Why and where, good grapes go bad

The well-known management dictum that what gets measured gets managed, is the principle at play in a study that seeks to answer critical post-harvest questions in the table grape industry.

The table grape industry is a complex supply chain where factors such as temperature, humidity, and contaminants can lead to post-harvest decay. The project, led by Prof. Lise Korsten, aimed to identify causal agents responsible for decay and develop control strategies.

**Post-harvest fruit decay** caused by post-harvest pathogens results in considerable economic losses. Long distribution chains are particularly vulnerable because, as fruit ripens and ages, it becomes more susceptible to decay. Although this vulnerability is known, neither the source of inoculum in extended supply chains, nor the actual losses in the distribution chain and the pathogens involved, is fully understood.

One of the more perishable fruit categories is table grapes. In extended supply chains, their demise is mostly caused by the B. cinerea and Penicillium spp. pathogens. Despite more than 30 Penicillium spp. having been isolated on grapes, existing literature fails to specifically identify the ones that are pathogenic to table grapes. This lack of knowledge results in guesswork when it comes to identifying pathogens in the supply chain.

Furthermore, no evidence or traceability exists to indicate the link between pathogen profiles and losses, and what the ultimate cost to the grower is. The result is the absence of a holistic loss reduction strategy.

According to Professor Lise Korsten, senior lecturer in the Department of Plant and Soil Sciences at the University of Pretoria, the only way to address this issue is to take an all-inclusive supply chain view. “If we don’t understand the causal agents involved and their impact on post-harvest decay, we cannot effectively and efficiently apply control measures,” she says.

Determined to give the table grape industry a handle on the situation, Lise designed a research study financed by the PHI Programme and industry. Initially planned to run from November 2014 until the end of 2016, her project was extended to December 2017 (see sidebar on page 150).

**Project aim and objectives**

The ultimate aim of the project is to identify and study the post-harvest pathogens that cause rot on table grapes as they move through local and export chains, so that more effective end-market disease control approaches can be developed.

Project objectives were formulated around three project facets.

**Facet 1**

- Determine the reason for decay in the local table grape supply chain by linking pathogens with losses, and quantify the economic impact.
- Determine the reason for losses in the export chain from South Africa to the United Kingdom by pinpointing causal agents throughout the chain, and establish the economic impact.

**Facet 2**

- Develop a novel, accurate and rapid method to identify pathogens.
- Determine pathogenicity and aggressiveness of B. cinerea and known and suspected pathogenic Penicillium spp. over a table grape cultivar range.

**Facet 3**

- Compare the South African and UK distribution chains to get an overview of causal agents and the extent of post-harvest losses in the export chain.
- Conduct a detailed economic analysis of selected table grape value chains to quantify post-harvest economic losses.

**Methodology and results**

**Facet 1**

Local and export fruit were sampled on two farms in the Hex River Valley and two farms in the Groblersdal area. Samples of in-year harvested grapes, as well as the air around them, were taken at the Tshwane, Johannesburg and Epping fresh produce markets.

Preliminary results showed that Penicillium species, notably P. expansum, P. digitatum and P. crustosum, are highly prevalent throughout the table grape supply chain, especially in the local fresh produce market receiving areas, and the repack and distribution areas.

Symptomatic table grapes contribute to poor air quality that, in turn, causes an inoculum build-up that can cross-contaminate other fresh commodities close to the stored decaying fruit. Air quality at the UK re-pack and distribution areas was of particular concern as the total colony forming units were significantly higher than elsewhere in the export chain.

Where table grapes are repacked and packaging is opened, airborne pathogens can cause infection if the berries have micro wounds. Poor air quality and inoculum build-up can be the source of infection in the different facilities within the table grape export chain.

A preliminary conclusion, therefore, is that air quality monitoring and inoculum reduction are of the utmost importance to ensure fresh and healthy table grapes.

**Facet 2**

PhD student Pat Carmichael sampled approximately one-third of all fresh fruits and vegetables are lost before they reach consumers.
By knowing which pathogens are present in every link of the table grape export supply chain, from the vineyard, packhouse (1),冷 room (2), reefer container and finally where the fruit is the consumer’s shopping basket, make it possible to link pathogens with losses.

Nadia Botha does air sampling while Patricia Carmichael and Nazareth Siyoum are ready to lend a helping hand.

At the different berry development stages, resulting in reduced post-harvest losses.

Facet 3
On the economic part of the project, MSc Agric Economics student, Lianda Louw, collected primary data via electronic questionnaires and telephone interviews with relevant stakeholders. Secondary data was collected through collaboration with various supply chain stakeholders.

Preliminary results, based on the analysis of both sets of data, indicated that significant losses and waste occur before produce leave South Africa. Importantly, losses and waste appeared to not be measured throughout the chain, hence making it almost impossible for role players to implement strategies to mitigate the negative impact on return on investment.

PROJECT EXTENSION
An initial delay in approving the project caused the research team to miss the 2014/2015 table grape export season.

Fruit collection in the local market started as planned but the delay in following the export chain caused a knock-on effect in terms of pathogen isolation and identification, and data analysis.

The team was therefore granted an extension in order to follow the export cycle in the 2016/2017 season so that the statistical requirement of the repeat of trials could be met.

The physical appearance of table grapes after six weeks in cold-storage (a) followed by four (b) and seven days (c) at ambient temperature. Botrytis symptoms (d) were evident on bunches after seven days of shelf life.

Table grapes are highly perishable. Their market life is a function of time and temperature, with the degree of deterioration linked to the length of exposure to higher temperatures, and handling practices.

Recently a simulated table grape supply chain revealed what really happens during the post-harvest life of grapes. It gave the industry much to consider with regards to market chain logistics and management.

In her study, Patricia Carmichael stored table grapes for four, six and eight weeks at cold-storage temperatures, and later exposed them to ambient temperature for four and seven days, respectively.

The aim was to determine the keeping quality at the end of the chain, and further assess the incidence of post-harvest pathogens under simulated conditions.

Preliminary results showed symptoms of mainly Botrytis at the end of the study period. Prior to exposure to ambient temperature, less than 5% of the stored grapes showed Botrytis symptoms eight weeks after cold-storage.

Contrary to the prevalence of post-harvest pathogens observed along the local and export chains, a very low prevalence of Penicillium (<2%) was observed in the simulated chain.

However, given the effect of seasonal differences, the study will be repeated in 2017 to reach a conclusive statement.

Reducing food losses and waste is a priority in achieving a sustainable food future with efficient food systems.

Lianda Louw