



CROWN GALL

Crown gall, caused by the bacterium *Agrobacterium tumefaciens*, is found worldwide. Crown gall affects both woody and herbaceous plants, attacking several hundred different plants belonging to at least 142 genera within 61 widely separated families.

Crown gall is economically important on only a relatively small number of young, rapidly growing plants. These include almond, apple, apricot, blackberry, cherry, cottonwood, crabapple, euonymus, fig, grape, honeysuckle, nectarine, peach, pecan, pear, plum, prune, poplar, pyracantha, raspberry, rose, sugarbeet, turnip, walnut, and willow.



Figure 1. Crown gall of *Euonymus*. (J. L. Forsberg)

Plants affected by crown gall often grow poorly because the disease interferes with the normal transport of water and food supplies. Infected plants become stunted, weak, and more susceptible to winter injury. The greatest economic loss, however, is to the nursery grower who must destroy infected plants and carry out stringent sanitary control measures.

Since the crown gall bacterium infects only through wounds, the disease can be confused with the callus overgrowths that often form at wounds or graft unions. Overgrowths can be perfectly normal or they can be caused by fungi, viruses, or other disease agents. Usually, tissue infected with crown gall develops more rapidly than that with callus overgrowths.

Crown gall tumors have been studied extensively because of their superficial similarities to animal and human cancers. However, there is no connection between the crown gall disease and any tumor of humans or animals. Current research suggests that a genetic factor initiates gall formation and is transmitted by the bacterium to the host plant.

Symptoms

Crown gall first appears as small overgrowths on the stem (trunk), crown, and roots – usually near the soil line, frequently at a graft union (Figure 1). On plants such as poplar and willow, the galls may appear on branches that are several feet above the ground. At first, the gall or tumor is white or flesh-colored, more or less round, and quite soft and spongy. The enlarging gall gradually develops an irregular, convoluted, rough, corky surface and a hard woody interior. The outer tissue gradually darkens. The galls may vary

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from pea-size to more than a foot in diameter and may weigh 50 pounds. Gall tissue gradually rots from secondary organisms. Tumors develop again in the same places the following year, or part of the gall may decay and slough off, with new tumor tissue developing in other parts of the same gall. On some host plants, secondary tumors develop at points several inches above or below the primary gall.

When the infection is severe, infected plants lack vigor, their leaves are stunted and may turn yellow or red, and the shoots often die back. As the galls continue to enlarge, plants may wilt and die.

Disease Cycle

Once introduced, the crown-gall bacterium overseasons in diseased tissue and in soil, where it lives as a saprophyte in organic debris for several years. The bacterium is spread in soil water or by rainsplash, and thus infects new plants.

Penetration occurs only through fresh wounds (less than 24 hours old). The wounds can be made during pruning, cultivating, transplanting, and budding or grafting. Wounds may also be caused by chewing insects, nematodes, or other animal pests. After entry, the bacteria multiply in the intercellular spaces and stimulate a rapid increase in plant cell division and an abnormal enlargement of the surrounding plant cells. In warm weather, when the host plant is growing rapidly, a small enlargement can often be seen 10 to 14 days after infection. As the rapid and irregular division and enlargement of host cells continues, the normal differentiation of cells within the tumorous growth decreases. This results in incomplete and disorganized water- and food-conducting tissues. When a gall is unable to obtain enough water and food to maintain itself, the enlargement ceases, decay commonly begins, and the outer, dead tissues slough away. The breakdown of the outer tumor tissues releases crown-gall bacteria back into the soil, where they can be carried in the water to infect new plants.



Figure 3. Cottonwood crown gall. Tumors may appear several feet above ground (photo, J.C. Carter)

The crown-gall bacterium produces a tumor-inducing principle (TIP), a bacterial Ti-plasmid DNA (T-DNA), that is transferred and incorporated into wounded host cells, altering their hormonal balance. Normal plant cells are converted into tumorous cells, which are induced to manufacture more TIP and pass it on to their daughter cells. These daughter cells continue to enlarge and divide in an uncontrolled manner – free of the crown-gall bacteria. Strains or physiologic races of the crown-gall bacterium differ in virulence and host range; hence, the type and amount of tumor tissue that develops differs.

Control

1. Plant only certified, disease-free nursery stock that has a smooth graft union and is free of suspicious overgrowths or enlargements on the roots and stems. Budding, rather than grafting, reduces the chance of infection.

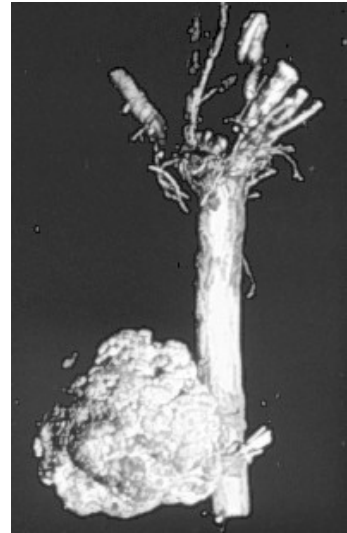


Figure 2. Crown gall of rose.

2. Carefully dig up and destroy all severely infected plants, especially woody ones.
3. Do not replant the same type of plant in the same spot for at least five years. Corn, small grains, grasses, onions, asparagus, and cowpea are immune.
4. Dip tools used for grafting, budding, and pruning in liquid household bleach between cuts. Prepare a fresh solution several times each day, using one part of bleach mixed with four parts of clean water.
5. Treat seeds, seedlings, cuttings, and bare-root plants. Excellent control of most strains of the crown gall bacterium has been obtained by soaking germinated seeds and dipping or spraying nursery seedlings, cuttings, or bare-root rootstock plants in a suspension of a nonpathogenic (or antagonistic) bacterium: strain 84 of *Agrobacterium radiobacter*, registered by EPA and available commercially as Galltrol-A sold by AgBioChem, Inc., 3 Fleetwood Court, Orinda, CA 94563. The nonpathogenic bacterium colonizes wounds, such as those made by root prunings, and thus prevents certain strains of the crown-gall organism from infecting the wounds.
6. Use resistant rootstocks. Peach rootstock S-37, certain Malling rootstocks for apple, and Japanese apricot (*Prunus mume*) are resistant to crown gall.
7. Sterilize the soil in greenhouses with steam (180°F or 82°C for at least 30 minutes at the coolest spot) or a soil fumigant such as methyl bromide, Vorlex, or chloropicrin, after first removing all woody roots and stems. If using a soil fumigant, carefully follow all the manufacturer's directions and precautions.
8. Avoid wounding plants while transplanting, cultivating, and mowing.
9. Protect roses, boxwood, young trees, and other susceptible plants against winter injury. Follow local recommendations. Fertilize and water properly to keep the plants vigorous.
10. Control chewing insects. Follow the recommendations of Extension Entomologists at the University of Illinois. This may mean treating the soil with an insecticide, as well as spraying or dusting the plants at appropriate times.