



## Red Stele Disease of Strawberries

Red stele is caused by the fungus *Phytophthora fragariae*. Soil-borne *Phytophthora* species usually thrive in poorly drained, cool, wet soils. The spores of *P. fragariae*, which reside in infected soils, are attracted to developing strawberry rootlets. After infection, the roots begin to rot from the root tip upwards toward the crown causing a characteristic reddening of the inner portion (stele) of the root; thus, the name "red stele". The most active periods of infection occur in early spring and late fall when cool, wet soil conditions are most conducive to disease development. Introduction of *P. fragariae* into a previously uninfected site is usually through infected planting stock or contaminated planting equipment. Once introduced to a site, the fungus spreads within a field via soil and water movement. Soil movement is usually accomplished through contaminated equipment such as plows, hoes, trowels, etc. Soil-water movement will often carry spores from higher areas of elevation to lower areas. *Phytophthora fragariae* is a very persistent fungus and can survive for many years once it has become established, even if no strawberries are grown during that time.

### Symptoms

#### Above Ground:

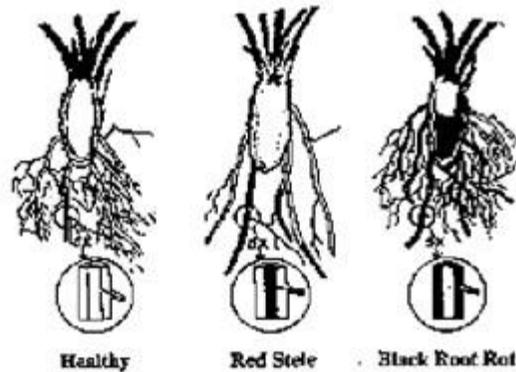
Symptoms of red stele rarely occur in the first year of strawberry growth unless plants were severely diseased before planting or if soil conditions were suitable for rapid fungal growth. Usually, red stele is first noticed during bloom of the second year. The symptoms will be most noticeable in low or soil compacted areas of a field where water drainage is poor. Strawberry plants infected with *P. fragariae* will show a general lack of vigor with poor runner growth and small berries. New leaves may appear bluish-green, while older leaves sometimes turn red, orange or yellow. The leaves tend to wilt during warm weather or drought stress. Severely diseased plants may collapse prior to fruiting. Although these aboveground symptoms are typical for red stele, they may resemble symptoms caused by other types of root disorders; therefore, roots also need to be examined.

#### Below Ground:

In order to correctly diagnose red stele, strawberry roots should be sampled during early spring and summer up until the time of harvest. Samples taken after harvest are not reliable because infected roots may have already begun to decay. When taking a plant sample, dig, rather than pull the plant from the ground. Examine roots of plants which are just beginning to show signs of wilting. If red stele is present, the roots will appear unbranched and will be lacking feeder roots. This "rat-tail" appearance of the root is a diagnostic trait of red stele. Select a white root with a rotted tip and make a lengthwise cut at the point where diseased root tissue meets healthy tissue.

Red stele infected roots will have a reddish-brown core, but the outer tissue will be white. The discoloration will begin at the root tip and move upwards, but usually will not move into the crown. This is in contrast to another root disease, black root rot, in which outer root tissues are affected earlier than the inner (stele) root area. Normal roots have both a white center and outer root surface (Figure 1).

Figure 1.



## Disease Management

Red stele development is favored by cool, wet soil. As a result, proper site selection and preparation are both important management tools for this disease.

### Site Selection:

The future planting site should be selected at least one year prior to planting. Soil drainage (both surface and internal) should be good because red stele requires free water (saturated soil) in order to develop. Avoid low-lying areas that tend to have poor water drainage. The fungus, which causes red stele, is reported to persist in the soil for at least 17 years, even in the absence of strawberry plants. Because of this, crop rotation cannot be relied upon as a management strategy for red stele; however, a three to five-year rotation is a recommended practice for management of other root disorders, such as *Verticillium* wilt, black root rot and nematodes.

### Site Preparation:

Cover crops should be planted for at least one growing season to build organic matter in the soil because heavy, compacted soils favor red stele. Cover crops include buckwheat, clovers, hairy vetch, annual ryegrass, Sudan grass and sorghum/Sudan (Sudex). If the site selected does not have good soil drainage, the strawberry planting should be established on raised beds of 10 inches or more. The raised beds will allow excess soil water to drain away from the strawberry root system, creating an environment less favorable to the disease-causing fungi. In addition, less soil compaction will occur near the root system. Be sure to clean cultivators or equipment used to build raised beds to ensure that soil is not being carried from red stele infected fields.

## Planting

Exclusion and prevention are the most important management tools at the time of planting. Red stele is introduced into fields most frequently on infected-plants; therefore, mother plants should be purchased from a reputable nursery. Before planting, examine roots carefully to see if any have the "rat tail" appearance and red core indicative of red stele. Exclusion of red stele is particularly effective if planting in a new site where strawberries had not been previously grown.

If the site is known to have had red stele in the past or if soil drainage is not ideal, resistant varieties should be selected. Varieties which have shown resistance to some strains of red stele include Allstar, Darrow, Delite, Earliglow, Guardian, Lateglow, Lester, Midway, Redchief, Redglow, Sparkle, Sunrise and Surecrop. Honeoye, a commonly planted variety in Connecticut, is susceptible to red stele. Refer to the current edition of *New England Small Fruit Recommendations* for updates on resistant varieties.

Note: The varieties classified as "resistant" are not resistant to all strains of *P. fragariae*. Therefore, it is possible that a new planting may again succumb to the disease if the site has poor drainage or if the site is improperly prepared.

## After Planting

Always use cultural practices which favor good plant growth and development. A soil and/or tissue analysis should be performed each year to determine optimum fertilizer applications. Be careful using cultivators or other equipment

which may have previously been used in a red stele infected field. Try to minimize soil compaction created by equipment and cultural practices. Avoid over or under irrigation of the strawberry field.

The main strategies for red stele management include proper soil drainage, use of resistant varieties and cultural methods discussed above. If red stele develops in an established planting, fungicides should help control the disease especially if used in combination with good cultural practices. Fungicides should not be used on a routine or preventative basis in order to minimize the development of resistance to these products.

Despite good cultural practices, pests and diseases at times may appear. Chemical control should be used only after all other methods have failed.

For pesticide information please call UConn Home and Garden Education Center weekdays, in Connecticut call toll free 877-486-6271. Out of state call 860-486-6271.

#### References

Pritts, M. and D. Handley (eds.) 1991. Bramble Production Guide. Northeast Regional Agricultural Engineering Service Pub. No. NRAES-35. 189 pp. Available from UConn Department of Natural Resources Management and Engineering.

Schloemann, S. (ed). 1992. 1992-93 New England Small Fruit Recommendations. 60 pp. Available from UConn Agricultural Publications Office. Wilcox, W. 1991. Red stele of strawberry. New York (Cornell) IPM Disease

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