Pierce's Disease symptoms. Image courtesy of University of California.

Xylella fastidiosa: What do we know and are we ready?

Part One

Suzanne McLoughlin, Vinehealth Australia's Technical Manager, analyses the grape and wine community's preparedness and knowledge about *Xylella fastidiosa*. This is the first in a two-article series on Xylella, which is known to the industry as Pierce's Disease.

XYLELLA FASTIDIOSA – a gram-negative, rod-shaped bacterium known as Pierce's Disease in viticulture, was the subject of an international symposium in Brisbane on May 17-18, organised by the Department of Agriculture and Water Resources (DAWR).

A broad range of international experts shared their knowledge and experience on Xylella with Australian federal and state government biosecurity personnel, as well as a small number of invited industry participants.

Xylella fastidiosa is considered one of the most harmful plant pathogenic bacteria in the world and causes death of infected plants. In Australia, Xylella is our number one priority plant pest and it's a high priority pest for the wine industry. Neither *Xylella fastidiosa*, nor its highly efficient vector found in California, the Glassy-winged sharpshooter, are known to be in Australia.

Xylella is a major threat due to its multiple hosts – more than 350 plant species, many of which do not show symptoms – its multiple vectors and its continued global spread.

The pathogen causes clogging of plant xylem vessels, resulting in water stress-like symptoms to distal parts of the grapevine, with vine death in one to two years post infection. The bacterium is primarily transmitted in the gut of sap-sucking insects and the disease cannot occur without a vector.

While *Xylella fastidiosa* is known as Pierce's Disease in grapevines, it's known as many other names in other host plants.

It is inherently difficult to control and there are no known treatments to cure diseased plants.

Xylella fastidiosa has been reported on various host crops, either symptomatic or asymptomatic, in North America, Central America, South America, Canada, Iran, Taiwan, France, Germany, Italy, Spain and Switzerland [as at 9 May 2017, according to the European and Mediterranean Plant Protection Organisation (EPPO) Global Database https://gd.eppo.int/taxon/XYLEFA/distribution]. Xylella has not been detected in any Australian native plant species grown overseas.

THE FACTORS THAT MUST INTERSECT FOR PIERCE'S DISEASE TO BECOME A THREAT

Based on international experience in the fight against *Xylella fastidiosa*, a number of key factors must intersect for Pierce's Disease to cause significant loss to the Australian wine industry.

In other countries, it has not simply been enough to just have susceptible host plants, the pathogen (*Xylella fastidiosa*) and available vectors – the system is a far more complex one (as described in Figure 1). Four key factors are necessary and must intersect each other, but a range of conditions pertinent to each key factor must also be present to result in significant vine loss. In Australia, we therefore need to be alert but not alarmed. We need to use our time wisely before a potential incursion to vastly improve our preparedness capacity and capability to manage such an incursion.

WHAT CONSTITUTES PREPAREDNESS?

To be prepared to face a Pierce's Disease incursion that would threaten the Australian wine industry, we need to look inwardly as a government/industry/research collective and ask ourselves a range of tough questions:

- Do we have a culture of strong leadership at the ready or do we have an uncoordinated, 'siloed' approach to preparedness by government, industry and researchers with stakeholders unclear on roles and responsibilities?
- What is our goal for eradication/management in the short, medium and long term, given our current capacity and capabilities, research status and available technologies?
- Do we have scheduled emergency response simulation activities? Are we recording results and proactively addressing weaknesses determined?
- Do we have a prioritised research and extension framework developed by multiple stakeholders, with an agreed

Figure 1. Key factors for Pierce's disease to be a threat to the Australian wine industry.

Glassy-winged sharpshooter. Image courtesy of Reyes Garcia III, USDA Agricultural Research Service, Bugwood.org.

funding model, which outlines high priority activities key to preparedness?

- Do we have readily available access to international resources and expertise?
- What does our pre-border, border and post-border quarantine management entail? What zones will be put in place and what movements will be allowed in and out? What disinfestation treatments will be required?
- What will be the surveillance strategies within these zones? Would industry representatives be required for surveillance as part of surge capacity following an outbreak? Would there be any additional foreseen imposition on nurseries as has occurred in California?
- Do we have a communications and awareness strategy for industry now and in the event of an incursion?
- Are we proactively training our personnel both locally and internationally in field diagnosis, surveillance strategies, lab diagnostics and social science?
- Do we have a clear understanding of xylem sap-sucking insects already in Australia, which could potentially vector the *Xylella fastidiosa* pathogen, and their host plant range?
- Do we have readily available, internationally recognised, clear guidelines on field sampling?
- Do we have internationally recognised diagnostic protocols that minimise false positive and false negative results?
- Which of our laboratories can test for *Xylella fastidiosa* and do we have sufficient surge capacity available?
- Can we successfully conduct strain typing and how long does this take? Do we have a rapid, accurate, cost-effective in-field diagnostic technique which could negate the need to move potentially infected material for diagnosis?
- What are our surveillance strategies for early detection and who is responsible for their coordination? Do they differ for symptomatic and asymptomatic hosts? Will they be cross-sectoral? Have we mapped our land use cover including riparian areas, in sufficient resolution? How can we best use our current technologies and what emerging technologies could assist?
- Do we have a range of effective management options in our toolkit to break the vector lifecycle and/or reduce vector populations that have been discussed with industry? Which of these if any will be mandated in the event of an incursion?
- Do we have capacity in our nurseries to replace infected vines with less susceptible varieties?
- Will we offer compensation to growers for vine loss and how would this be financed?
- Have we performed economic analyses on potential effects of an incursion on our industry that have been ground-truthed by industry?

WHAT HAVE WE LEARNT FROM THE REST OF THE WORLD?

Some in-depth, practical presentations were delivered at the symposium from the Californian and Italian viewpoints, outlining their approaches to dealing with *Xylella fastidiosa* incursions in predominantly grape and olive hosts, as reported below.

US EXAMPLE

The Californian model for management of Pierce's Disease has been used as a blueprint in the United States to combat other high priority plant pests. It was realised early on that with limited available research and the relative strength of the Glassy-winged sharpshooter vector, broad-scale disease eradication was not possible in the short-medium term and that, therefore, vector management was the key.

Collaboration has been imperative – between federal, state, regional, local council regulatory and extension staff, multiple industries, researchers, nurseries and the public – with roles and responsibilities documented and understood by all parties. A strong emphasis on communication and awareness strategies ensured that the effectiveness of management measures were constantly ground-truthed. This approach avoided negative social backlash, especially from treatment programs, and even incorporated visits to local schools.

Understanding the vector lifecycle was crucial. Due to the nature of the vector, area-wide, cross-sectoral vector management was needed, involving treating the vector in citrus as the alternative host where it overwinters, before moving into grapes as the primary host, causing Pierce's Disease. Multifaceted trapping and monitoring programs were established to determine the boundaries of the vector's location.

Federal and state quarantine regulations were instituted including nursery treatment protocols and inspection programs, where all propagation material was inspected for the vector prior to leaving a nursery and was also inspected upon arrival at the destination.

Core to a strong system was an agreed funding framework by federal, state, industry and regional players for necessary activities, including containment through quarantine, statewide surveys (trapping, visual assessments and biocontrol), public awareness campaigns, cultural treatments

to primary and alternative hosts (grubbing and insecticide spraying), research, and nursery treatment programs.

Federal funding covers many of these activities (in the early 2000s US$22m was invested, now around US$15m). A winegrape industry fund (arising from self-assessment contributions from growers of US$0.75-$2.00 per $1000 grape value) managed by an industry-established Pierce's Disease/Glassy-winged sharpshooter Board, finances research activities and eradication treatments on properties where the vector has not been seen before. Because of the large discrepancy in crop value between wine and table grapes, only winegrape growers have contributed to the industry fund to date. Nurseries self-fund their compliance activities.

It is important for all Australian industries that could potentially be affected by *Xylella fastidiosa*, to proactively consider their contingency for funding research, on-ground activities and potential compensation, in the event of a local incursion.

ITALIAN EXAMPLE

The Italian approach to surveillance for *Xylella fastidiosa* in olives in the Apulia region, presented a strong use of technology and an integrated track and trace system for sample collection from the field to the laboratory. Much of the technology presented mirrored Australia's current capacity in pockets, but highlighted our lack of coordinated national GIS and remote sensing system capability necessary in the event of a cross-border incursion.

Surveillance activities focus on three designated quarantine zones, the infected area bounded by a 20 kilometre containment zone, further bounded by a 10 kilometre buffer zone. In the buffer zone, one olive tree is sampled per hectare and if verified as positive for the pathogen, then all remaining plants in that hectare recognised as hosts of the Apulian Xylella strain are removed. In both buffer and containment zones, 1,000 hectare virtual grids are overlaid over the landscape and then further sub-divided to one hectare resolution for sampling. High resolution (10cm accuracy) remote sensing RGB-NIRGB imagery is used to 'photo interpret' and categorise the relative health of olive trees as severe, moderate, mild, symptomless or doubtful, in an attempt to geolocate affected trees for diagnostics, as well as to conduct non-biased sampling to survey asymptomatic trees.

While not a failsafe method of pinpointing olive trees infected with Xylella (because disease symptoms can be confused with water stress, salt, fungal and dieback diseases and boron deficiency), it has merit. Inspectors use an impressive real-time mobile app (Xylpp) in-field to view the geolocation of the tree health maps, allowing them to initially inspect low-health trees, aimed at ultimately reducing pathogen spread. Inspectors also log visits spatially and tag diagnostic samples in real-time through the app, results of which can be viewed by other field staff and laboratories through storage in the XylWeb database. Future technological developments include assessing the applicability of hyperspectral and thermal imagery to assist in early disease detection, with results to date showing promise. Automatic tree counting is also performed using aerial imagery which can provide updates on tree removal.

HOW IS VINEHEALTH AUSTRALIA WORKING TO IMPROVE OUR PREPAREDNESS FOR *XYLELLA FASTIDIOSA*?

Vinehealth is working hard to keep South Australian grape and wine businesses free from a range of high priority pests and diseases, including Pierce's Disease and its vectors. We see our role as posing the tough questions to state and federal government and industry bodies to ensure we are jointly on the right path to preparedness. We support and will lobby for strong leadership, a coordinated approach between the wine industry, government, researchers and other stakeholders, and a focused and prioritised research and extension plan. We will encourage government to better share their preparedness plans with our industry and ensure industry is updated regularly on progress. We believe we are in a strong position to act as a sounding board to ensure preparedness plans are practically focused and realistic in their timeframes and activities.

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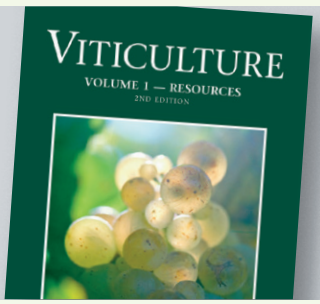
On a practical note, Vinehealth is currently undertaking the design and build of a biosecurity platform to capture surveillance data and other biosecurity information critical to preparedness and response activities. Vinehealth also continues its lead role in communications and awareness for grape and wine businesses and stakeholders on Xylella and other priority plant pests, to ensure greater understanding throughout industry so that informed decisions can be made by all to prepare for and manage a Pierce's Disease incursion.

About Vinehealth Australia

Vinehealth Australia is a statutory authority operating under the Phylloxera and Grape Industry Act (1995) with legislative powers in South Australia. As part of its role, Vinehealth works to increase the wine industry's knowledge of biosecurity threats and their management. ww.vinehealth.com.au



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