

# A foliage blight of euonymus caused by *Phytophthora*

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The fungal genus *Phytophthora* is recognized worldwide for its impact on agriculture because of the diseases it causes. Many species of *Phytophthora* inhabit the soil, and infective propagules may be carried to above-ground plant parts, where they can incite diseases and cause serious damage. In production nurseries of southern California, a *Phytophthora* species has been found to cause an economically important foliage blight on *Euonymus japonica* shrubs. Cultivars of *Euonymus japonica* vary considerably in susceptibility or resistance to the disease, and different isolates of the fungus vary in their virulence toward those cultivars.

*Euonymus japonica*, commonly known as "evergreen euonymus," is an evergreen shrub with glossy leaves and inconspicuous flowers. It thrives in full sun and may grow to a height of 3 meters, with crowns spreading 2 meters or more. Euonymus is popularly recognized for its colorful and generally variegated foliage that differs greatly from one cultivar to another. Several cultivars were tested for susceptibility to *Phytophthora*: 'Aureo-marginata', 'Silver King', 'Silver Queen', 'Goldspot', and the nonvariegated cultivar. The disease was first detected on 'Goldspot' by the senior author, and three isolates were subsequently taken from three separate 'Goldspot' plantings at different locations.

## Conditions for disease

Disease has occurred in outdoor blocks of plants in 4- and 20-liter containers and on young rooted cuttings under shade. The most favorable conditions for infection are during rainy weather when temperatures are mild, usually in late winter or early spring. However, tropical-front storms, which may occur in southern California at any time during the normally colder months, also greatly favor infection. Although most irrigation is by overhead sprinklers, closely simulating rainfall, foliar strikes have not as yet been noted in southern California during the warm growing season from May through November. We can only speculate that the longer moisture periods occurring during rainy weather are required for the infection process

to take place, whereas drying conditions after sprinkling are unfavorable.

## Disease symptoms

Typically, in a large production nursery the first indications of the disease are dead terminal shoots, which must be pruned away before affected plants can be marketed. The dry, dead shoots are usually observed two to several weeks after a rain, but early stages of the disease can be detected by careful inspection soon after favorable weather conditions for infection occur. Young shoot tips appear slightly wilted with brown discolorations of the yellow stems and leaf petioles. Shriveling and browning continue down the stem until the entire shoot is gradually killed. Lesions originating along the stems have also been found.

The disease occurs differently in propagation areas. The organism finds its way into the soil mix in small plots and attacks young rooted cuttings just below the soil line (collar), turning the stems brown at that point and progressing in both directions, killing the plants. This syndrome is usually first detected as darkening areas in some of the flats.

## The cause

The organism causing the disease in euonymus is a species of *Phytophthora*, a soil-borne fungus closely related to *Phytophthora citrophthora*. However, it differs from typical *P. citrophthora* in some characters, and further study is necessary for positive identification of the pathogen. *Phytophthora citrophthora* is one of the fungi causing gummosis of citrus trees, which are widely grown in southern California. Conditions in production nurseries are conducive to the survival and spread of soil-borne *Phytophthora* species, because the soil is kept moist by overhead irrigation all year long. Since both flats and containers are generally placed directly on the soil surface, infective propagules of the fungus can be disseminated readily to aerial plant tissues and planting media in cutting flats.

To prove that the *Phytophthora* isolate from infected euonymus shoots was causing

Foliar Infections and Infection Severity Resulting from Artificial Inoculations of *Euonymus japonica* Cultivars with Zoospores of *Phytophthora* sp.

| Cultivars              | Isolates* |       |       |
|------------------------|-----------|-------|-------|
|                        | Ph-8      | Ph-12 | Ph-16 |
| <b>Nonvariegated</b>   |           |       |       |
| % infected shoots      | 22        | 0     | 70    |
| Severity of infection† | 1         | 0     | 3     |
| <b>Goldspot</b>        |           |       |       |
| % infected shoots      | 90        | 0     | 88    |
| Severity of infection  | 3         | 0     | 4     |
| <b>Aureo-marginata</b> |           |       |       |
| % infected shoots      | 10        | 0     | 79    |
| Severity of infection  | 1         | 0     | 3     |
| <b>Silver Queen</b>    |           |       |       |
| % infected shoots      | 33        | 0     | 40    |
| Severity of infection  | 1         | 0     | 2     |
| <b>Silver King</b>     |           |       |       |
| % infected shoots      | 78        | 0     | 88    |
| Severity of infection  | 3         | 0     | 4     |

\*Ph-8 was from blighted shoots in nursery A; Ph-12 from soil-line infections of rooted cuttings in liners in nursery A; and Ph-16 from necrotic aerial stem tissue in nursery B.

†Severity of infection was rated 0 (no infection) to 5 (entire shoot blighted).

the disorder, artificial inoculation methods were needed that would simulate natural infections. Most *Phytophthora* species produce free-swimming zoospores that can be carried considerable distances by splashing water and are capable of inciting infection. Suspensions of zoospores in water were sprayed on young euonymus shoots, which were then kept humidified in the greenhouse under plastic canopies for 48 hours. Typical field symptoms were reproduced in six days, and cultures of similar *Phytophthora* species were re-isolated from the affected tissues.

In the case of the rooted cuttings that were being killed in flats resting on the soil, tissues initially infected were just below the level of the planting media on stem tissue kept continuously moist by regular, frequent sprinkling. It was therefore assumed that natural infections resulted from a series of events. First, fungus propagules were splashed from infested soil to the planting media in small liner pots containing the rooted cuttings. Second, the fungus became established in the moist planting medium; and third, infective propagules produced by the fungus attacked the moist stem tissue and initiated infection. To simulate this type of infection, the fungus



Lesion from *Phytophthora* stem infection.



Young euonymus shoot succumbing to aerial attack by *Phytophthora* sp.

was established on sterile millet seed, which was then mixed with a planting medium similar to that used in the nursery. Young healthy, rooted cuttings were planted in the artificially infested medium, and typical field symptoms were reproduced.

### Variations

To further understand the ability of different isolates of this organism to incite foliar infections, zoospore suspensions of each of three isolates were sprayed on foliage of five *Euonymus japonica* cultivars. The isolates all appeared the same morphologically in culture, but two were from foliar infections in different nurseries, and one was from the collar

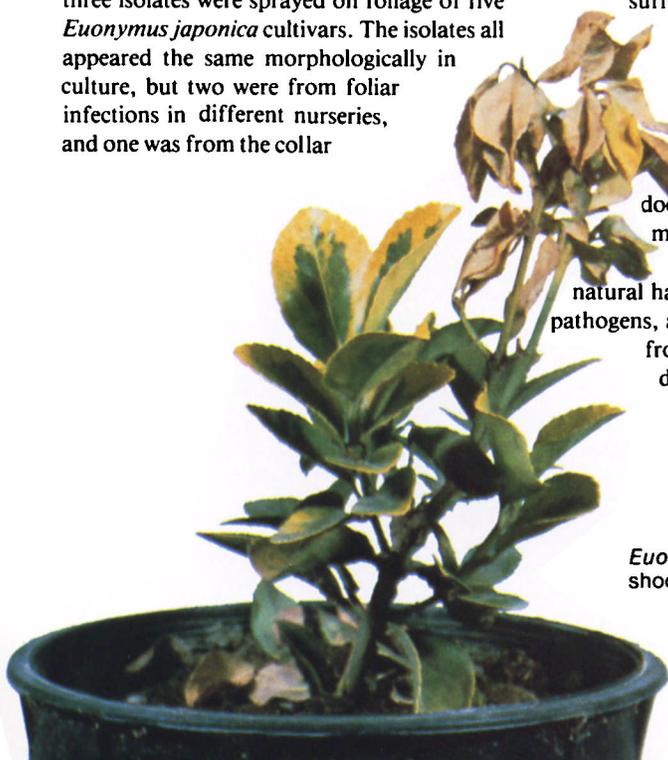
infection of a rooted cutting. It is obvious that the zoospores of the collar-infecting organism were unable to infect aerial shoot tissue (see table). The isolate (Ph-8) from aerial infections of 'Goldspot' in nursery A was most virulent on foliage of 'Goldspot' and 'Silver King', whereas the isolate from aerial tissue on 'Goldspot' in nursery B was highly virulent on all cultivars except 'Silver Queen'. Generally, 'Goldspot' and 'Silver King' were the most susceptible, and they suffered the most severe infections.

### Control

The southern California coastal basin has an ideal climate for producing container-grown plants outdoors. As a result, the industry has mushroomed into major agricultural importance. The soil is a natural habitat for many soil-borne plant pathogens, and where watering is primarily from overhead sprinklers, foliage disease can become a problem.

Because foliar infections on *Euonymus japonica* have occurred primarily during periods of prolonged rain or mist and mild temperatures, pest managers in production nurseries have had success with regular applications of fungicides when unsettled weather conditions are forecast. Copper formulations similar to those used in preventive sprays against *Phytophthora* sp. causing brown rot on citrus have been effective.

To help control collar rot of rooted cuttings, it is important to take cuttings only from disease-free mother plants grown without overhead irrigation and treated regularly with suitable fungicides to ensure a disease-free condition. Fungicides, such as ethazol, that are selectively active against water molds have been used effectively as drenches after rooted cuttings have been transplanted into liner pots. When fungicides that are systemically active against *Phytophthora* sp. become commercially available, they could be used in the cutting flats sufficiently in advance of transplanting to greatly reduce the initial liner infections.



*Euonymus japonica* 'Goldspot' shoot killed by *Phytophthora* sp.

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