Black Rot of Orchids Caused by *Phytophthora palmivora* and *Phytophthora cactorum*[1]

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Black rot of orchids can be caused by several pathogens. Frequently, black rot is caused by *Phytophthora cactorum* or *Phytophthora palmivora* (Hine 1962; Uchida 1994; Orlikowski and Szkuta 2006). Although *P. cactorum* and *P. palmivora* are very similar, they can be identified by morphological characteristics or by the use of molecular diagnostic techniques (Tsai et al. 2006). Another organism, *Pythium ultimum* can also cause black rot. *Pythium ultimum* can be differentiated from *P. cactorum* and *P. palmivora* based on morphology; however, *P. ultimum* is less commonly seen in orchids. Although *Phytophthora* and *Pythium* are different genera, their life cycles, morphology, epidemiology, and control are similar.

Host Range

Phytophthora palmivora and *Phytophthora cactorum* have been known to cause disease on several different orchid genera, including *Aerides, Ascocenda, Brassavola, Dendrobium, Gongora, Maxillaria, Miltonia, Oncidium, Paphiopedilum, Phalaenopsis, Rhynchostylis,* and *Schomburgkia*, as well as some less commonly grown genera (Alfieri et al.1994; Orlikowski and Szkuta 2006). However, the disease is frequently seen on *Cattleya* orchids and their hybrids, such as *Brassocattleya* and *Laeliocattleya.*

Symptoms

Small black lesions can be observed on the roots or basal portions of the pseudobulbs. As the lesions age, they enlarge and may engulf the entire pseudobulb and leaf (Figures 1 and 2). The pathogen can spread through the rhizome to other portions of the plant. Eventually, the entire plant will be killed.

Figure 1. *Cattleya sp*. Black rot symptoms caused by *Phytophthora cactorum*.
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Figure 2. *Cattleya sp*. Close up view of black rot symptoms caused by *Phytophthora cactorum*.
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Figure 3. *Cattleya* hybrid. White mycelium containing sporangia of *Phytophtora palmivora* can be seen on the end of pseudobulbs.
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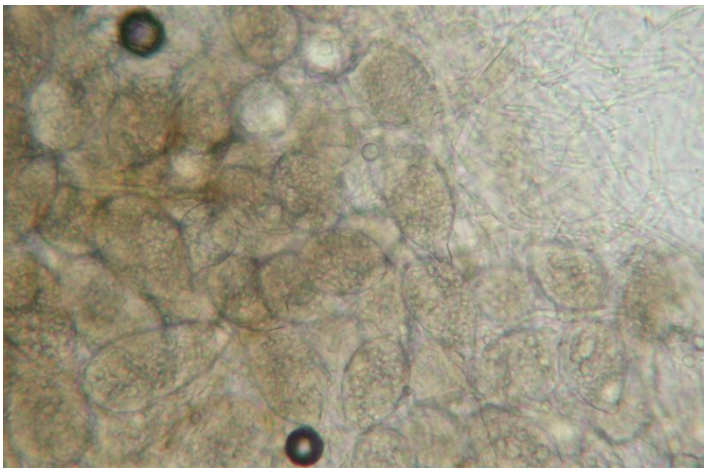

Figure 4. Sporangia of *Phytophtora palmivora* taken directly from plant tissue observed in Figure 3.
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Figure 5. *Cattleya* hybrid. White hyphae containing sporangia can be seen on basal portion of leaf.
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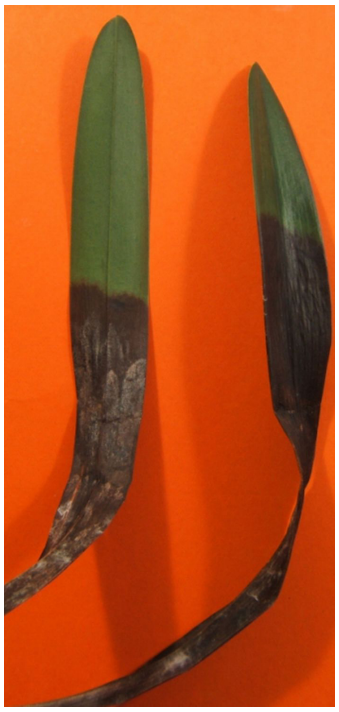

Figure 6. *Oncidium* hybrid with black-rot caused by *Phytophthora palmivora*.
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Diagnosis

Diagnosis of black rot caused by *Phytophthora cactorum* and *Phytophthora palmivora* is based on morphology of the pathogen or through the use of molecular techniques. Identification is based on characteristics of the mycelium, shape of zoosporangia (asexual reproductive structures) and the presence and shape of oospores (sexual reproductive structures).

If zoosporangia are present, and are roughly lemon-shaped with a short pedicel (stalk at the base of the spore) after the zoosporangium has been detached and contains a papilla (small swelling on the tip of the spore, see Figure 7), one

can be fairly confident it is a member of the *Phytophthora* genus.

In most cases, identifying the pathogen to genus will provide enough information to identify proper prevention and control strategies.

Figure 7. Sporangium of *Phytophthora palmivora*. Sporangium is papillate and ovoid with a short pedicel.
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Management

Phytophthora cactorum and *Phytophthora palmivora* are considered water molds and require water to spread the spores and to germinate on new hosts. The spores can easily spread in irrigation water and can splash from one plant to another during watering (Uchida 1994). In addition, zoospores, which are motile, are normally considered the infective spore and can move readily when free water is available. Therefore, it is crucial to remove infected plants immediately to prevent further spread, reduce periods of prolonged wetness, and provide adequate ventilation. Elevating the plants above the ground or keeping them on a solid surface can also help prevent infections. To prevent black rot, growers should also do the following:

Nursery Sanitation Recommendations for *Phytophthora*

Fungicides should be considered as a tool for managing *Phytophthora* and if not used properly (according to the manufacturer's label) they will not be effective or may cause more harm than benefit. However, they are your primary defense in an existing crop and provide at least some level of management when used appropriately.

Getting *Phytophthora* under control requires a longer-term strategy and actions that focus on changing and improving procedures and materials to reduce the opportunity for spread or reintroduction of the pathogen. Successful management of *Phytophthora* in a nursery has been accomplished in the past when dramatic measures were undertaken. Some growers keep a clean laboratory or surgical room in mind as they think through their nursery sanitation procedures.

Fungicide Options

For more information on disease management and chemical recommendations refer to *Professional Disease Management Guide for Ornamental Plants,* http://edis.ifas.ufl.edu/pp123 or *Homeowner's Guide to Fungicides for Lawn and Landscape Disease Management,* http://edis.ifas.ufl.edu/pp154.

FUNGICIDE RESISTANCE MANAGEMENT

Resistance to a fungicide occurs when a pathogen develops a genetic mutation at the target site that reduces its sensitivity to a specific fungicide. If a single fungicide continues to be used, the fungicide-sensitive portion of the population is suppressed over time, and only the resistant portion of the population remains. This population goes reproduces and becomes the majority. Eventually, the fungicide is ineffective because this majority of the population is no longer susceptible to it. If a pathogen is resistant to a fungicide, it is usually resistant to all fungicides in that class.

To minimize the potential for fungicide resistance, the Fungicide Resistance Action Committee (FRAC) provides codes to facilitate proper rotation of chemical families that have similar modes of action. FRAC codes make proper fungicide rotation easy and are included with the chemical recommendations in this fact sheet (Table 1). When purchasing fungicides for managing downy mildew, fungicides with different FRAC codes should be selected and the manufacturer's label followed.

NON-COMMERCIAL HOMEOWNER RECOMMENDATIONS

The landscape management recommendations described above should be followed and the fungicides listed in Table 2 can be used.

ADDITIONAL NOTES

Rhapsody or Cease (*Bacillus subtilis* strain QST 713) may also provide protection against *Phytophthora* in Florida landscapes, nurseries, and greenhouses when applied prior to infection.

Soilguard (*Gliocladium virens* G1-21) may also provide protection against *Phytophthora* in Florida nurseries and greenhouses when applied prior to infection periods.

Growing Media and Storage

Use only unopened bagged growing media stored on a covered paved surface that can be periodically washed down with a 1:3 ratio of bleach (sodium hypochlorite) to water. It is likely that the pathogen will move into your growing media if not bagged or completely covered.

Each use, use only disinfected tools and hands (disposable latex gloves that can be purchased at the grocery store or professional cook equipment stores work well). Bleach works by oxidizing or destroying the molecular bonds in microorganisms. Store purchased bleach solutions are now usually 6% sodium hypochlorite. The older non-concentrated versions are probably around 5% solutions. Avoid mixing bleach with acids or toxic chlorine gas may result. Always use with good ventilation.

Containers

Store new pots in sanitized areas similar to the growing media storage area. Your best option is to always use new potting containers, but if this is not feasible submerge potting containers in a 1:3 ratio of bleach (sodium hypochlorite) to water with agitation for a minimum of 10 minutes.

Bench Sanitation

Make sure that bench surfaces are at high enough above the soil surface to avoid splashing from the ground below.

Sanitize all bench surfaces and tools used to prune or work with plants before each use. Remove or sanitize any surfaces that may drip water onto crop. Bleach dunking will cause steel to rust. Some growers handle this by dipping in bleach and then dunking in oil after drying.

Examples of disinfectants for tools and benches include:

1. 25% chlorine bleach (3 parts water and 1 part bleach);
2. 25% pine oil cleaner (3 parts water and 1 part pine oil);
3. 50% rubbing alcohol (70% isopropyl; equal parts alcohol and water);
4. 50% denatured ethanol (95%; equal parts alcohol and water);
5. 5% quaternary ammonium salts.

Soak tools for 10 minutes and rinse in clean water.

Do not mix quaternary ammonia with bleach. The wood portions of your bench may be very difficult to sanitize because they are porous. Scrubbing to remove algae, scum, mildew and dirt before treating may help.

Water Supply and Hand Watering

Well and not surface water should be used unless disinfected.

If hand watering is utilized, be sure to sanitize the hose and water wands with bleach solution and hang in areas where the ends of the hose or wands will not contact soil or other potentially contaminated surfaces.

New Plants Brought Into Nursery

Any new plants brought into the nursery should be kept isolated (including tools and continuous bench space used for these new plants) from other plants for at least 6 weeks to observe any disease or pest symptoms, and to avoid contamination with other crops.

Other

Do not forget about other potential contamination surfaces like plant transport trailer or cart surfaces.

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Table 1. Fungicides for use in managing *Phytophthora* by commercial operations.

Product (active ingredients)	FRAC Group[2]	Use[1]
Adorn (fluopicolide)	**43**	**N, L, & G**
Aliette (fosetyl-Al)	**33**	**N, L, & G**
Heritage (azoxystrobin)	**11**	**N, L, & G**
Micora (mandipropamid)	**40**	**N & G**
Mural (azoxystrobin + benzovindiflupyr)	**11 + 7**	**N, L, & G**
Orkestra (fluxapyroxad + pyraclostrobin)	**7 + 11**	**N, L, & G**
Orvego (ametoctradin + dimethomorph)	**45 + 40**	**N & G**
Pageant (pyraclostrobin + boscalid)	**11 + 7**	**N, L, & G**
Protect (manganese + zinc + ethylenebisdithiocarbamate)	**M3**	**N, L, & G**
Segway (cyazofamid)	**21**	**N, L, & G**
Segovis (oxathiapiprolin)	**U15**	**N, L, & G**
Stature (dimethomorph)	**40**	**N & G**
Subdue Maxx (mefenoxam)	**4**	**N, L, & G**
Vital (potassium phosphite)	**33**	**N, L, & G**

[1] **N= Nursery; L= Landscape; G= Greenhouse**
[2] **F**ungicides within the same group (with same numbers or letters) indicate same active ingredient or similar mode of action.

Table 2. Fungicides for use in managing *Phytophthora* in home landscapes.

Non-Commercial Homeowner Products
Concern Copper Soap Fungicide (copper octanoate)
Ferti-lome Broad Spectrum Landscape and Garden Fungicide, Ortho Max Garden Disease Control (chlorothalonil)
Monterey Agri-Fos (phosphorous acid)
Southern Ag Liquid Copper Fungicide (copper ammonium complex)
Southern Ag Triple Action Neem Oil (extract of neem oil)