Factsheet

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Rugose wood – associated viruses

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Summary

Rugose wood of grapevines is the name given to a group of five serious diseases: Kober stem grooving, corky bark, LN33 stem grooving, corky wood and rupestris stem pitting. These are of major importance to viticulture worldwide.

Each of the diseases is named for the symptoms induced during indexing on a specific sensitive indicator variety: kober stem grooving affects the rootstock Kober 5BB (*Vitis berlandieri* × *V. riparia*) and is associated with grapevine virus A (GVA); corky bark affects the rootstock LN33 (Coudero 1613 × *V. berlandieri*); *V. rupestris* and LN33 stem grooving affects LN 33; both diseases are associated with Grapevine virus B (GVB), and rupestris stem pitting observed on *V. rupestris* cv. St George is associated with Rupsetris stem pitting associated virus (RSPaV). Grapevine virus D (GVD) was isolated from a grapevine with corky rugose wood disease in Italy however its role in the disease is not clear.

Many grapevine cultivars affected by rugose wood diseases can have reduced quality and yield of fruit and/or reduced quality and production of wood for propagation. GVA and RSPaV have been implicated in Shiraz disease in Australia and Syrah decline in other countries, although their role remains unclear. RSPaV is also associated with vein necrosis disease in the specific indicator *V. rupestris* × *V. berlandieri* 110 Richter. Symptomless infections of GVA, GVB and RSPaV can occur and these infected grapevines may act as a reservoir for other sensitive varieties.

Figure 1a: Stem pitting symptoms (top, arrow) on *Vitis rupestris* (Rupetris St George) inoculated with a strain of RSPaV from Cabernet Franc C24-1 compared to un-inoculated *V. rupestris* (Rupestris St George, bottom).

Figure 1b: Stem pitting symptoms (Vines 1, 3 and 4, arrows) on *Vitis rupestris* (Rupestris St George) inoculated with a strain of RSPaV from Cabernet Franc C24-1 compared to un-inoculated *V.rupestris* (Rupestris St George, Vine 2).

Symptoms

Wood

Removing the bark aids the observation of symptoms on the wood. Specific symptoms associated with GVA, GVB and RSPaV are observed on sensitive indicators during biological indexing. Swelling of the graft union may be observed on other commercial varieties and rootstocks. The diameter of the scion and rootstock may be significantly different from each other and the scion is often larger. The wood around or above the graft union may be rough, pitted, grooved and/ or corky (Figures 1–3). Necrosis may be observed at the join of the graft union. Graft incompatibilities can occur that may result in decline and death of the grafted scion. The canes of Shiraz disease-affected grapevines may not mature.

Vine growth

In rugose wood-affected grapevines budburst may be delayed. Affected grapevines can have reduced vigour and growth and may decline and die, affecting the lifespan of the vineyard. A reduction in cane pruning weight associated with a reduction in the circumference and/ or the length of the canes can occur. This will affect the quality of wood collected for propagation. *V. rupestris* × *V. berlandieri* 110 Richter rootstock affected by vein necrosis may show reduced growth, decline and die.

Foliage

In many varieties no foliar symptoms are observed. However leafroll-like symptoms have been reported in some varieties in which reddening or yellowing of the entire leaf blade, including the veins, and downward rolling of the leaves was observed.

GVA and RSPaV have been implicated in Shiraz disease and Syrah disease-affected grapevines in Australian and overseas in which entire canopies were affected with leafroll-like symptoms and leaves were retained through winter.

Vein necrosis primarily affects the rootstock *V. rupestris* × *V. berlandieri* 110 Richter and most other varieties and rootstocks are symptomless. Symptoms include necrosis of the veinlets on the underside of the leaf blade, which can extend to the upper surface with time (Figure 4). Symptom expression initially occurs on the basal leaves of a shoot and then progresses to the younger leaves of the shoot. Tendrils may also express necrosis.

Fruit

Significant yield reduction may be observed in rugose wood and Shiraz and Syrah disease-affected grapevines, which may be due to smaller and fewer bunches. Up to 50% yield losses have been reported in varieties infected with GVA and up to 70% in vines affected by corky bark associated with GVB.

Figure 2: Swelling and pitting of the shoots on an LN33 rootstock inoculated with a corky bark disease associate strain of GVB.

Figure 3: Possible mild rugose wood symptoms (left, arrow) on LN33 inoculated with GVB compared to un-inoculated LN33 (right).

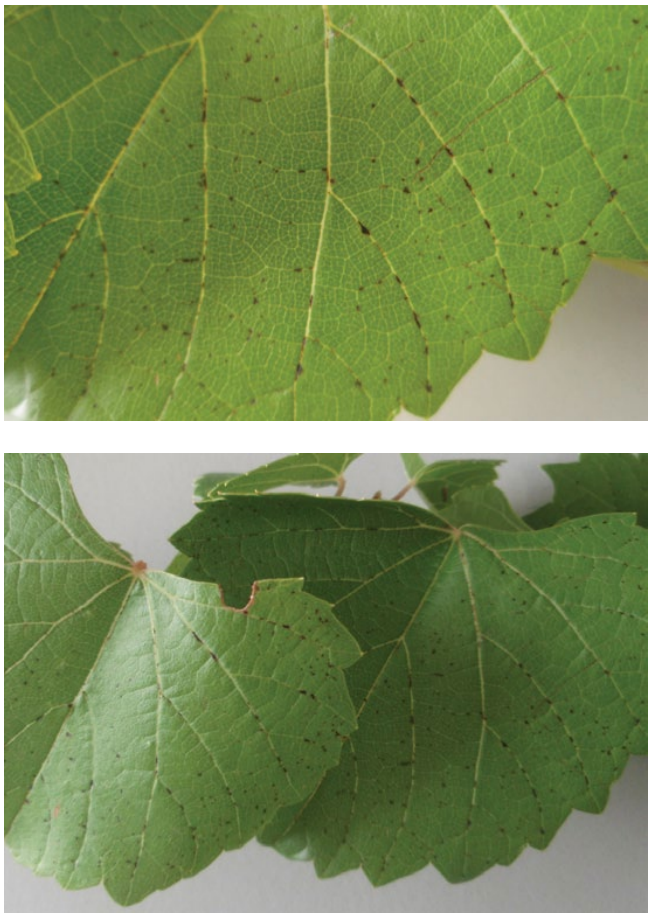

Figure 4: Vein necrosis symptoms on 110 Richter associated with RSPaV.

Varietal susceptibility

Symptom expression is dependent on the variety of the scion and rootstock and may be attributed to variation in susceptibility, resistance and tolerance to virus infection. Differences in symptom severity may also be associated with a specific virus species and strain variation within a virus species. Disease expression may be affected by environmental factors, such as temperature.

Biology

Rugose wood – associated viruses found worldwide

Two genera of the family *Betaflexiviridae* are associated with the rugose wood complex: *Vitivirus* species include GVA, GVB, GVD and Grapevine virus E (GVE) and RSPaV is the sole *Foveavirus* species. There are many strains of each virus species. The role of GVE in grapevine disease is unknown.

GVA, GVB and RSPaV occur in Australia, however corky bark disease, which is associated with strains of GVB, is not known to occur in this country. In a recent survey

Figure 5: Longtailed mealybug *Pseudococcus longispinus* (Targioni Tozzetti). (David Cappaert, Michigan State University, Bugwood.org)

of grape growing districts of mainland Australia (NSW, SA, QLD, WA and Vic.) RSPaV was detected in 214 of 218 (94%) grapevines. In the same survey GVA was more frequently detected (82 of 218 vines; 34%) than GVB (2 of 218 vines; 1%).

Transmission

GVA, GVB, GVD, GVE and RSPaV are not known to be mechanically transmitted on pruning equipment or harvesters, nor are they known to be transmitted by touch. Vitivirus species are phloem restricted and seed transmission has not been reported. The restriction of RSPaV to the phloem is not known, however it can be detected in pollen and seed and is difficult to eradicate during heat treatment and tissue culture suggesting that it invades other cell types. Although RSPav has been detected in pollen, seed and seedlings, transmission through seed to seedlings has not been proven.

GVA, GVB, GVD, GVE and RSPaV are transmitted through propagation and grafting. Graft transmission can occur from rootstock to scion and vice versa.

Field spread of GVA and GVB has been observed. GVA, GVB and GVE can be transmitted by mealybug and/or scale insects including several species that are common in Australian vineyards: the longtailed mealybug (*Pseudococcus longispinus*, Figure 5) and the obscure mealybug (*P. viburni*). Natural spread of RSPaV is not reported and no vector is known, however it occurs with high incidence in many grape growing regions worldwide.

Virus movement and disease development

Virus titre may be low and distribution can be uneven in grapevines at certain times of the year, particularly in the first season after an infection event. It can take

more than 12 months for viruses to move from the point of infection to shoots and cordons of the grapevine. This can have important implications for virus detection and disease expression.

Alternative hosts

No naturally occurring alternative hosts have been reported for GVA, GVB, GVD, GVE and RSPaV.

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 screen for the presence of virus-associated diseases through visual inspection and active diagnostic testing for viruses. 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 GVA occurs in Australia and vineyards should be routinely monitored for the presence of associated diseases. If the presence of disease and associated viruses are suspected diagnostic testing can be done to confirm the presence of viruses. Removal of infected vines may reduce the risk of virus spread in a vineyard. Vineyards should also be monitored and treated for mealybug and scale that may transmit GVA, GVB and other viruses.

Because grapevines may be symptomless, active virus testing of grapevines is recommended prior to top working to a new variety. If the new variety has not been obtained from an accredited certification scheme then it is recommended that it also be actively tested for virus. Symptomless infected grapevines may act as a reservoir of virus for other sensitive varieties.

Rugose wood symptoms can be difficult to observe in the field. Consequently visual inspection alone cannot be relied upon for disease diagnosis and pathogen detection. Active diagnostic testing is required to confirm the presence of viruses.

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