Verticillium wilt in New Zealand vines

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The disease

Verticillium wilt is a systemic fungal disease of grapevines: that is, the disease-causing agent is found inside the vine, usually in old wood such as the trunk or permanent cordons, as opposed to the leaves. The disease is caused by species of fungus belonging to the genus Verticillium, including Verticillium dahliae and Verticillium albo-atrum. In Verticillium wilt, the fungus invades and blocks the xylem vessels – the woody tissue that conducts water upwards into the vine. Symptoms are similar to acute water stress.

Verticillium wilt fits into the category known as grapevine trunk diseases. Although it has been previously reported as being present in New Zealand, the disease has not been a common occurrence in this country. Certainly, in all our years of work with vine diseases, Verticillium wilt did not pop up on Linnaeus laboratory's "radar" until 2005/2006 – despite the fact that internal symptoms (inside the wood) are quite distinctive. Most of the examples we have encountered over the last two seasons have been in younger vines on new developments in the Marlborough region, and it may be a result of developments being made on sub-optimal sites. It is our impression that the disease is now on the increase in some parts of the country.

How it spreads and infects vines

Verticillium wilt is mainly a soil-borne disease: the fungus usually enters the grapevine through one or more of the roots by either direct penetration or through wounds, and then works its way upwards into the trunk. The disease favours cool climates and cooler soils.

Typically found on sites that can be categorised as high risk, Verticillium wilt prospers on:

- poorly drained sites
- sites with high water tables, or heavy wet soils
- sites prone to periods of standing water.

The disease often occurs where previous land use has included:

- arable or cool-season vegetable crops, such as peas or potatoes
- fruit trees
- lucerne
- berry fruits
- tobacco
- hops
- kiwi fruit
- pasture with weeds.

While Verticillium wilt is commoner in heavier soils and on the high-risk sites described above, the disease can also occur on sites that would not be classified as high risk.

Affected vines are often seen in small groups or clusters within the vineyard, indicating that the disease probably spreads slowly from vine to vine if conditions are favourable. Nematodes have been implicated in the spread of these fungi.

Symptoms

By the time the fungus has worked its way up into the trunk of the vine, symptoms start to appear. The fungus often blocks only a part of the xylem, and symptoms will then be confined to a section or even one-half of the vine.

Symptoms are similar to acute water stress: fruit shrivels, and leaves dry out and die but usually remain attached to the shoot (see Figure 1). Leaf symptoms typically begin with an inter-veinal yellowing before the leaves turn necrotic and die.

Affected vines may suddenly collapse with a full load of fruit in mid-summer heat, when water demands are at their highest. Vines that undergo full or partial collapse in mid-

Fig. 1. This vine has collapsed during the first half of the season. Note that the leaves are dead and shrivelled, but still attached to the shoots

Fig. 2. This vine was badly affected last season and is showing a very slow start this season. Note reduced shoot growth and pale foliage.

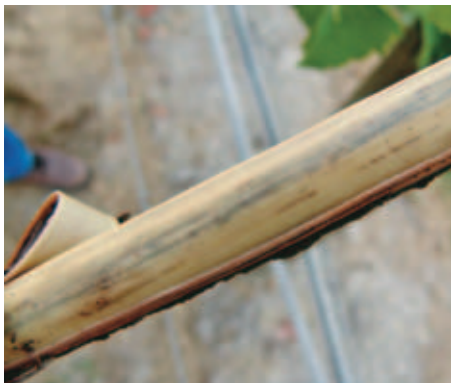

Fig. 3. Note the longitudinal streaks visible on the outside of the central xylem when the surrounding vascular tissue is removed

Fig. 4. Concentric rings of brown stained tissue visible on cross section through the xylem. Note the phloem and cambium vascular tissue directly between the outside bark and the central xylem appears to be coming loose from the xylem.

Fig. 5. Often, the brown staining visible on cross section through the xylem is concentrated towards the outside edge of the xylem.

summer may show pale foliage and very stunted or slow growth in the following spring (see Figure 2). Some vines appear to "recover" from the disease, but whether the recovery will be sustained is not known (we have observed this phenomenon in the Marlborough region).

The fungus can be most easily isolated from the vines in spring. What we commonly find is that when the cambium-phloem layer is removed and the central xylem cylinder is exposed, the fungus can be seen to have caused longitudinal streak markings on the outside surface of the central xylem cylinder (see Figure 3). The cambium-phloem layer is a narrow sheath of vascular tissue directly beneath the external bark and directly outside of the central xylem tissue, and the fungus may be most easily isolated from the interface between these two tissue layers. In vines affected by Verticillium wilt, we often find that the cambium-phloem layer comes away from the central xylem cylinder very easily, whereas in healthier vines, this does not usually happen.

In cross section, trunks of affected vines often show concentric rings of brown stained tissue in the central xylem (see Figure 4); in other instances, there may be a ring of darkened tissue close to the outside edge of the central xylem (see Figure 5).

Control

Drainage is very important in the control of this disease. If drainage is poor, improvements must be made.

Removal of affected vines and as much of the root-mass as possible will help, although some fungal inoculum will be left in the soil – this inoculum can potentially re-infect replacement vines.

Replacement vines should have the planting holes seeded with Trichoderma or Mycorrhizae preparations before planting.

Mycorrhizae are naturally occurring symbiotic fungi that inhabit the roots of many different plants and are known to assist in the uptake of nutrition. They are considered to be a potentially useful treatment against fungal diseases, especially root-borne ones, probably by simply improving the overall health of the plants.

Trichoderma are also naturally occurring fungi, and some species are known to be predatory on other fungi. They attack and eat other fungi in the root-zone and are thought to provide protection by removing potentially pathogenic fungi in this manner.

In some instances, growers have reported a remission of symptoms after drenching the base of affected vines with Carbendazine fungicides, such as Prolific® or Protek® and watering the application in to get the fungicide down to the root-zone. How long symptom remission will last when achieved in this way is not known. If vines are to be treated, it is essential to remove the fruit. This will help to reduce any stress on the vines, but is also recommended because such chemical applications are unlikely to be an approved registered use. Wineries are likely to be very concerned about potential chemical residues in the fruit. Check with the winery before proceeding.

Another treatment that may be worth trying, although its efficacy remains unproven for Verticillium wilt in grapevines, is the use of Phosphorous acid preparations. These preparations have proven action against Phytophthora species in avocados and have been extensively trialled against the fungus Phaeomoniella chlamydosporum, the causative agent of Petri disease (previously known as "Black Goo") in grapevines.

Based on first principles, the use of Phosphorous acid preparations against other trunk diseases, including Verticillium wilt, may therefore be worth trying, although its effectiveness certainly has not been proven. Phosphorous acids are commonly used in foliar fertiliser applications on grapevines and are unlikely to cause harm unless used to excess.

Some wineries are concerned about the possibility that the excess use of phosphorous acid preparations may result in residues called "Phosphonites" occurring in the wine. Wineries should therefore be consulted if a phosphorous acid regime involving repeated applications within one season is planned.

Forward planning

If you are considering establishing a vineyard on a site that fits into the "high risk" category, soil tests for fungal inoculum should be done before final development decisions are made. Soil fumigation is not effective at combating Verticillium wilt. Crop rotation and fallowing is likely to be much more effective. A few years of rotation through non-susceptible host crops is recommended. Drainage should be optimised, and care should be taken in the selection of root stocks.