

Grapevine trunk diseases in BC: From identification to control

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What are grapevine trunk diseases?

In the early 2000s, vineyard growers noticed significant grapevine decline, initially thought to be from cold winter temperatures. Grapevines were growing and producing less, and parts of the vine would die. In 2010, researchers from Agriculture and Agri-Food Canada (AAFC) set out to identify the cause and potential solutions.

After a 3-year research project, AAFC researchers determined that the primary cause of decline was due to **grapevine trunk diseases – a group of diseases each caused by a different set of fungal species**. The fungi infect grapevines through pruning wounds. Their spores land on the wounds and, in favourable environmental conditions, will start to grow. The fungi grow in plant tissues that transport water and nutrients (xylem and phloem), resulting in the development of cankers and/or wood rot. The cankers interrupt the flow of water and nutrients, resulting in the death of spurs, cordons, and/or trunk, and eventually leading to the death of the vine.

Worldwide, over 100 different fungal species have been associated with these trunk diseases. All known grapevine trunk diseases have been found in BC, including ones affecting young vineyards (within ~5 years after planting) (Petri disease and black foot) and those affecting mature vineyards (Esca, Eutypa dieback, Botryosphaeria dieback, and Phomopsis dieback). **In total, over 40 different fungi associated with these diseases have been identified in BC. The most common trunk disease in BC is Botryosphaeria dieback.** AAFC researchers have developed new molecular diagnostic techniques that allow them to identify which fungi are present and how widespread they are in plants and in soil, water, and air.

Symptoms

Symptoms include a slow or rapid decline of the vine, which depends on the disease(s) and/or fungal pathogen(s) present in the plant. In addition, symptoms overlap among different grapevine trunk diseases as well as with other factors such as spring frost, winter damage, and/or nutrient deficiency, which can make it difficult to accurately identify between diseases in the field.

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Production Type

- Wine grapes

Practice Benefit(s)

- ☀ Disease management

Research Location

- Okanagan, BC



Figure 1. Grapevine with dead spurs and cankers. Photo by J. R. Úrbez-Torres, AAFC.

Foliar (leaf) symptoms of Petri disease and black foot in young plants are characterized by an overall stunting, delayed budbreak, shortened internodes, yellowing foliage with black margins, and wilting of leaves or entire shoots. Internally, the grapevine will have black/dark areas and/or spots primarily at the base of the trunk (rootstock or self-rooted cultivar), which can be seen in cross and lengthwise cuts.

Esca is known for its "tiger-stripes" symptoms of the leaves, which are multiple banding discolorations surrounding dry, light or red-brown tissue on the leaf blade. These foliar symptoms are not commonly seen in BC. Small reddish and dark spots, known as 'black-measles', can also develop on the skin of white cultivars. **The acute form of Esca is characterized by a sudden wilting of the entire plant, one arm, or several shoots.** Cross-sections of esca affected trunks will have a variety of internal wood symptoms, such as black spots in the xylem, brown to black vascular discoloration, or dry wood with a yellowish appearance. In older vines, the wood may develop a white to yellow soft rot.

Eutypa, Botryosphaeria and Phomopsis dieback are generally known as **canker diseases**. Their main wood symptom is a wedge-shaped perennial canker, indistinguishable among the three diseases. Sometimes, cankers can develop non-uniform or circular shapes. **Eutypa** can be distinguished from Botryosphaeria and Phomopsis dieback in the field for its **characteristic foliar symptoms**, including stunted shoots with yellowing leaves, that are often cupped (rolled) and have black margins. A common symptom for Botryosphaeria and Phomopsis dieback is a **lack of spring growth** from affected spurs. However, sometimes infections will occur internally in the wood and have **no apparent foliar symptoms**.



Figure 2. Symptoms of Petri disease in young vines. Internal necrosis (top left), wilting and collapse of shoots (top right). Esca symptoms on grapevines. Canker and soft rot (middle left), "black measles" (middle right), "tiger-stripes" (bottom left), and sudden collapse of a mature vine (bottom right). Photos by J. R. Úrbez-Torres, AAFC.



Figure 3. Symptoms of canker diseases. Wedge-shaped canker (far left), cordon dieback (middle left), and infections in the wood (middle right). Foliar symptoms from Eutypa dieback (far right). Photos by J. R. Úrbez-Torres, AAFC.

How common are grapevine trunk diseases in BC?

To understand the prevalence and spread of grapevine trunk diseases in BC, AAFC researchers analyzed over 500 samples collected from about 191 vineyards between 2010 and 2014. They also evaluated the health status of the nursery planting material with regards to grapevine trunk diseases fungi by collecting and analyzing plant samples from nurseries between 2014 and 2019.

For the vineyard survey, researchers sampled 191 vineyard blocks (90 young vineyards, 101 mature vineyards) across BC including the Okanagan, Similkameen, Kamloops, Fraser Valley, Vancouver Island, and the Gulf Islands. 95% of the vineyards surveyed had symptoms of trunk disease, but incidence varied significantly and was usually higher in older blocks. Out of the ~60,000 vines they inspected, 10% showed symptoms of trunk diseases. This is considered a very conservative number as these results are based on leaf symptoms observed in the field and the diseases can occur internally without leaf symptoms.

Researchers sampled 3 nurseries that supplied to Canada. They collected 30 plants per nursery (10 each of Chardonnay, Merlot, and Pinot Noir) and assessed their roots, base of the trunk, graft union, and scion for grapevine trunk diseases. All of the plants evaluated were infected with at least one disease-causing fungal species. However, being infected does not necessarily mean that the vine will get sick and die. There is likely a trigger (abiotic and/or biotic stress) that causes some of these fungi to go from endophytes (not causing harm to the plant) to becoming virulent (harmful). Understanding these stressors will significantly help with managing grapes, primarily during the first years after vineyard establishment.

What solutions are available to control grapevine trunk diseases?

Solutions have been developed in other grape-growing regions around the world and have been, or are in the process of being, tested in BC. Chemical and biological products to combat grapevine trunk diseases were not available in Canada until recently. Most of these solutions require more research, but current information is described below.

Trunk Renewal

Type: Responsive

What it is: Cutting/removing infected parts of the vines. The vine is then re-trained from suckers that develop below the cut.

Status: This strategy has been widely adopted in BC and has been very successful at controlling grapevine trunk diseases.

Its advantages include a faster return to full production and allowing growers to keep the same cultivar/clone. Its disadvantages include high cost and high labour intensity. However, research has shown that this method is more economical for growers compared to doing nothing or replanting. Trunk renewal can also be used to recover vines from winter freeze.

Figure 4. Grapevine two years after conducting trunk renewal (left). Vine producing grapes four years after trunk renewal conducted (right). Photos by J. R. Úrbez-Torres, AAFC.



Biocontrol

Type: Preventative

What it is: A group of natural microorganisms (bacteria and fungi) that have anti-fungal properties that can help to control diseases, including grapevine trunk diseases. The most common biocontrol organisms are fungi in the genus *Trichoderma*.

Status: Currently, there are no registered biological control products in Canada for trunk diseases. AAFC researchers have found several biological control agents (*Trichoderma* species) in BC and have tested them in the lab, greenhouse, and field. They found that some of the *Trichoderma* species are just as effective, or more effective, than chemical products in controlling trunk diseases. They found that some of the *Trichoderma* species can protect pruning wounds for up to two months and are just as effective, or more effective, than chemical products in controlling trunk diseases.

Pruning wound protection

Type: Preventative

What it is: A spray chemical that seals/protects pruning wounds, preventing fungal spores from entering the grapevine. Pruning wound protection can be done by tractor spraying or by hand application of a paint/paste directly onto the pruning wound.

Status: Through the work of AAFC researchers and the Minor Use Program at Summerland, **the first chemical was registered in Canada in 2024 to control**

grapevine trunk diseases – Senator® 50 SC Fungicide (active ingredient: thiophanate-methyl). Research is underway to determine if this chemical not only has a preventative effect (protecting the pruning wound before spores land) but also an eradicative effect (killing spores already present in the pruning wound).

Timing of pruning

Type: Preventative

What it is: A pruning schedule that takes into consideration the life cycle of the disease-causing fungi. **Fungal spores are most present in the air from early spring (end of March) to early summer (late June) in the Okanagan.** Pruning late in the Okanagan (March-April), therefore, can pose a risk since those pruning wounds would be highly susceptible to spores.

Status: AAFC researchers tested different pruning times and found that **pruning earlier in BC (December to January) can reduce infection by up to 60%** compared to pruning in March to April (when most growers currently prune). Pruning early, however, can pose a risk to growers. Yield may be reduced if there is an extreme cold event after, as there are less buds to survive through the cold. Pruning earlier also causes vines to ‘wake up’ early in the spring, creating a risk for frost damage. AAFC researchers are currently conducting trials to address this issue.

Figure 5. Tractor spraying pruning wound protectant product against grapevine trunk diseases (left). Grapevine trunk painted to protect against fungal spores (right). Photo by J. R. Úrbez-Torres, AAFC.



About this Brief

This brief was prepared by Nisa Chavez and Juliana Cao from the BC Food Web team, with the help of Jose Úrbez-Torres, and is based on the following publications:

- Gramaje, D., Úrbez-Torres, J. R., & Sosnowski, M. R. (2018). Managing grapevine trunk diseases with respect to etiology and epidemiology: Current strategies and future prospects. *Plant Disease*, 102(1). <https://doi.org/10.1094/PDIS-04-17-0512-FE>
- Hrycan, J., Theilmann, J., Mahovlic, A., Boulé, J., & Úrbez-Torres, J. R. (2023). Health status of ready-to-plant grapevine nursery material in Canada regarding young vine decline fungi. *Plant Disease*, 107(12). <https://doi.org/10.1094/PDIS-05-23-0900-SR>
- Pollard-Flamand, J., Boulé, J., Hart, M., & Úrbez-Torres, J. R. (2022). Biocontrol activity of *Trichoderma* species isolated from grapevines in British Columbia against *Botryosphaeria* dieback fungal pathogens. *Journal of Fungi*, 8(4), 409. <https://doi.org/10.3390/jof8040409>
- Pollard-Flamand, J., Boulé, J., Hart, M., & Úrbez-Torres, J. R. (2023). Biological control of *Botryosphaeria* dieback of grapevines in British Columbia, Canada. *American Journal of Enology and Viticulture*, 74(2). <https://doi.org/10.5344/ajev.2023.23052>
- Úrbez-Torres, J. R., Haag, P., Bowen, P., & O'Gorman, D. T. (2014). Grapevine trunk diseases in British Columbia: Incidence and characterization of the fungal pathogens associated with black foot disease of grapevine. *Plant Disease*, 98(4), 456–468. <https://doi.org/10.1094/PDIS-05-13-0524-RE>
- Úrbez-Torres, J. R., Haag, P., Bowen, P., & O'Gorman, D. T. (2014). Grapevine trunk diseases in British Columbia: Incidence and characterization of the fungal pathogens associated with esca and Petri diseases of grapevine. *Plant Disease*, 98(4), 469–482. <https://doi.org/10.1094/PDIS-05-13-0523-RE>
- Úrbez-Torres, J. R., Haag, P., Bowen, P., Lowery, T., & O'Gorman, D. T. (2015). Development of a DNA microarray for the detection and identification of fungal pathogens causing decline of young grapevines. *Phytopathology*, 105(10), 1373–1388. <https://doi.org/10.1094/PHYTO-03-15-0069-R>
- Úrbez-Torres, J. R., O'Gorman, D. T., Boulé, J., Walker, M., & Pollard-Flamand, J. (2019). Pruning time can reduce grapevine trunk disease infection under British Columbia environmental conditions. *Phytopathologia Mediterranea*, 58(2), 426–427. (Published conference abstract, 11th International Workshop on Grapevine Trunk Diseases, July 7–12, 2019, Penticton, BC, Canada.) <https://oajournals.fupress.net/index.php/pm/article/view/10627/10622>
- O'Gorman, D. T., Walker, M., Theilmann, J., Boulé, J., & Úrbez-Torres, J. R. (2019). Development and implementation of a droplet digital PCR assay for epidemiological studies of *Botryosphaeria* dieback of grapevines in British Columbia. *Phytopathologia Mediterranea*, 58(2), 409. (Published conference abstract, 11th International Workshop on Grapevine Trunk Diseases, July 7–12, 2019, Penticton, BC, Canada.) <https://oajournals.fupress.net/index.php/pm/article/view/10627/10622>

Want to learn more?

- For any questions regarding this research, contact José Úrbez-Torres at joseramon.urbeztorres@AGR.GC.CA.

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