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Scientific journal articles and industry resources

Grapevine Crown Gall in BC vineyards

Researchers: Portiaa McGonigal, Tanja M. Voegel, Paige Munro, Thomas Forge, Louise M. Nelson

KEY TAKEAWAYS

- Grapevine crown gall is a widespread and economically important disease. It occurs in grape-growing regions around the world and can reduce vine health, productivity, and longevity.
- There is currently no cure for grapevine crown gall. Once established in vines or vineyard soils, the bacterium can be difficult to eliminate, making symptom management, wound prevention, and limiting the spread of disease the most effective strategies for reducing disease risk.
- Vine injuries create opportunities for infection. Cold damage, grafting, and mechanical wounds can trigger gall formation. Pest damage causing root wounding can facilitate infection in diseased soil and cause more severe disease symptoms to manifest.
- There is still much to learn about crown gall. Ongoing research is focused on understanding how to prevent the disease, reducing symptoms, limiting spread between vines and vineyards, and finding effective biological control

Production Type
- Wine grapes

Practice Benefit(s)
- Disease management

Research Location
- Kelowna, BC

Key Terms
- *Grapevine crown gall (GCG):* A bacterial disease of grapevines that causes tumour-like growths called galls
- *Gall:* A swollen, tumour-like growth that develops on infected vine tissue, often around wounds
- *Biological control:* The use of beneficial or non-disease-causing organisms to suppress a plant disease or its pathogen

How can this information be used?

This factsheet provides an overview of grapevine crown gall, including its biology, spread, detection, and management. The content presented here is intended to be informative rather than provide specific recommendations. Since every vineyard and winery operates under different conditions, any management practices presented here should be adapted to local circumstances whenever possible.

What is grapevine crown gall?

Grapevine crown gall (GCG), sometimes called “plant cancer,” is an important grapevine disease worldwide and can be especially damaging in cold regions such as British Columbia’s Okanagan Valley. In 2004, GCG losses on the U.S. east coast were estimated at $65,000 CAD per acre over six years, or about $110,000 CAD today. No similar economic studies have been done in Canada, but in BC, vineyard re-establishment costs have been estimated at about $42,360 per acre. Although this figure reflects a range of diseases and environmental damage rather than crown gall alone.

GCG is caused by the bacterium *Allorhizobium vitis*, which enters grapevines mainly through wounds on the roots and sometimes the trunk. Once inside the vine, the bacterium genetically modifies the grapevine genome, resulting in tumor (gall) formation at wound sites.

Galls further support the growth of the infectious bacteria within the grapevine. However, grapevines may not show any symptoms of infection and appear healthy for years. Symptoms often develop only after the vine experiences stress or injury, such as freezing temperatures, mechanical damage, or grafting. The most common visible symptoms are galling and root decay.

Figure 1. Crown galls on an infected grapevine trunk. Photo from AAFC

Galls are cauliflower-like growths that develop on aerial grapevine parts, mainly the trunk, but can appear along cordons and canes. New galls appear throughout each growing season at sites of external wounding. They start off fleshy and light green, white, pink, or beige in colour and darken with age. Galls eventually die at the end of the growing season, turning black and woody. As galls enlarge or girdle the vine, they can restrict the movement of water and nutrients throughout the vine. This weakens the plant and may cause leaf yellowing and poor vigor which can lead to lower yields, poor fruit quality, and eventually partial or complete vine death.

While galls are rarely seen on grapevine roots. GCG causes root necrosis that impacts nutrient and water uptake from the soil. Young vines are particularly vulnerable, making GCG a significant threat to newly established vineyards as well as long-term productivity.

How does grapevine crown gall spread?

GCG can be difficult to eliminate once it becomes established in a vineyard. The bacterium is primarily introduced through infected but asymptomatic nursery material and can persist for years within infected grapevines and vineyard soils. *A. vitis* can remain in the soil and reinfect newly planted vines, even after diseased vines are removed.

Infection often begins when *A. vitis* enters the vine through wounds in the roots, trunk, or other tissues. These wounds may result from winter injury, pruning, mechanical damage, or root-feeding organisms. Once inside the vine, the bacterium can remain present without immediately causing visible symptoms.

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Figure 2. Partial vine dieback associated with crown gall. Photo from AAFC

Once GCG is present in a vineyard, several factors can influence how the bacterium spreads and how severe the disease becomes. These factors are summarized in the table below.

Method of contamination	How contamination or infection occurs
Planting	Infected grapevines from cuttings and nursery stock may be planted before showing visible symptoms, introducing crown gall into clean soil. Symptoms may then manifest if vines experience disease pressures, such as winter freezing or mechanical damage. Likewise, crown gall-free grapevines may be planted into contaminated soil, where the bacterium enters through root wounds.
Unsterilized equipment	Pruning, grafting, and cultivation equipment can spread the bacterium between vines and vineyard blocks. When contaminated tools that were previously used on infected vines create fresh wounds, they may facilitate the spread of infection. Sterilizing equipment can help reduce disease transmission within vineyards.
Soil nematodes	Some soil-dwelling nematodes feed on grapevine roots and create wounds that make it easier for *A. vitis* already present in the soil to enter the plant and establish infection. The Northern Root-Knot nematode has been identified as a potential contributor to more severe crown gall infections through root feeding.
Water splashing	Water splashing due to rain or watering may facilitate secondary above-ground infections by spreading *A. vitis* between vines. Water may spread the bacterium from diseased tissues (galls) onto open wounds of neighboring vines.

Grapevine crown gall detection and management

Once GCG is established in a vineyard, it is often challenging to manage symptoms and is essentially impossible to eliminate. Most management recommendations focus on limiting disease spread and reducing external wounding. This section provides a brief overview of suggested management methods. Please note, the economic implications of the practices outlined below have not been thoroughly evaluated, and their feasibility and effectiveness may vary among vineyards.

Certified planting material

Researchers and industry partners have focused on developing technologies and certification programs that can identify infected grapevine material and reduce the risk of introducing GCG into vineyards. In Canada, the Canadian Grapevine Certification Network (CGCN) operates a certification program that supports the production and distribution of disease-free grapevine material. Another certification program is the Clean Plant Center Northwest Grapes (CPCNG) Program in Washington State. Both programs test grapevine material for a range of pathogens to provide nursery stock that has undergone extensive health screening. More information is available through the CGCN and CPCNG websites. Certified vines from these programs can be purchased and used to establish new vineyard blocks.

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There are important limitations to these programs when it comes to GCG. The GCG pathogen is not uniformly distributed throughout grapevines and therefore leaves, roots, and other tissues may contain different pathogen concentrations. For example, the roots might test positive, but the leaves might test negative.

It is typically impractical to test every part of a plant, especially at commercial scales, so growers should discuss the associated risks with sourcing planting material from certification programs with program staff. Current tests also indicate more generally about the presence of GCG, but results don't evaluate whether bacterial populations are high enough to impact vine productivity. A positive test does not necessarily mean a vine will develop symptoms or experience reduced productivity. More research is needed to better understand the relationship between bacterial populations, symptom development, and vineyard performance.

When certified material is unavailable, grapevine cuttings can undergo hot water or copper treatment before planting to reduce *A. vitis* populations. However, this treatment does not eliminate the bacterium or prevent reinfection.

Preventing cold damage

Since gall formation is often triggered by winter injury, scouting vineyards after severe cold events is an important management practice, as previously dormant crown gall infections may become more noticeable following extreme cold weather. Planting cold-hardy varieties may help reduce winter injury, although these varieties can still develop severe crown gall infections. During frost and freeze events, wind machines can be used to circulate warmer air and minimize vine injury.

Other strategies include hilling soil around the graft union to protect it from cold injury and reduce the risk of gall formation, choosing vineyard sites with well-drained soils and good air drainage, and carefully managing irrigation.

Figure 3. Pruning for crown gall management. Photo from AAFC

Retrunking and replanting

When crown gall affects only part of a vine, retraining or replacing an affected trunk can help maintain vineyard productivity without removing the entire vine. Multiple-trunk systems can also make this easier by allowing growers to remove damaged trunks while keeping healthy ones in production. Replanting is generally more appropriate when crown gall is severe or vine performance has declined substantially.

Where replanting is necessary, removing infected vines and allowing remaining vine debris to decompose before planting new grapevines may help reduce disease pressure. Waiting at least two years before replanting is recommended to reduce the risk of crown gall becoming established in new vines. Although the effectiveness of fallowing depends on how much infected vine material remains in the soil, *A. vitis* can persist in root debris and has been detected in vineyard soil after infected vines are removed.

Figure 4. Pruning grapevines with hand shears. Photo by B Young, Jordan Winery

Preventing wounds

Horticultural practices that reduce the likelihood of aboveground wounds can limit gall formation and perhaps the entry of the GCG pathogen into the grapevine through infected pruning shears or water splashing from infected vines. Chemical products are available that can be applied to pruning wounds to help protect these entry points and reduce the risk of infection, although these products do not control crown gall itself. Hand harvesting can be gentler on the plants, and having good grafting practices can help ensure good callus formation before planting in the vineyard.

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Mechanical injury can also be reduced by properly installing and calibrating sensor bars on grape hoes and other undervine weeders, carefully de-hilling vines in spring, keeping rows straight so trunks do not lean into equipment paths, and using undervine cover crops to reduce the need for mechanical weeding.

When pruning or using other equipment that will create a wound, it is suggested to sanitize equipment to prevent secondary spread. Reducing root-feeding pests can also help limit GCG infection. Soil testing can help identify nematode pressure, particularly where Northern Root-Knot nematode is a concern. Planting resistant or poor-host rootstocks may also help reduce nematode populations in affected vineyards.

Chemical and biological control

There are currently no proven chemical or biological controls available for GCG. However, several biological approaches are being studied. Non-disease-causing strains of A. vitis, including ARK-1, have reduced crown gall development in field trials by limiting the activity of disease-causing strains.

These approaches are promising because they could provide growers with additional management options once crown gall is present. More research is still needed to determine how consistently these treatments work under vineyard conditions and whether they can be developed into practical products for growers.

What's next?

There are still many gaps in our knowledge about GCG management, and it remains a challenging disease to control. Infected vines can remain symptomless for years, making it difficult to predict when bacterial populations/disease pressures will become problematic. Researchers are continuing to work on identifying what levels of pathogen populations shift an infection from relatively symptomless to likely to affect vine health and productivity. Other studies are exploring how the bacterium moves through vineyards and testing new candidates for biological control.

GCG is unlikely to be eradicated entirely from grape-growing regions. Instead, future research will focus on understanding how the bacterium survives, spreads, and interacts with grapevines and how GCG can be managed once present or prevented upon planting. With this information, growers will be able to better detect, prevent, and manage the disease while reducing its impact on vineyard productivity.

About this factsheet

This factsheet was prepared by Nisa Chavez and Yussuf Adedeji from the BC Food Web team, with the help of Portiaa McGonigal and Louise M. Nelson, and is based on the following scientific journal articles and resources:

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Want to learn more?

- For any questions regarding this research, contact Portiaa McGonigal at portiaa.mcgonigal@gmail.com

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Funding for this research was provided by Canadian Grapevine Certification Network (CGCN) through the British Columbia Wine Grape Council and the Canadian Agricultural Partnership Program. This research was conducted by the University of British Columbia (Okanagan) and Agriculture and Agri-Food Canada (Summerland).

Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

Canadian Grapevine Certification Network CGCN · RCCV Réseau canadien de certification de la vigne

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Funding for this factsheet is provided by the Government of British Columbia through programs and initiatives delivered by the Investment Agriculture Foundation of BC.

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The Government of British Columbia and the Investment Agriculture Foundation of BC are pleased to participate in the production of this publication. We are committed to working with our industry partners to address issues of importance to the agriculture and agri-food industry in British Columbia. Opinions expressed in this publication are those of the authors and not necessarily those of the Investment Agriculture Foundation or the Government of British Columbia.