Australian grapevine yellows

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Summary

Australian grapevine yellows disease (AGYd) is observed in many Australian grape growing regions from spring through to late summer and is associated with three phytoplasmas (simple bacteria): *Candidatus Phytoplasma australiense* (Australian grapevine yellows phytoplasma or CPa), Tomato Big bud phytoplasma (TBBp) and Buckland Valley grapevine yellows phytoplasma (BVGYp). The disease is named to distinguish it from grapevine yellows diseases that occur overseas and are associated with other phytoplasma species that have different biology and epidemiology to CPa, TBBp and BVGYp. A higher incidence of AGYd occurs in the warmer inland districts of the Murray Valley in NSW and Vic, the Riverland in NSW and the Riverland in SA compared with other Australian grape growing regions.

Figure 1. Early symptoms of AGYd developing on a young shoot. Note the yellowing (chlorosis) of the veins and tissue between the veins and overlapping leaves, which are rolling downwards.

Figure 2. Symptoms of AGYd associated with CPa affecting a Chardonnay shoot. Note the necrosis and yellowing, overlapping leaves, which are rolling downwards.

Symptoms

Shoots

Rows of black pustules can develop on the green bark of affected shoots. The tips of affected shoots may die and shoots may die back. Affected shoots fail to harden off and remain rubbery. The disease can affect only one shoot on a vine through to the entire canopy.

Foliage

Leaves show irregular yellowing in white varieties or reddening in red varieties (Figures 1–5). The discoloured leaf tissue may become necrotic (Figures 2, 4, 5). The leaves curl backwards (Figures 1–5). There is overlapping of leaves on affected shoots (Figures 1 and 4). The leaf blade often falls prematurely, leaving the petiole (stem) attached to the shoot. Eventually the petiole separates as well.

Fruit

Flowers on affected shoots may abort or berries may shrivel (Figures 6–8). Sensitive varieties may have significant reductions in yield.

Vine growth

Phytoplasmas have been implicated in restricted spring growth disorder (RG) and late season leaf curl symptoms (LSLC). No clear association has been determined between the presence of these diseases and AGYd or phytoplasmas. RG has been associated with other biotic and abiotic factors and phytoplasmas may be one of many causes for this disorder.

Varietal susceptibility

The severity of all grapevine yellows diseases differs depending on the variety, for example Chardonnay and Riesling are more severely affected than red varieties.

Figure 3. Symptoms of AGYd associated with CPa affecting a Shiraz shoot. Note the reddening and downward rolling of the leaves.

Biology

Phytoplasmas in grapevines

Phytoplasmas are intracellular bacteria of the family *Acholeplasmataceae*, class *Mollicutes* (common name: mollicutes), of the kingdom *Prokaryotae*. They are mainly restricted to the phloem cells (part of the vine's vascular system) of infected plant hosts (Figure 9) or the salivary glands of their insect vectors. Phytoplasmas have not been successfully cultured in vitro.

At least ten phytoplasma species have been associated with grapevine yellows diseases in many viticultural regions worldwide. CPa, TBBp and BVGYp are the only phytoplasmas known to infect grapevines in Australia. They have not been detected in grapevines overseas.

Figure 4. Symptoms of AGYd associated with BVGYp affecting a Chardonnay shoot. Note the yellowing, necrosis and overlapping leaves, which are rolling downwards.

Figure 5. Symptoms of AGYd associated with CPa affecting a Chardonnay shoot. Note the yellowing and necrosis of the leaves, which are rolling downwards.

CPa is most commonly detected in symptomatic Australian grapevines. Both TBBp and CPa can occur in the same regions and the same vineyards. Mixed infections of TBBp and CPa can occur in the same grapevine. BVGYp has only been detected in grapevines from the Buckland Valley of Victoria.

Transmission

The transmission of AGYp, TBBp and BVGYp through grapevine cuttings has not been demonstrated; transmission of other grapevine phytoplasmas through propagation material can occur. Many phytoplasmas are spread to plants by insect vectors, most of which belong to the superfamilies *Cicadelloidea* (leafhoppers), *Fulgoroidea* (planthoppers) and *Psylloidea* (Psyllids). TBBp is transmitted in other crops in Australia by the common brown leafhopper (*Orosius orientalis*, Figure 10) but this has not been demonstrated in grapevines. The insect vectors for CPa and BVGYp are not known, although strains of CPa are transmitted by *Zeoliarus atkinsonii* and *Z. oppositus* in New Zealand.

Phytoplasma movement and disease development

CPa and TBBp can persistently infect Australian grapevines and systemically invade shoots, cordons trunks and roots. However, phytoplasma concentration may be low and distribution can be uneven in grapevines. This can have important implications for virus detection and disease expression. Symptomless infections occur. Grapevines affected by AGYd may have remission of disease in subsequent years, however recurrence of disease in the following years is also observed. Persistent phytoplasma infection and new infection events are likely to contribute to recurrent expression of disease from year to year.

Figure 6. Berry shrivel associated with AGYd on a Chardonnay vine infected with CPa.

Alternative hosts

CPa has been detected in other plant species in Australia, including crop plants such as strawberry, papaya, pumpkin and paulownias, and native plants such as Yanga Bush (*Maireana brevifolia*), Ruby Saltbush (*Enchylaena tomentosa*), *Euphorbia terracina* and *Einardia nutans*. However, their role in the epidemiology of AGYd is unknown. TBBp has a broad plant host range and is found in most parts of Australia where phytoplasma surveys have been conducted. No alternative hosts have been identified for BVGYp.

Disease management

Certification schemes have been established in Australia that aim to reduce the risk of spread of serious grapevine diseases by providing industry with high-quality, pathogen-tested planting material. High-health grapevine material is routinely screened for the presence of AGYd through visual inspection and active testing if required. These schemes contribute to the improved productivity and sustainability of the viticulture industry and the use of high-health material is encouraged for vineyard establishment and vine replacement.

Field spread of phytoplasmas seems to occur in Australia and vineyards should be routinely monitored for the presence of AGYd. If the presence of disease and phytoplasmas are suspected, diagnostic testing can be done to confirm the presence of phytoplasmas. Removal of infected vines may reduce the risk of AGYd in a vineyard.

Figure 7. Berry shrivel associated with AGYd on a Chardonnay vine infected with BVGYp.

Persistent and symptomless phytoplasma infections occur in Australia and the distribution of AGYd does not reflect the distribution of phytoplasmas. Because grapevines may be symptomless, active testing of grapevines is recommended prior to top working to a new variety. Symptomless infected grapevines may act as a reservoir of phytoplasma for other sensitive varieties.

A hot water treatment of 50°C for 20 minutes may reduce the risk of phytoplasma spread through propogating material.

Other biotic and abiotic factors can cause symptoms similar to AGYd and active diagnostic testing is required to confirm the presence of phytoplasmas.

Figure 8. Berry shrivel and foliar symptoms associated with AGYd on a Chardonnay vine infected with CPa.

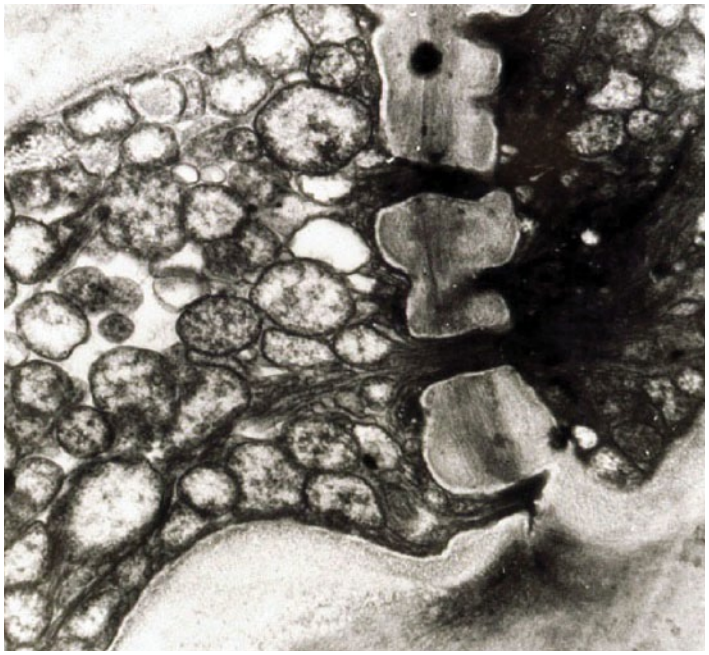

Figure 9. Phytoplasmas in a phloem cell.

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Figure 10. The common brown leafhopper (Orosius orientalis) is a vector for TBBp in other crops (Image courtesy of Dr Piotr Trebicki, DPI-Victoria).

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