



## STRAWBERRY RED STELE ROOT ROT

Red stele, caused by the soilborne fungus *Phytophthora fragariae*, is a serious disease of strawberry plants in the northern two-thirds of the United States. Many desirable commercial cultivars are highly susceptible. The disease is most destructive in heavy clay soils that are saturated with water during cool weather. Once established in the soil, the fungus remains alive for up to 13 years and possibly longer, regardless of the crop rotation used.

The fungus attacks strawberry, loganberry, and *Potentilla* (a genus of rosaceous herbs commonly called cinquefoil). Loganberry is a minor host, however, and most infections are passed directly from strawberry plant to strawberry plant.



Figure 1. Red stele infected roots. Note the absence of numerous roots and, particularly the discolored stele of existing roots.

Red stele usually does not appear in a new planting until the spring of the first bearing year, from about full bloom to harvest. Minor symptoms of root infection may appear, however, in late fall of the first growing season. Damage increases each year that susceptible cultivars are grown in infested soil.

Red stele may appear to be fairly well distributed over an entire strawberry field or patch during a cool, wet spring. Normally, however, the disease is most prevalent in the lower or poorly drained areas.

### SYMPTOMS

When plants start wilting and dying in the more poorly drained areas of a field, the cause is frequently red stele. Certain other symptoms are more specific. A red stele infected plant has very few new roots, whereas the roots of a healthy plant are thick and bushy with many secondary roots (see figure). Infected strawberry roots will appear gray, while the new roots of a healthy plant are yellowish white.

The best way to identify if a plant is infected with the red stele fungus is to carefully dig it up and peel off the outside portions of several roots, exposing the central core (known as the "stele"). The stele is pink to brick red or brownish red in an infected plant and yellowish white in a healthy one. No other disease extend the length of the root. The red center is best seen in the spring, up to the time of fruiting. Later in the season, the discoloration may disappear as the rotted roots are replaced by new ones.

Infected plants lack vigor, are stunted, lose their shiny green luster, and produce few runners. The younger leaves often have a metallic, bluish green cast and older leaves turn yellow or red prematurely. During the hot, dry weather of early summer, infected plants wilt, collapse, and die rapidly. Infected plants that survive usually show symptoms in the late fall or the following spring.

## DISEASE CYCLE

The red stele fungus is spread from one field, or area, to another primarily by the distribution of nursery-infected plants. Infection is then spread within the field by moving water and by soil carried on implements and shoes. Once in the field, thick-walled resting spores (oospores) in infected roots produce large numbers of motile spores (zoospores) that swim about when soil moisture is high, infecting the tips of the young, fleshy roots and destroying their water- and food-conducting tissues. Infection and growth of the fungus in roots reduces the flow of water and nutrients to the developing leaves and fruit – causing drought-like symptoms in the plant.

The optimum temperature for growth and infection of the red-stele fungus is 57°F (14°C). When the soil moisture is high and the temperature is cool, plants show typical symptoms within 10 days after infection. The fungus is inactive at 40°F (4.5°C) and above 86°F (30°C). Thus, the critical periods for disease development and spread are in the spring and the fall, with little activity during the summer months.

As summer approaches and soil temperatures rise, the fungus forms large numbers of oospores in the stele of infected roots. The fungus survives periods of hot, dry, or cold weather primarily as these oospores.

Soil types do not affect the presence or absence of the red-stele fungus. It grows in any soil with a pH of 4.0 to 7.6, but will not grow in an alkaline soil (a pH of 8.0 or above). Heavy clay soils, which retain moisture for long periods of time, provide a conducive environment for the development of the red-stele disease because the zoospores can spread greater distances and produce more infection sites.

## CONTROL

1. **The only practical method of controlling red stele is to grow certified, disease-free plants of resistant cultivars.** Resistant cultivars include Darrow, Delite, Earliglow, Guardian, Midway, Pathfinder, Redchief, Redglow, Sparkel (Paymaster), Stelemaster, Sunrise, and Surecrop. All of these cultivars are adapted to conditions in Illinois. However, not all are resistant in all infested soils because different races or strains of the fungus occur. These races vary in their ability to infect the different cultivars. A cultivar that is resistant to red stele in one area may be susceptible in another. Several races of *Phytophthora fragariae* have been found in Illinois. Earliglow, Guardian, Redchief, Sunrise, and Surecrop are the only resistant cultivars presently suggested for use in Illinois. They are resistant to three or more races of the fungus. Even these cultivars should be rotated with other crops to reduce the chance that a new, more virulent race of the fungus may appear – one that could attack resistant cultivars. Always plant small "trial" plots of new varieties to test them for resistance to red stele on your farm, and to evaluate their performance before you make extensive plantings.
2. **Whenever possible, select a planting site that has never had red stele, has good to excellent drainage, and is located where water from nearby land will not drain through it. Avoid low, wet spots.**

3. **If possible, use your own tools and machinery for setting out a strawberry field and carrying out general cultural practices.** If you borrow equipment, be sure to clean off the soil and plant debris thoroughly before using it.
  
4. **Soil fumigation with soil sterilants and/or pesticide applications may be helpful in situations where resistant varieties are not available or are not adapted.** Extreme care should be taken not to reinfest a fumigated field by using contaminated equipment or plants. Soil fumigation should be the **last** resort in controlling the red stele disease. The first step is to use resistant varieties and selection of well-drained planting sites.