GRAPES

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Grape Crown Gall

Agrobacterium vitis (Ophel & Kerr 1990)

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Introduction

Crown gall of grape is an important disease in all areas where grapes are grown worldwide, but is particularly severe in regions with cold climates. Formerly designated as *Agrobacterium tumefaciens* biovar 3, *A. vitis,* the bacterium that causes of the disease, only occurs on grape. *A. vitis* survives systemically in grapevines, and initiates infections at wound sites, such as those caused by freeze injuries. As a result, vineyards in climates with cold winters are prone to suffer extensive damage from crown gall. In addition to freeze-induced wounds, graft unions are also common sites for infection.

Crown gall can reduce vine vigor and growth, thus reducing crop yield. Cultivars of *Vitis vinifera* tend to be highly susceptible to crown gall, although certain French-American hybrids and Native American varieties may also become severely infected. Crown gall can kill young vines to the soil line, thereby reducing cropping potential and requiring establishment of new trunks. Vines that are completely killed need to be removed and replaced, at significant costs to growers and wine and juice producers.

Signs and Symptoms

As noted previously, *A. vitis* can induce tumors at wounds on trunks and canes of the vine (Figures 1 and 2). Galls tend to be more common on the lower trunk; however, they may develop in canes, at graft unions (Figure 3), and at nodes where buds have been removed from rootstocks.

Galls are normally first observed in early summer. Newly formed galls are creamy tan- or white- to light green-colored soft masses of disorganized plant cells. Infections are initiated in the cambium of injured trunks or canes, where infected cells rapidly multiply and enlarge, forming galls that differ greatly in size. Galls become desiccate in the autumn, becoming dark and necrotic.

Because galls are initiated in the cambium, the subsequent vascular tissue development is affected, compromising nutrient flow and vine health. *A. vitis* may also have adverse effects on the healing of the graft union. In vineyards with field-grafted vines, tumors can develop at the unions, prevent graft-take, and lead to the collapse of the new scion.

In addition to gall formation tumorigenic and non-tumorigenic strains of *A. vitis* cause necrosis of young grape roots (Figure 4).

Disease Cycle

A. vitis survives in living as well as dead grape tissues that may persist in soil. It is unclear as to whether the root necrosis affects vine and root growth (Figure 5); however, it may provide access points through which the pathogen enters the vine. *A. vitis* is known to colonize vines systemically and can be isolated from grape sap.

PHOTO BY J. CREASAP

Figure 1

PHOTO BY J. CREASAP

Figure 2

PHOTO BY J. CREASAP

Figure 3

PHOTO BY T. BURR

Figure 4

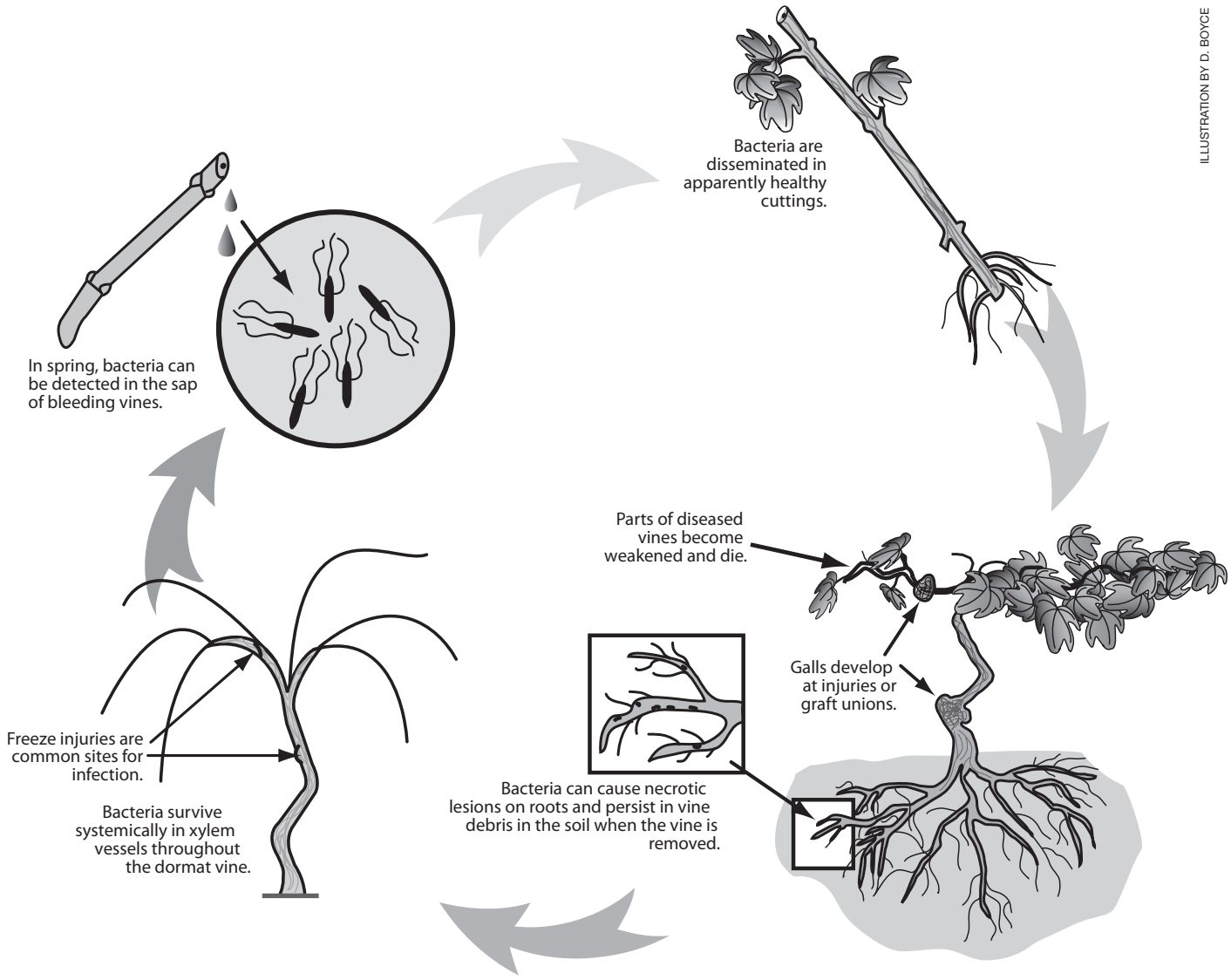

Figure 5. Disease Cycle of Grape Crown Gall

Consequently, the pathogen is disseminated in cuttings that are used for propagating new plants.

As indicated, crown gall develops at wound sites, primarily during wound healing in the cambium, where dividing cells are susceptible to infection. Infected cells overproduce plant growth hormones leading to gall formation and enlargement.

Control

To date, no effective chemical treatments are available for grape crown gall control. Topical treatments of antibiotics or other bactericides may kill bacteria on the surfaces of galls, but fail to control the pathogen residing systemically. Crown gall control focuses on prevention of injuries and on maintenance of healthy vines.

Site selection is an important factor in disease management. Where possible, vineyards should be established in soil not previously planted to grapevines and at sites with good air and water drainage to reduce freeze injuries. Another means to reduce the occurrence of crown gall – to plant winter hardy varieties.

Other cultural control strategies include mounding soil around vines in the fall to protect against freeze injury and training vines with multiple trunks (seen in Figures 1 and 2). Establishing multiple trunks allows growers to remove galled trunks and train suckers as new trunks (Figure 3), while ensuring crop production from non-galled trunks. Infected vines that are growing poorly and producing a light crop should be removed.

A. vitis has not been detected in soil from non-vineyard sites; therefore, planting vines that are free of the pathogen in non-vineyard soil is an effective control. Vines free of the pathogen may be propagated by shoot tip culture. Such vines planted into mother blocks can serve as sources of pathogen-free propagation material.

Although biological control of crown gall in other plants through *A. radiobacter* K-84 is highly effective, this strain does not prevent the disease in grapes. However, an alternative biological control bacterium, *A. vitis* strain F2/5 shows promising disease control and is under further investigation. Strain F2/5 is nontumorigenic and is effective in experiments when applied to grape wounds before they are inoculated with tumor-causing bacteria. F2/5 is not commercially available, and research is being done to determine its efficacy in field trials.

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