

Problems in Controlling *Phytophthora cactorum* on Cattleya Orchids

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The major fungus on cattleya orchids in Florida and in the New and Old World countries is *Phytophthora cactorum* (Lebert & Cohn) J. Schroet. and *Phytophthora palmivora*, which causes black rot of leaf and heart rot during the cooler months of the year. All species of cattleya and their interspecific and intergeneric hybrids are susceptible. *Phytophthora cactorum* infects leaves, pseudobulbs, rhizomes, and flower buds. Recovery studies of infected plants that involved cutting out the infected tissue were found not to be effective, even with treatments of fungicides such as Banrot, Natriphene, Shield Brite, Truban, and Phytan 27. A second study of fungicide sprays and drenches of Banrot, Heritage, Shield Brite, Stature, Truban, Pentathlon, Aliette, Subdue Maxx, and Insignia for the control of phytophthora-infected leaves, pseudobulbs, and rhizomes was conducted from 2005 to 2008. The fungicides Aliette, Insignia, Stature, and Subdue Maxx, when applied as preventive sprays, were found to be significantly effective for the control of cattleya leaf and flower bud infection. However, Aliette was only effective for control of *P. cactorum* when applied to leaves that were in the receptive stage. The fungicides Aliette, Banrot, Heritage, Insignia, Shield Brite, Stature, Subdue Maxx, and Truban, when applied as preventive drench, were found to be significantly effective for the control of *P. cactorum* in community pots of cattleya seedlings.

The cattleya orchid is dedicated to William Cattley, a 19th century English horticulturist. He was one of the earliest persons to build a collection of this exotic orchid. Orchids in the genus *Cattleya* are commonly called the corsage orchids.

Cattleyas are among the most commonly grown orchids in the world. Their culture is often used as the basis for comparison with other types of orchids. The flowers in cattleya and their related hybrids come in many colors. Culture varies only slightly among most of these groups.

Like most other cultivated orchids, cattleyas are epiphytes. Being epiphytes, they have developed water storage organs called pseudobulbs, and have large fleshy roots covered with a spongy water-retentive velum. The cattleya alliance is native to the Americas, with most of the ornamental species coming from Central and South America. *Cattleya*, *Laelia*, *Sophranitis*, *Brassavola*, and *Broughtonia* are the genera that make up most modern hybrids. Cattleyas and their relatives are indigenous to the New World, Mexico and Central and South America. Brazil is probably the home of more species of *Cattleya* and their relatives than any other country.

The major fungus on *Cattleya* orchids in Florida and in the New and Old World countries is *Phytophthora cactorum* (Lebert & Cohn) J. Schroet., and *P. palmivora*, which causes black rot of leaf and heart rot during the cooler months of the year (Alfieri et al., 1994; Hine, 1962; Orlikowski and Szkuta, 2006; Uchida, 1994). All species of *Cattleya* and their interspecific and intergeneric hybrids are susceptible (Burnett 1965). *Phytophthora cactorum* infects leaves, pseudobulbs, rhizomes, and flower buds (Figs. 1–2).



Fig. 1. Cattleya cultivar showing black rot symptoms caused by *Phytophthora cactorum*.



Fig. 2. Cattleya cultivar showing black rot symptoms, leaf blight, pseudobulb, and root rot, caused by *Phytophthora cactorum*.

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Although black rot of cattleyas can be caused by several pathogens, *P. cactorum* and/or *P. palmivora* are found to be the ones most frequently found to be causing the disease (Alfieri et al., 1994; Hine, 1962; Orlikowski and Szkuta, 2006; Uchida, 1994).

Phytophthora palmivora and *P. cactorum* are found to cause disease on *Cattleya*, *Laelia*, *Sophronitis*, *Brassavola*, and *Broughtonia* and their modern hybrids such as *Brassocattleya* and *Laeliocattleya* (Alfieri et al., 1994; Simone and Burnett, 1995).

The purpose of this research was to reproduce the disease and to determine effective methods of control.

Methods and Materials

A culture of *P. cactorum* originally isolated from a naturally infected *C. skinneri* was transferred periodically on potato-dextrose agar and maintained at 22 °C. This isolate was employed throughout this study.

Recovering *P. cactorum* was accomplished by inoculating ten, 2-year-old *Cattleya* hybrid clones, replicated 4 times, with a 3-d-old hyphal suspension of *P. cactorum*, placed in a dew chamber at 27 °C for 7 d, and observed for symptoms after 10 d. The visible symptoms and signs were removed from the infected cattleyas. These orchids were treated with drenches and sprays with four applications of five fungicides: Banrot, Natriphene, Shield Brite, Truban and Phytan 27. In addition to the water control checks there were also control plants free of *P. cactorum*. The plants were evaluated for symptoms of *P. cactorum* after 120 d in a greenhouse maintained at temperatures of 21 °C day/18 °C night.

The drench and spray efficacy studies of *P. cactorum* was accomplished by applying drenches and sprays with an initial application of nine fungicides: Aliette, Banrot, Heritage, Insignia, Pentathlon, Shield Brite, Stature DM, Subdue MAXX, and Truban on ten, 2-year-old *Cattleya* hybrid clones, replicated 4 times in a randomized block design. After the initial fungicide treatment the orchids were then inoculated with a 3-d-old hyphal suspension of *P. cactorum*, placed in a dew chamber at 27 °C for 7 d after which they were removed from the dew chamber and placed on benches in a greenhouse maintained at temperatures of 21 °C day/18 °C night. The plants were periodically evaluated for disease symptoms caused by *P. cactorum* for total of 120 d.

The drench and spray efficacy studies of *P. cactorum* in community pots of cattleya seedlings was accomplished by applying drenches and sprays with an initial application of eight fungicides—Aliette, Banrot, Heritage, Insignia, Shield Brite, Stature DM, Subdue MAXX, and Truban—on ten, 2-year-old *Cattleya* hybrid clones, replicated 4 times in a randomized block design. After the initial fungicide treatment the orchids were then inoculated with a 3-d-old hyphal suspension of *P. cactorum*, placed in a dew chamber at 27 °C for 7 d after which they were removed from the dew chamber and placed on benches in a greenhouse maintained at temperatures of 21 °C day/65 °F night.

All control treatments used throughout the trials were treated with water.

The plants were periodically evaluated for disease symptoms caused by *P. cactorum* for a total of 120 d.

Results and Discussion

Recovery studies of infected plants which involved cutting out the infected tissue were found not to be effective, even with

treatments of fungicides such as Banrot, Natriphene, Shield Brite, Truban, and Phytan 27 (Table 1.). A second study of fungicide sprays and drenches of Banrot, Heritage, Shield Brite, Stature, Truban, Pentathlon, Aliette, Subdue Maxx, and Insignia for the control of *Phytophthora* infected leaves, pseudobulbs, and rhizomes was conducted in 2005 and 2008 (Table 2.). The fungicides Aliette, Insignia, Stature, and Subdue Maxx when applied as preventive sprays, were found to be significantly effective for the control of cattleya leaf and flower bud infection. However, Aliette was only effective for control of *P. cactorum* when applied to leaves that were in the receptive stage. The fungicides Insignia, Shield Brite, Stature, and Subdue Maxx when applied as preventive drench, were found to be significantly effective for the control of *P. cactorum* in community pots of *Cattleya* seedlings (Table 3).

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Table 1. Fungicides applied to cattleya plants that were inoculated with *Phytophthora cactorum* and showing symptoms in the leaves, pseudobulbs, and rhizomes, which were pruned to white tissue that appeared to be pathogen free.

Treatment	Rate of product/379 L ^z	Disease incidence ^y
Control	Uninoculated	5.0 a ^x
Control (water)	H ₂ O	1.3 e
Banrot (etridiazole)		
+ thiophanate-methyl	118.28 mL	2.1 de
Natriphene (sodium salt of 8-hydroxydiphenyl)	4.93 mL	3.4 bc
Phytan 27 (copper sulfate)	295.7 mL	1.4 e
Shield Brite (thiabendazole)	283.5 g	3.6 bc
Truban (etridiazole)	118.28 mL	2.3 cd

^zApplication dates: 20 and 27 May, and 3, 10, 17, 24 June 2005.

^yDisease rating: 1 = dead and 5 = healthy.

^xMeans followed by the same letter are not statistically different from each other (Fisher's protected LSD, *P* = 0.05).

Table 2. Drench and spray efficacy studies of *Phytophthora cactorum* infected cattleya plants conducted in 2005 and 2008.

Spray treatments	Rate of product/379 L	Percent disease ^z	
		2005 ^y	2008 ^x
Control (water)	Untreated	96.5 a ^w	99.5 a
Aliette (fosetyl-al)	340.19 g spray	2.8 d	3.0 d
Banrot (etridiazole)			
+ thiophanate-methyl)	118.28 mL drench	3.0 d	3.9 d
Heritage (azoxystrobin)	25.51 g spray	4.0 d	3.8 d
Insignia (pyraclostrobin)	453.59 g spray	4.5 d	3.5 d
Pentathlon (maneb)	946.35 mL spray	11.5 b	12.2 b
Shield Brite (thiabendazole)	283.50 g spray	10.0 b	11.5 b
Stature DM (dimethomoph)	240.97 g spray	2.5 d	3.5 d
Subdue MAXX (metalaxyl)	29.57 mL drench	5.0 cd	4.5 d
Truban (etridiazole)	118.28 mL drench	3.5 d	3.5 d

^zDisease rating: 1 = healthy and 5 = dead.

^yApplication dates: 18 and 25 May, and 1, 8, 15, 22, and 29 June 2005.

^xApplication dates: 15, 22, and 29 May, and 5, 12, and 19 June 2008.

^wMeans followed by the same letter are not statistically different from each other (Fisher's protected LSD, *P* = 0.05)

Table 3. Efficacy of drenches for the control of *Phytophthora cactorum* on community pots of cattleya seedlings.

Treatment	Rate of product/379 L ^z	Disease rating ^y
Control (water)	H ₂ O	5.0 c ^x
Aliette (fosetyl-al)	340.19 g	1.0 a
Banrot (etrizazole + thiophanate-methyl)	118.28 mL	1.5 ab
Heritage (azoxystrobin)	25.51 g	2.5 ab
Insignia (pyraclostrobin)	453.59 g	2.0 ab
Shield Brite (thiabendazole)	283.50 g	4.5 c
Stature DM (dimethomorph)	240.97 g	1.5 ab
Subdue MAXX (metalaxyl)	29.57 mL	3.5 bc
Truban (etrizazole)	118.28 mL	1.5 ab

^zApplication dates: 18 and 25 May, and 1, 8, 15, 22, and 29 June 2005.

^yDisease rating: 1 = healthy and 5 = dead.

^xMeans followed by the same letter are not statistically different from each other (Fisher's protected LSD, $P = 0.05$)

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