Managing virus in New Zealand vineyards

Dr Roderick Bonfiglioli
Technical Director
Riversun Nursery Ltd.
Gisborne, New Zealand
rbonfiglioli@riversun.co.nz

Nick Hoskins
Viticulturist
Riversun Nursery Ltd.
Masterton, New Zealand
nickvineman@xtra.co.nz

The topic of grapevine viruses seldom hits the national news, but not long ago *The Dominion Post* gave it front-page treatment. "Winemakers forced to destroy top vines" ran the banner headline in one of New Zealand's most widely read daily newspapers.

The article, written by Bernard Carpinter, described the "devastating" damage caused by Grapevine Leafroll-associated Virus Type 3 (GLRaV-3) and cited vineyards where infection had become so widespread that the only option was to pull up entire blocks and replant – blocks that had formerly produced award-winning wines.

Although the newspaper coverage was quickly dismissed as "sensationalist" by many growers, the fact remains that GLRaV-3 is already having a severe negative effect on a number of vineyards around the country. Indeed, New Zealand Winegrowers (the national industry body) recently commissioned a report from Nimmo-Bell & Company Ltd. entitled *The economic effects and financial impact of GLRaV-3* (a full copy of which can be read on the industry website www.nzwine.com)

Over the past two years, New Zealand Winegrowers has committed significant funding through its research program to address GLRaV-3. To that end, the organisation has focused on three core components to ensure the long-term health and viability of our vineyards, including:

- The development of the New Zealand Winegrowers Grafted Grapevine Standard, to ensure the supply and planting of virus-free vines from nurseries;
- The effective management of mealybugs, which are the primary vector for the spread of GLRav-3; and
- Improved management of virus in vineyards, through careful monitoring for the virus and the removal of infected vines.

New Zealand is not alone in its concern about how to manage the spread of GLRaV-3. While field-based research conducted here and overseas may not yet be complete, recent findings can nonetheless provide some practical guidelines for vineyard management over the coming growing season.

The nature of the virus

Grapevine leafroll viruses have for many years been recognised as a major (and entrenched) problem affecting vineyards in older wine-producing countries. GLRaV-3 is certainly the most destructive virus in this group, and, in New Zealand, the most common.

Readily spread by infected propagation material and by insect vectors – notably by mealybugs (which carry and transmit the virus between adjacent vines) – GLRaV-3 has a well-known and documented detrimental effect upon vineyard performance in the following ways:

- serious declines in vine health
- delayed ripening and reduced yields
- poor fruit quality, with reduced colour and flavour compounds.

In red varieties (especially Pinot Noir), the reduction in fruit quality results in a corresponding decline in wine quality. Little research has been conducted on the effects of GLRaV-3 on white varieties, which often show no visual symptoms at all. One study, however, conducted by Bernard Walter, a research director for ▸

Grapevine leafroll symptoms in red wine-grape varieties (note the early autumn colourations of red between green veins, and leaves with margins rolled backwards)

Grapevine leafroll symptoms in white wine-grape varieties (note leaves with margins rolled backwards)

the National Institute of Agricultural Research (INRA) in France, demonstrated that the impact of GLRaV-3 on Chardonnay was no different from the impact on Pinot Noir: yields decreased, sugars were lower and acids were higher. This was confirmed in a recent paper by Franco Mannini, who found that the eradication of GLRaV-3 resulted in an overall improvement of the qualitative parameters of White Muscat winegrapes.

GLRaV-3, like many plant viruses, stores its genetic information in an RNA-based chromosome. This genetic information continuously undergoes minor mutations in the RNA sequence: in this way, the viruses develop new strains or variants of themselves. The continual development of new strains presents a challenge to the identification and accurate diagnosis of these viruses because our diagnostic methods are usually limited to detection of the commonest – or known – strains. Curiously, despite the frequency of occurrence and major economic impact of GLRaV-3, comparatively little work has been done in the characterisation of the different strains of this virus.

Last year, Linnaeus laboratory detected hitherto unknown strains of the virus within New Zealand that diverge significantly from strains previously reported. The laboratory subsequently developed new screening techniques, enabling it to better diagnose GLRaV-3 in this country's vineyards. At the 15th Meeting of the International Council for the Study of Viruses and Virus-like

Diseases of the Grapevine (ICVG) held in February 2006 in Stellenbosch, South Africa, it was revealed that other strains of the virus (also with dramatic variations from the reported "norms") have been detected in South Africa, Italy and Chile. While such research may seem somewhat removed from day-to-day viticultural concerns, the accuracy and comprehensiveness of laboratory diagnostics has an important role to play in the certification of vine health at the nursery level.

Observations from the field

Delegates at the ICVG also had a chance to learn more about the latest developments in virus management at the vineyard level. Perhaps not surprisingly (given its level of virused vineyards), South Africa is now developing some of the world's most comprehensive guidelines for the control of GLRaV-3, but new research hints that the virus may be even more insidious than was previously thought.

South African vineyard managers, like their New Zealand counterparts, have traditionally identified virused vines through a combination of visual monitoring for symptoms and laboratory confirmation. The diseased vines are killed and removed after harvest, and the area is typically replanted the following spring. But during a presentation at the ICVG by Gerhard Pietersen (from the University of Pretoria), we learned that the virus may in some instances remain (in the soil and on root tissue that has not been completely removed) for one or more years – only to reappear again on newly planted, certified material. As we know already, mealybugs are able to over-winter under grapevine bark, in the soil, and on root structures, thus paving the way for rapid spread of the virus once replanting occurs.

Pietersen's research is not yet complete, but the preliminary findings indicate that, where extensive areas of infected vines are pulled, a fallow period of one to two years should follow – along with the subsequent removal of any volunteer vines – before replanting takes place. This observation tallies with some anecdotal evidence from New Zealand growers who have found – to their horror – that their newly replanted vineyards start showing virus symptoms only a year or two later. Unfortunately, only time and further research will provide us with guidelines for the optimum period to leave a vineyard fallow after diseased vines are pulled.

In a related presentation by N.A. Spreeth, ICVG attendees learned about South Africa's integrated control strategy to prevent the spread of grapevine leafroll disease. Based on a case study at Vergelegen Wine Estate, in Somerset West, the strategy is quite labour intensive and relies on a full suite of chemical controls comprising:

Mealybugs on the underside of grapevine leaves (the best time for monitoring is late in the season and after harvest)

- Systemic insecticide (Confidor), used as a soil drench after vines are removed from entire blocks and/or 5 weeks after planting new vines.
- Contact insecticides (Dursban) used in conjunction with bark stripping.
- Systemic herbicides (Roundup) used to kill infected vines and roots (often in two separate applications).
- Mealybug pheromone traps set in summer (if more than 15 females per trap are collected, then a contact insecticide is used again on all plant and soil surfaces in later winter).
- Ant control – especially for Argentine ants – with contact insecticides (it's worth noting that Argentine ants have been recently introduced into New Zealand).
- Fallowing ground for one to two years after the removal of a whole block, with the removal of volunteer vines.

Such a program is not without controversy, nor is it likely to fall completely within acceptable practices under the Sustainable Winegrowing New Zealand (SWNZ) program. One area within the case study, however, certainly warrants immediate consideration. The South African researchers are not convinced that simply removing infected vines (sometimes referred to as "roguing") is sufficient.

They have expanded the protocols to the following:

- If there is one infected vine, then one vine on each side (up and down the row) will also be removed.
- if there are three infected vines in a row, then two vines on each side of the infected area will also be removed.
- if there are five infected vines in a row, then three vines on each side will be removed and vines opposite to those in adjacent rows will be ELISA tested to determine if the virus has already spread to those areas.

The nature of the bug

No discussion of GLRaV-3 is complete without mention of its primary vector – the mealybug. In work funded by NZ Winegrowers, a team at HortResearch is currently researching mealybug ecology and management within the New Zealand context. Such an investigation is vital: while mealybugs are the main vector for GLRaV-3 in other countries as well, the species are likely to differ.

The two main species of mealybugs in New Zealand are citrophilus and longtailed mealybug, which have two to four generations per year (typically there are more generations in warmer regions). In this respect, we can count ourselves fortunate: we don't have to deal with the vine mealybug – which lives in South Africa and has recently arrived in California. The vine mealybug has up to nine generations per season, thus dramatically increasing the ability to spread GLRaV-3 throughout a vineyard.

Regardless of which species or where, mealybugs are difficult to control by sprays because they can happily overwinter under grapevine bark or in the soil (the vine mealybug can survive as deep as 30 cm under the soil).

In a major review of the virus (written by HortResearch and commissioned by NZ Winegrowers), the authors noted:

"In reality, the combination of mealybug species, climate and vineyard environment that comprises the New Zealand wine industry is unique. New Zealand appears to be one of the very few countries that is warm enough for mealybugs to regularly reach high population densities, yet not warm enough to provide sufficient additional ripening to ▸

compensate for the effects of GLRaV-3 in grape quality and harvest."

Peter Lo, Vaughn Bell and Jim Walker, the HortResearch team in Hawkes Bay that is working on mealybugs, have reported some of their preliminary findings in the August issue of *New Zealand Winegrower* magazine). They note that "best practice" guidelines for controlling mealybugs can be summed up in one sentence: "Hit them hard and hit them early." The team recommends a program that combines monitoring for mealybug infestations late in the season, and using two insecticides the following spring:

- Tokuthion® and oil, at budburst; and
- Applaud, as late as possible before the start of flowering.

Lo, Bell and Walker – like Pietersen in South Africa – also recommend adopting the sort of sanitary procedures that will already be familiar to growers who have had to confront the spread of Phylloxera:

- Minimise the potential to transport mealybugs by thoroughly cleaning equipment like trimmers and harvesters, before leaving mealybug infested blocks, or entering new blocks and vineyards.
- Programs involving the use of machinery or staff should ideally begin in younger blocks/vineyards where mealybug numbers and the incidence of virus are likely to be lower than in more established blocks.
- Consult with neighbours to determine mealybug impact and to co-ordinate control measures between all vineyards in the area.

On a related note, NZ Winegrowers is co-funding research aimed at the identification and production of sex pheromone traps specifically designed for the mealybug species present in this country's vineyards. The project is also being overseen by HortResearch, and we can look forward to one day having an effective tool for monitoring infestation levels.

What to do in the season ahead

So where does all this research leave New Zealand winegrowers in their efforts to control the spread of GLRaV-3 during this year's growing season?

Let's assume that last year you became concerned when one or more of your vines showed symptoms of leafroll virus (as shown in the accompanying photographs). You identified the troublesome vines (say, by tagging the vines with coloured tape), and you also sent some leaf and/or vine samples away for laboratory testing to confirm your suspicions. At harvest time, you inspected the vines for mealybugs and found some level of infestation. Infected vines were immediately removed and you're now mulling over whether to replant immediately or leave the ground fallow in order to remove all roots and volunteer vines that may appear in the coming year.

What it boils down to in the meantime is mealybug control. The traditional method has been to apply drenching sprays of non-selective insecticides (mostly Tokuthion, an organo-phosphate) to vines in late dormancy. This can and has worked well, although today's growers are much more reluctant to use non-selective insecticides of this nature – with good reason:

- They are toxic to humans, and
- They may kill off natural predators that are helping with mealybug control.

In our experience, blanket sprays of non-selective insecticides may lead to a situation where there is a population explosion of mealybugs when the use of these types of insecticides is discontinued. Tunnel sprayers are now available that are suitable to spray dormant vines without spreading the insecticide over the whole vineyard. These tunnel sprayers are shielded hydraulic sprayers that catch and recycle up to 80% of the spray applied. This results in far less chemical per hectare being used and also stops the chemical falling in the inter-row area, allowing natural predators a greater chance of survival.

Previous recommendations for mealybug control with selective insecticides have asked for two sprays early in the season after budburst. Based on the HortResearch team's preliminary findings, however, good control can be achieved by using Applaud (an insect growth regulator). It's important to note that Applaud requires two sprays for what it terms a "single application" – if you can arrange for the first spray in October and the follow-up in November (using a water rate around 500 L/ha) you'll be in line with HortResearch's new recommendations.

HortResearch also recommends spraying with Tokuthion in the early spring. If your rate of infestation seems high enough, this spray could be applied using the tunnel sprayer already mentioned. Start the season with a Tokuthion, oil and (possibly) adjuvant application at budburst between Bud swell EL stage 2 and Woolly bud EL stage 3, using water rates of around 500-1000 L/ha, with the objective of drenching the canes and trunks of the vines (this would normally be applied without fan assistance).

The Export spray schedule states that Tokuthion can be used "not past budburst" for all countries covered in the schedule (probably because it has a residual life on plant surfaces). If you have missed this window, you could use Lorsban (Chloropyrifos) with a summer oil after budburst, although it won't be as effective. Strip flaking older bark from vines, especially on the trunks, during winter to help increase mealybug mortality and improve insecticide penetration.

One final thought: in South Africa GLRaV-3 remains the single biggest obstacle to the development of a high-quality export wine industry. During the ICVG conference, one prominent Cape winemaker acknowledged that he was now keeping red juice on the skins for about 10 weeks after picking and before pressing and fermentation because they had trouble "getting the colour up" in the juice due to the effects of GLRaV-3. The New Zealand wine industry relies on its reputation for producing premium wines for export and, for that reason alone, we must do everything in our power to keep GLRaV-3 at bay – and out of the headlines.