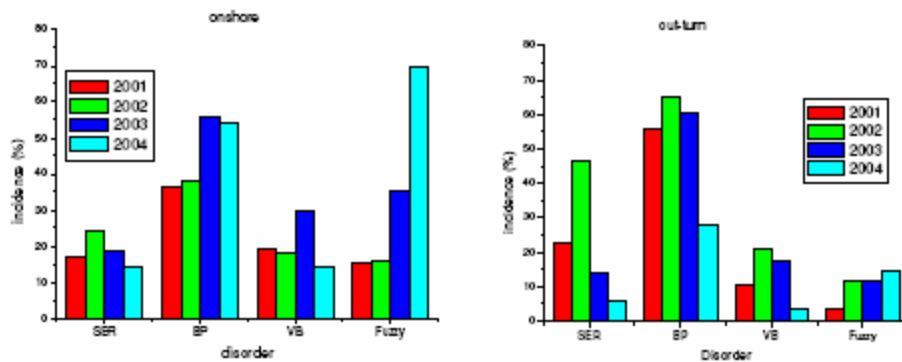
Figure 1. Yearly trends in the major quality disorders (SER = stem-end rot, BP = body rots, VB = vascular browning, Fuzzy = fuzzy patches) for onshore library trays and at out-turn.

The quality disorders present at out-turn are generally reflected in the onshore library trays, despite the differences in the subsequent handling of fruit after packing and the change in programme from the USA to Australia in 2003/4.

Key Factors Impacting on Fruit Quality

Analysis of the library tray data to extract the influence of the individual factors is confounded by the interactions between the numerous uncontrolled factors associated with each library tray. Fruit quality on an individual orchard can also vary markedly over a short time frame, suggesting that daily weather patterns are driving quality to a greater extent than previously anticipated. Despite these limitations it has still been possible to extract the influence of some of the key variables impacting on fruit quality.

Fruit age. Fruit age has been demonstrated to have a significant impact on quality. The fruit assessments in the 2002/3 season were done by individual packers. Despite a standardized storage and assessment protocol there was still significant variability in the length of time for which fruit were coolstored prior to assessment. Analysis of the 2002/3 data indicated that the factor with the greatest impact on ripe fruit quality was the age of the fruit (days from picking) when ripe (Fig. 2). Longer ripening times and increased time in coolstorage both contribute to a marked deterioration in fruit quality with greater than 20 % unsound fruit once fruit age exceeds 35 days when ripe. Information of this nature assists with inventory management to maximize quality.

Pick to pack times. Within each season, analysis of the library trays data consistently illustrates the detrimental effect of an increased delay between packing and packing on ripe fruit quality. Pick to pack times exceeding 48 hours resulted in a significant increase in the incidence of stem-end rot incidence in the 2002/3 season (Fig. 3). Increased pick to pack times generally led to a higher incidence and a greater severity of body rots and stem-end rots in each season for which data was collected.
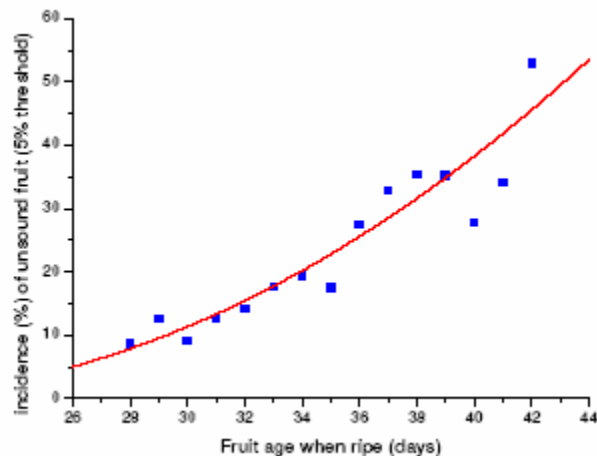
Figure 2. Incidence of unsound fruit (5% threshold) in relation to age of fruit when ripened (library tray data from 2002/3 season). Fitted line ($Y^{0.5} = -5.1 + 0.28X$, $R^2 = 83.9\%$)
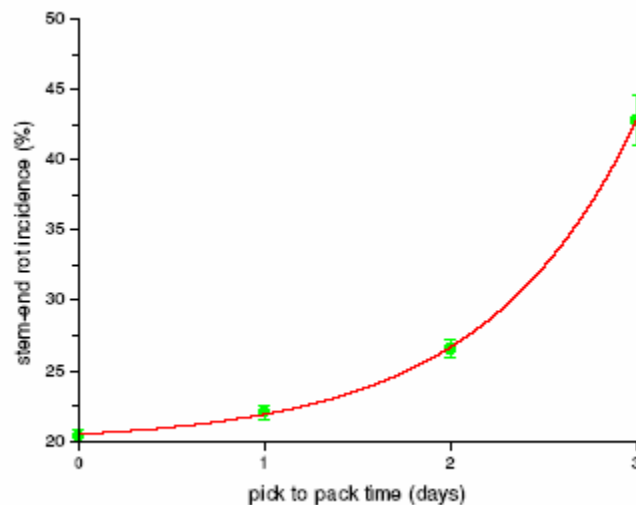

Figure 3. Effect of a delay between picking and packing on incidence of stem-end rots (2002/3 season).

Wet fruit. The library tray database also provides information on the effect of rainfall immediately prior to harvest on fruit quality. In New Zealand it is recommended best practice not to harvest fruit if more than 5 mm of rain has fallen in the previous 24 hours. The data from the 2002/3 season (Fig. 4) illustrates clearly that once rainfall in the 24 hours prior to harvest exceeds 10 mm than both the incidence of stem-end rots and the severity of body rots increase significantly.

Regional differences. Interrogation of the library tray database allows comparison of the most prevalent quality disorders amongst the different growing regions. Figure 5

illustrates the incidence of stem-end rots and body rots for the main growing regions. Whangarei had significantly higher incidence of both stem-end and body rots. This is most likely a reflection of lower levels of copper application in this region over the past two seasons, due to light crops.
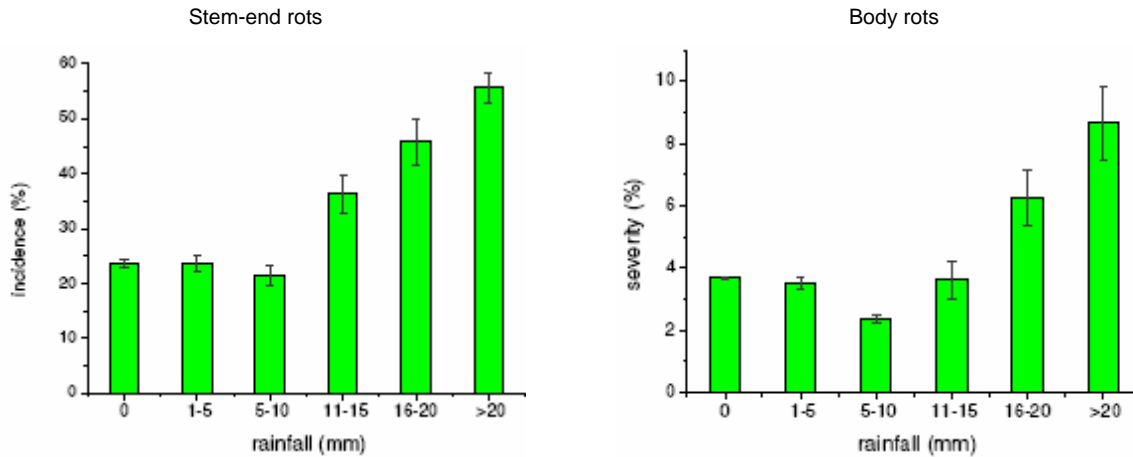

Figure 4. Effect of the amount of rain (mm) in the 24 hours prior to harvest on the incidence of stem-end rots and the severity of body rots (2002/3 season).
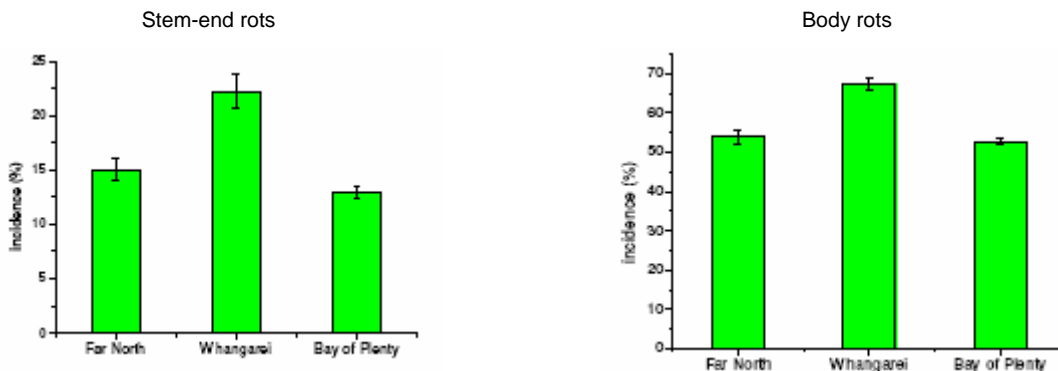

Figure 5. Incidence of stem-end rots and body rots (± s.e.) for the three main growing regions based on the 2004/5 library trays.

Advance warning of potential quality problems in export markets

At an industry level the library trays provide information on the major quality disorders affecting New Zealand avocados and how these vary over time both within and between seasons. Trends in disorder development are monitored on a regular basis together with out-turn data. Once a potential problem is identified then a warning is issued to packers and exporters together with advice on any measures that should be taken to ameliorate the problem. The levels of various disorders relative to past seasons also provides exporters with an expectation as to how fruit will perform in the market and allows them to update their marketing plans accordingly.

In the 2004/5 season there was a relatively high incidence of fuzzy patches from August onwards (Fig. 6). Throughout November updates were passed to exporters and packers advising of the situation and measures to be taken. Amongst these was a recommendation to reduce storage and shipping temperatures.
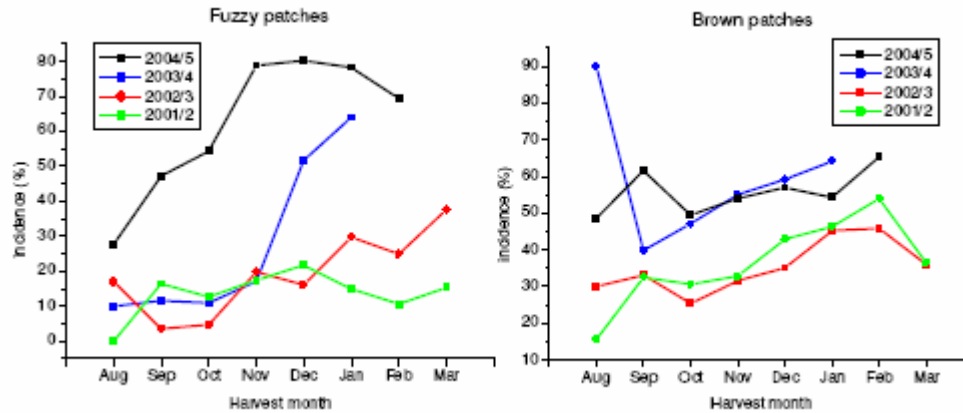

Figure 6. Seasonal trends in the incidence (%) of fuzzy patches and brown patches for the past four seasons.

Audits of packers undertaken by Agriquality indicated a high level of compliance with the remedial actions. Fruit flesh temperatures monitored at loadout showed a substantial reduction in flesh temperatures following the release of the advisory memo to industry (Fig. 7). Average flesh temperatures of export fruit were on average 2 °C lower than that of the library trays (5 °C). This reduction in flesh temperature contributed significantly to an improvement in fruit quality at out-turn. The fruit quality observed at out-turn in Sydney during January and February was on the whole the best that has been recorded since the out-turn programme has been running.
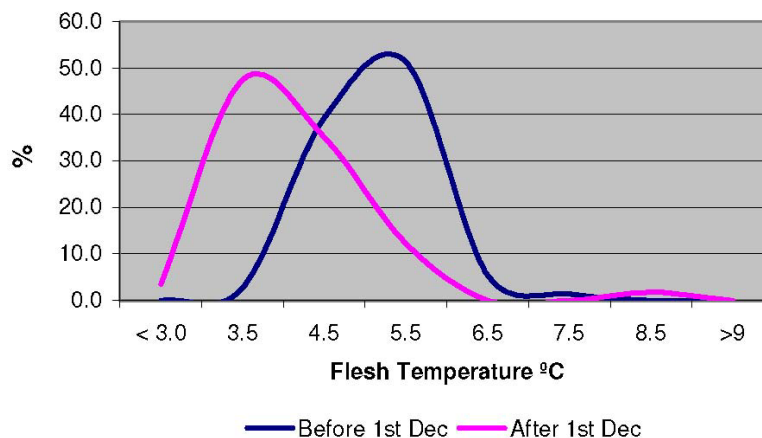

Figure 7. Relative frequency (%) of flesh temperatures monitored during the 2004/5 season prior to and after 1 December 2004.

SUMMARY

Library trays are an invaluable tool in determining the quality issues facing the New Zealand industry and the factors that impact on them. Information gained from the library trays provides a framework to improve quality on orchard, by providing feedback on the quality of individual grower's fruit. They are used as a real time management tool to identify and where possible rectify quality issues as they arise during the course of a season. Several factors have been demonstrated to consistently impact on fruit quality. These include fruit age, harvesting fruit following a period of rain immediately prior to harvest, and delays between picking and packing of fruit exceeding 48 hours.

REFERENCES

AIC (2001). Fruit Quality Assessment Manual 2001. Avocado Industry Council Ltd.