

PHYTOPHTHORA ROOT ROT OF CRANBERRIES

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Many crop species are affected by *Phytophthora* root rot (3). Most of the more than 50 species in the genus *Phytophthora* are soil-borne and cause symptoms ranging from root rots, butt rots, trunk cankers and tuber rots. *Phytophthora* root rot was described from cranberry relatively recently (1). The disease is caused principally by *P. cinnamomi* although other species such as *P. megasperma*, *P. dreschleri* and others have been implicated (2,4). These pathogens are members of the class Oomycetes and are very dependent on water for dispersal of the self-motile, flagellated zoospores. As such, many *Phytophthora* species are spread through irrigation water (7,9) and under sufficiently wet conditions will disseminate, infect and ultimately kill the plant. A typical *Phytophthora* life cycle is shown in Fig. 1.

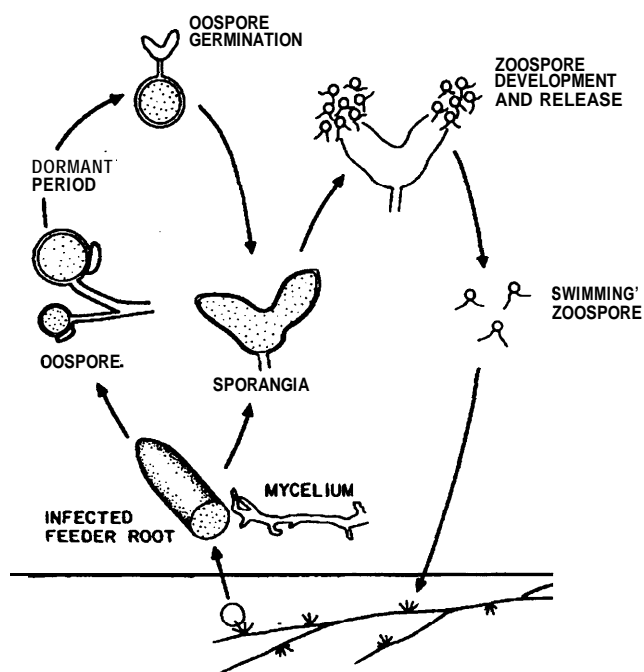


Fig. 1. A typical *Phytophthora* life cycle. Sporangia are formed under nearly saturated conditions and zoospores are released. The zoospores swim in saturated soil and infect cranberry roots and runners. Other spore types include oospores and chlamydospores (not shown). These spores form in rotted tissues and over winter in soil and initiate infections the following season.

Cranberry root rot causes a reduction of root mass, stunting and eventual death of the vine. Since cranberry plants colonize areas by runner growth, inhibition of runner root development also slows the colonization of a cranberry bed with vines. The symptoms of root rot appear as weakened vines and as a general decline (i.e. unlike upright dieback). Closer inspection generally reveals a weakened root system and discolored lesions in the runners. Lesions often form near a rooting point. Since *Phytophthora* species reduce root volumes several additional symptoms coincide with root rot. The most severe symptoms (plant death) are the result of infections by *Phytophthora cinnamomi*, a species that does not occur in Wisconsin. Under less severe conditions plants can be stunted,

display symptoms of nutrient deficiency, and be less tolerant of drought (5,6). These chronic infections can significantly reduce yield. Sandler et al. (8) showed that loss of *feeder root* densities through *Phytophthora parasitica* infection of citrus plants could reduce yield and fruit quality significantly without having major impacts on tree health. In that study, tree decline ratings differing by as much as 0.6 (scale of 0-3, i.e. treated trees 0.2 versus untreated trees 0.8) resulted in significantly different yields. This type of situation is probably very common although methods for detection and mapping of affected plants can be problematic.

Optimum conditions for spore germination and plant infection

- Sporangia form on infected plant tissues
- The optimum condition for formation and germination is wet - saturated soil
- Zoospores are released under saturated conditions and swim in water
- Plant infection occurs when zoospores are present

The zoospores of *Phytophthora* are carried in surface irrigation water (not in well water) and therefore are introduced regularly into the cranberry beds (7). However, symptoms develop in only a small percentage of the total acreage exposed. This low level of symptom expression is due to the generally excellent drainage of cranberry soils as well as the low pH values (3.0-4.5). These factors are known to reduce development of root rot (3, 10). Research has repeatedly demonstrated that under saturated soil conditions *Phytophthora* species produce sporangia, release zoospores and infect plant roots (10). As soil conditions become less saturated and flooding episodes less frequent, the probability of infection is reduced and the number of infection cycles declines.

Control practices.

Controlling cranberry root rot requires integration of several components. The most critical control practice relates to water management methods. Drainage is the most important soil property determining the degree of damage to be caused by *Phytophthora* infection. Uniform drainage allows soil water content to be managed to a level where infections are minimized. Problems arise where soil drainage is highly variable. In those cases it is not possible to irrigate sufficiently in well-drained areas and not over irrigate in poorly drained ones. Thus in establishing new beds uniform

drainage should be attempted. The formation of a puddle or standing water is first place *Phytophthora* infections occur. Thus drainage methods that remove standing water such as ditches or underdrains are very useful in controlling root rot. Irrigation uniformity is also an important factor since over watering in some areas can increase the chances of

Management practices important for *Phytophthora* control

- Soil drainage
- Soil drainage uniformity
- Irrigation uniformity
- Irrigation timing
- Soil pH
- Sanitation practices
- Diagnosis of the pathogen
- Resistance level of cultivars
- Timing of fungicide applications

infection. Repeated cycles of wetting and drying, especially extreme cycles are conducive for root rot development. Irrigation timing should focus on consistently maintaining soil moisture near the optimum level determined for the crop as opposed to long intervals between irrigation events. Soil pH is a questionable factor used for *Phytophthora* control. Since cranberry is an acid loving plant it can tolerate relatively low pH levels. However, use of sulfur to reduce pH in areas with symptoms of root rot can lead to additional damage if the soils are not dry or well drained. Thus this practice should be used with caution. Sanitation practices are generally recommended however, do not strictly apply to cranberry culture. Growers should be aware of the levels of *Phytophthora* in irrigation reservoirs and if possible the species that are present. This information is useful in determining the critical timing for control measures (see below) as well as potential fungicides that may be effective (see below).

Several *Phytophthora* species have been described from cranberry. These species are different in terms of pathogenicity, temperature optima, fungicide sensitivity and geographic distribution. For this reason, diagnosis can be important component in developing a *Phytophthora* management program. A summary of the *Phytophthora* species found on cranberry is given below.

Species	Distribution	Ridomil Sensitivity	Temperature optimum	Pathogenicity
<i>P.cinnamomi</i>	NJ, MA, OR, WA, (BC)	Sensitive	20-30C	very pathogenic
<i>P.megasperma</i>	above, WI	Resistant	15 C	Pathogenic below 15 C
<i>P. dreschleri</i>	above, WI, BC, Que	Sensitive	Not determined	Not determined
P. spp. (3-5)	All	Mostly sensitive	Not determined	Not determined

Fungicides are used to treat infected areas. The use of fungicides for root rot control should be delayed until drainage has been improved. The greatest effects of Ridomil will be seen when the infected areas are properly drained and beginning to recover. In fact the major effect of the fungicide will be to increase the rate of recovery. Fungicide applications should be made to coincide with the timing of fungal activity and also to protect vulnerable tissues. Generally, a root flush in cranberry occurs during early bud break and again in late summer to early fall. The young roots are particularly susceptible and therefore applications timed to root flushes are most effective.

Conclusions

Phytophthora root rot is a widespread disease in cranberry production in North America. In the worst case scenarios plants are killed leaving bare spots in the beds. However, chronic infections, where plants are stunted, are probably much more common. These chronic infections cause crop losses of varying levels depending on the *Phytophthora* species present and the extent and duration of flooding. Treatment of these chronic

infections is complicated by the difficulty in detection. One approach being developed for this use is remote sensing. Color infrared aerial photographs have been used to visualize and begin modeling cranberry yields. These photographs are now being used to detect *Phytophthora* injury along with other yield limiting factors.

Useful sources of information:

RCE FAX INFO LINE has newsletters and fact sheets available in a FAX-back format.
(732) 932-6767

Rutgers University Blueberry and Cranberry Research Centers Website has various documents and sources for information.

<http://aesop.rutgers.edu:80/~bluecran/>

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