Pre-harvest sanitation on table grapes

Sanitisers and biologicals as part of your supplementary spray-programme arsenal

This research project, which commenced in 2022, shows that sanitisers can supplement growers' spray programmes and be an effective part of their arsenal against pathogens and decay.

In table grape production, the principle "a stitch in time saves nine" is especially relevant, as pre-harvest practices such as canopy management and vineyard sanitation have a direct and significant impact on post-harvest quality, storability and decay management.

However, when it comes to managing pre-harvest decay, effective control strategies are not always clear. Along with physical removal of symptomatic berries from vineyard floors and bunches, sanitisers and biologicals can be incorporated into spray programmes to support post-harvest success.

To better assist growers with this, a study was initiated to determine the efficacy of integrated pre-harvest sanitation practices for improving decay control in the table grape industry.

It was jointly funded by the South African Table Grape Industry (SATI) and the Post-Harvest Innovation (PHI) Programme. The research team comprised Dr Johan Fourie, Inge Block and Daniël Viljoen of ExperiCo.

First, sanitisers and bio-fungicides were identified by the industry. Eight were used during in-vitro testing against specific post-harvest pathogens, namely *Alternaria alternata, Botrytis cinerea* and *Penicillium expansum*. Varying product concentrations (1X, 2X and 4X the recommended dose) were employed, whilst the most effective products were tested, using three different spore loads, i.e. (5 x 104, 1 x105 and 2 x 105 spores /mL and at different contact periods (5, 10, 15 and 30 minutes).

Ultimately, only four of the most effective products (90–100% efficacy) were selected for vineyard trials. Sanitisers and biologicals were incorporated into the existing fungicidal and insecticidal spray programmes of commercial vineyards in the Western Cape that exhibited a history of decay problems. These trials, as well as berry removal, were supervised throughout. Moreover, the table-grape cultivars, 'IFG Ten', 'Sugra 35' and 'Crimson Seedless', were evaluated during this trial.

The use of sanitisers to bolster a preventative arsenal

Table grapes are thin-skinned and, therefore, susceptible to decay caused by post-harvest pathogens. These pathogens thrive under fluctuating weather conditions, which can lead to berry cracking – an ideal entry point for infection. Consequently, increased decay is often observed when excessive rain is followed by high temperatures. Mitigation strategies for post-harvest disorders such as berry drop, weight loss, stem browning and fungal decay are therefore essential.

Sanitisers generally leave minimal residue that can be defined as trace amounts of fungicide or chemical compounds that remain on or in the fruit after application. It thus makes them a suitable option for expanding the fungicide toolbox for use on table grapes. As a result, researchers set out to identify sanitisers and biologicals with suitable active ingredients to do much of the heavy lifting.

Sanitisers, bio-fungicides and fungicides

Block clarified that a sanitiser is any surface disinfectant. It kills on contact and is primarily used in pack-houses to sanitise equipment and ensure worker hygiene. In the laboratory, it was found to be effective, killing up to 99.9% of bacteria or mould, subject to the conditions. The sanitiser's role is to decrease the incidence of spore inoculum.

A bio-fungicide is basically a biological, i.e. a living organism that finds itself in competition with a fungus: both compete for the same thing but the bio-fungicide outgrows it.

A fungicide is an agricultural remedy – a chemical or biological substance – used to prevent, control

or eliminate fungal infections, pathogens or spores that damage plants, crops and agricultural commodities (CropLife South Africa).

What separates the above-mentioned products are, firstly, mode of action and, secondly, active ingredients (actives). Block stated that the mode of action for sanitisers is more general in type, whilst in fungicides, it specifically targets the fungus and is registered as such.

The role of active ingredients

The products classified overall as sanitisers and biologicals had a combination of the active ingredients (see Table 1).

Table 1: Active ingredients in classified sanitisers and biologicals

Product	Ingredient
Bio-fungicide	Ascorbic acid and bioflavonoids
Biologicals	Bacteria *(Bacillus spp.)* and one a fungus *(Trichoderma sp.)*
Disinfectant	Hypochlorous acid and sodium chloride-based sanitisers
Sanitisers	Peracetic acid and hydrogen peroxide among others.

The effectiveness of sanitisers depends on certain present actives. The whole point of sanitation is inoculum load reduction, and to keep it as low as possible until the time of harvest.

Fungicides, on the other hand, have a longer lifespan. But growers are limited; they may only use a certain number of actives in a season, and use is prescribed by international regulations. This is known as the pre-harvest interval or withholding period, which is the number of days required between the last spray and harvest.

It is critical that growers adhere to this, otherwise they risk exceeding the maximum residue limit (MRL), which is the highest level of pesticide residue legally permitted in food. Exceedance jeopardises market access.

Dwell time also needs to be considered. Dr Fourie emphasised that for both the fungicide and sanitiser, the duration of contact with the fruit's surface is important. He said that it was more so for a sanitiser than a fungicide, because sometimes the latter had mobility and could penetrate, leaving a residue.

A pre-harvest focus

A clear distinction needs to be made between vineyard management and sanitation. Day-to-day vineyard practices are aimed at maintaining vineyard health. These also act to optimise fruit quality. In the long run, these practices are designed to make life less favourable for a fungus, through mitigation like canopy management.

On the other hand, sanitation refers to practices specifically aimed at the removal and destruction of infected berries, mummified fruit, and vineyard debris, along with equipment hygiene, in order to reduce pathogen inoculum.

Infection increases just before harvest, as the fruit matures. Dr Fourie noted, "It's due to the natural process of senescence." He explained that the closer to harvest, the more growers would need to reduce spore loads on the fruit surface. They try to harvest just before that optimal stage.

So, in a sense, growers' harvesting interrupts the maturing process of table grapes, to get the fruit to the consumer in good condition.

This is where MRLs really come into play. Growers' dilemma is that they must know what actives they need to combat the problems that they are experiencing in the field, but they are also faced with fungicide resistance or losing sensitivity. Sanitisers and biological products supplement growers' fungicide arsenal through ongoing reduction of inoculum loads.

Biggest challenge and the way forward

Field trials in the 2023/4 season did not reveal significant treatment effects in terms of the following:

- reduction in decay;
- loose or split berries;
- pedicel, receptacle and rachis condition; and
- berry firmness.

Block observed, "I think the biggest challenge of this project was environmental." The laboratory is tightly controlled. Close communication with growers ensured timeous application of products and the

trials were supervised throughout. But other factors, notably moisture, played a significant role. Clearly, contact time within the laboratory environment can be controlled, but how does one do that in the field?

Block said that she believed the way forward was continued testing. In the future, this could entail focusing on areas of high inoculum zones or disease pressure. The four products that performed very poorly during in-vitro testing had failed by a considerable margin, she said, and they would not be reconsidered for future trials.

Conclusion

As many researchers can attest, promising results in a controlled environment must be thoroughly assessed before they can be relied upon in real-world conditions. The same can be said about this project: after promising in-vitro trials where some products were 100% effective against *Botrytis*, *Alternaria* and *Penicillium*, field testing did not replicate the glowing results under field conditions. Environmental factors had, in all probability, influenced this discrepancy, especially the temperature and wetness duration.

Research findings show that sanitisers must be used in conjunction with fungicidal and insecticidal sprays, not as a stand-alone product. Dr Fourie encapsulates the new knowledge acquired: "Sanitisers must be seen as supplementary to fungicides used."

During the trials, farmers continued with their own fungicide spray programmes, whilst the sanitisers and biologicals were applied at intervals before harvest. However, the researchers observed that a hypochlorous and sodium chloride-based sanitiser, as well as peracetic acid and hydrogen peroxide-based sanitiser, generally reduced decay during the in-vitro and field trials.

Ultimately, users should not expect sanitisers to kill as effectively out in the field. Sanitisers cannot replace fungicides. This knowledge is novel and is encouraged as an additional sanitation practice.

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