

# Crown and Root Rot of Gloxinia and Other Gesneriads Caused by *Phytophthora parasitica*

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## ABSTRACT

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*Phytophthora parasitica* incited a root and crown rot of the florist gloxinia. Subdue 5W was superior to Banrot 40W, Truban 30W, or Ortho 20615 50W in controlling the disease on the Improved Red Velvet and Improved Pink Velvet cultivars of gloxinia. Host range studies showed pathogenic variation among isolates of *P. parasitica* on gloxinia, African violet, and new hosts *Episcia cupreata*, *Columnnea gloriosa*, and an unidentified species of *Columnnea*.

The family Gesneriaceae contains a wide variety of floriculturally important plants. The florist gloxinia (*Sinningia speciosa* [Lodd.] Hiern. of the Fyfiara group) has been an immensely popular potted flower for over a century (5). The African violet (*Saintpaulia ionantha* H. Wendl.) has been known and appreciated for only about half as long but is considered the most important and popular member of the family today because of its adaptiveness as a house plant and the variety of flower colors available. Other members of the family include Achimenes (*Achimenes* spp. Pers.), *Columnnea* (*Columnnea* spp. L.), *Episcia* (*Episcia cupreata* Hook. and *E. reptans* Mart.), lipstick plant (*Aeschynanthus* spp. Jack), *Nematanthus* (*Nematanthus* spp. Schrad.), and *Streptocarpus* (*Streptocarpus* spp. Lindl.).

Millions of gloxinia seedlings are produced in Florida as transplants for potted plant production in and out of the state. Tuberos rhizomes are of minor importance as a means of propagation. A disease with symptoms resembling those incited by *Phytophthora cryptogea* Pethyb. and Laff. was first observed in the state in 1970 (W. H. Ridings, *personal communication*). Seedlings as well as mature plants are affected, usually during

the warmer months of the year. Fungal organisms isolated from diseased plants included *P. parasitica* Dastur.

A black discoloration of gloxinia leaves was attributed to *P. cactorum* or *P. parasitica* in Holland in 1925 (21). *P. parasitica* was observed in 1935 on gloxinia in England and Wales (3), and a stem and leaf rot of gloxinia was reportedly caused by *P. parasitica* and *P. cryptogea* in Austria in 1956 (23). More recently, Busch and Smith reported a root and crown rot of African violet and gloxinia caused by *P. nicotianae* var. *nicotianae* (*P. parasitica* var. *nicotianae* Tucker) in Canada (4). *P. cryptogea* on gloxinia has been reported in Florida (1,18), California (13,14), and New York (14).

The magnitude of African violet production in Florida exceeds that of the florist gloxinia by several times (A. John, *personal communication*). Of the disease problems confronting the growers of this plant, none is more serious than the root and crown rot incited by *P. parasitica*. The disease has been reported in Germany (12), California (17), North Carolina (19), and Florida (11) and constitutes a threat to all stages of growth.

Research reported here established the pathogenicity of *P. parasitica* on gloxinia in Florida and demonstrated pathogenic variation among different *P. parasitica* isolates on gloxinia, African violet, *Columnnea* spp., and *Episcia cupreata*. Also, pathogenicity of *P. parasitica* on

new hosts *Columnnea* spp. and *E. cupreata* was shown. A preliminary report was published in 1979 (16).

## MATERIALS AND METHODS

**Experiment 1.** Gloxinia seedlings (1 mo old) were planted one per 10-cm plastic pot in a soil mix containing 5:3:3:1 (v/v) of Florida peat, sand, vermiculite, and perlite, respectively. The mix was amended with dolomitic limestone, hydrated lime, superphosphate, and a trace element mix, resulting in a final mix with a pH of 6.5. Two pathogenic isolates of *P. parasitica* (No. 3967, isolated from gloxinia, AREC-Bradenton, FL, and FTCC No. 560, isolated from gloxinia, Division of Plant Industry, Gainesville, FL) were used to infest the soil. Each isolate was grown separately on 200 cc of oat seed plus 200 ml of deionized water autoclaved on consecutive days in 1-qt Mason jars. The two isolates were incubated at 28 C under constant cool, white fluorescent light. After a 3-wk incubation period, the isolates were combined (1:1, v/v) and added to the soil mix at the rate of 5,200 cc of inoculum per cubic meter of soil mix. Seedlings of the gloxinia cultivars Improved Red Velvet and Improved Pink Velvet were watered in with 50 ml of a solution containing 7.5 ml of soluble fertilizer (20-20-20 plus trace elements) per 4 L of water. The soil was then drenched with 50 ml of one of the following fungicide suspensions (Table 1): Banrot 40W, 5-ethoxy-3-(trichloromethyl)-1,2,4-thiadiazole (Truban 15%) plus dimethyl 4,4'-oxydiphenylenebis(3-thioallophanate) (25%); Truban 30W; Ortho 20615 50W, 2-chloro-N-(2,6-dimethylphenyl)-N-(tetrahydro-2-oxo-3-furanyl) acetamide; and Subdue 5W, metalaxyl, N-(2,6-dimethylphenyl)-N-(methoxyacetyl)-D L-alanine methyl ester. Treatments were replicated four times and arranged in a completely randomized design on a shaded (about 35%) greenhouse bench.

Plants were observed for phytotoxicity beginning 3 days after treatment, and disease ratings were made after 10 days.

**Experiment 2.** Each of seven isolates of *P. parasitica* from various hosts (Table 2) was grown on 200 cc of millet seed plus 150 ml of deionized water autoclaved on consecutive days. The infested millet seed was incubated for 3 wk at 28 C under constant cool, white fluorescent light. Seven batches of infested soil were then prepared by individually incorporating the resultant inoculum for each isolate in the soil mix described for experiment 1 (3,000 ml of inoculum per cubic meter of soil mix). The same soil mix amended with a comparable rate of sterilized millet seed was used for a control treatment.

Planted into each of the above soils in 10-cm plastic pots were 2-mo-old seedlings of the gloxinia cultivars Improved Red Velvet and Improved Pink

Velvet, 6-wk-old rooted leaf cuttings of the African violet cultivars Erica and Lisa, rooted stolons of the *Episcia* (*E. cupreata*) cultivar Frosty, and rooted stems of the *Columnnea* sp. cultivar Rose and *Columnnea gloriosa* cultivar unknown.

Treatments were completely randomized and replicated five times on a shaded greenhouse bench. All pots were placed on plastic trays to elevate them above the bench surface and fertilized as described for experiment 1 the day after planting. Night temperatures in the greenhouse were consistently above 21 C for the duration of the experiment, whereas day temperatures frequently rose to 35 C. All plants were rated for disease 14 and 23 days after planting.

## RESULTS

Symptoms on gloxinia, African violet, *Episcia*, and *Columnnea* included a soft

brown rot originating at the root collar and progressing basipetally to the roots and acropetally to the stem, leaf petioles, leaves, and peduncles (Fig. 1). Diseased roots were brown and water-soaked and usually sloughed off when washed. Infected seedlings invariably died. Although initially soft, diseased tissue usually maintained its original form when dried (Fig. 2). Diseased mature gloxinia plants frequently lost their foliage to decay but some subsequently resprouted from the rhizome. Given favorable moisture and temperature (the cardinal temperatures of *P. parasitica* are 10 C, 30–32 C, and 37 C), however, these plants and rhizomes also eventually decayed and died.

**Experiment 1.** Both cultivars of gloxinia were highly susceptible to both *P. parasitica* isolates (Table 1). Disease development was severe but uniform within treatments. The 4X rate (four times the label rate) of Truban 30W provided only moderate disease control relative to the water control plants. The three rates of Subdue 5W (one, two, and four times the suggested rate) provided disease control superior to that provided by corresponding rates of Truban 30W, Banrot 40W, and Ortho 20615 50W. All other treatments gave poor disease control.

**Experiment 2.** All seven isolates killed plants of each gloxinia cultivar within 23 days (Table 2). Four isolates (560, 077-852, 4203, and 4376) were also pathogenic and highly virulent on each of the cultivars of African violet and usually killed plants before the 23rd day after planting in the infested mix. The remaining isolates (3967, 4377, and 4375), however, were slightly virulent on African violet. Any pathogenic isolate: susceptible combination (mean disease rating > 2.0) was of a highly significant nature when compared to the water control.

Symptoms produced by a given isolate

**Table 1.** Control of crown and root rot of gloxinia incited by *Phytophthora parasitica* with soil drenches of fungicides

Treatment (a.i./L)	Disease index <sup>a</sup>	
	Cv. Improved Red Velvet	Cv. Improved Pink Velvet
Control (H <sub>2</sub> O)	5.0 e	5.0 d
Banrot 40W 0.13 g (0.5X)	4.8 de	4.8 cd
Banrot 40W 0.27 g (1X)	4.0 bcde	4.8 cd
Banrot 40W 0.54 g (2X)	4.8 de	4.5 cd
Banrot 40W 1.08 g (4X)	3.8 abcde	4.5 cd
Truban 30W 0.18 g (1X)	4.5 cde	4.8 cd
Truban 30W 0.36 g (2X)	4.5 cde	4.5 cd
Truban 30W 0.72 g (4X)	3.3 abcd	3.5 ab
Ortho 20615 50W 0.02 g (1X)	4.5 cde	4.5 cd
Ortho 20615 50W 0.04 g (2X)	4.5 cde	4.8 cd
Ortho 20615 50W 0.07 g (4X)	4.0 bcde	4.5 cd
Subdue 5W 0.02 g (1X)	3.0 abc	4.0 bc
Subdue 5W 0.04 g (2X)	2.3 a	3.5 ab
Subdue 5W 0.07 g (4X)	2.5 ab	2.8 a

<sup>a</sup>Average disease ratings of four plants in a treatment. 1 = no disease; 2 = slight disease, > 25% of total leaf surface necrotic, no detectable stem necrosis; 3 = moderate disease, 25–50% of total leaf surface necrotic, stem partially girdled; 4 = severe disease, 50–75% of total leaf surface necrotic, stem almost completely girdled; 5 = dead, 75–100% total leaf surface necrotic, stem completely girdled. Disease means in a column followed by the same letter are not significantly different at the 5% level according to DMRT.

**Table 2.** *Phytophthora parasitica* disease ratings on seven gesneriads 23 days after inoculation<sup>a</sup>

Host plant	Noninoculated control	<i>P. parasitica</i> isolate and origin						
		560 (Gloxinia)	3967 (Gloxinia)	4377 (Gloxinia)	077-852 (Kalanchoe)	4203 (Kalanchoe)	4376 (African violet)	4375 ( <i>Columnnea gloriosa</i> )
Gloxinia cv. Improved Red Velvet	1.4 ax	5.0 cy	5.0 dy	5.0 dy	5.0 cy	5.0 by	5.0 by	5.0 cy
Gloxinia cv. Improved Pink Velvet	1.0 ax	5.0 cy	5.0 dy	5.0 dy	5.0 cy	5.0 by	5.0 by	5.0 cy
African violet cv. Erica	1.0 ax	4.8 cy	1.8 abx	1.6 ax	5.0 cy	5.0 by	5.0 by	1.0 ax
African violet cv. Lisa	1.0 ax	5.0 cz	1.2 ax	1.4 ax	3.6 by	4.8 bz	5.0 bz	1.2 ax
<i>Episcia cupreata</i> cv. Frosty	1.2 ax	1.0 ax	2.4 by	1.4 ax	1.4 ax	1.4 ax	1.2 ax	1.4 ax
<i>Columnnea</i> sp. cv. Rose	1.0 ax	3.4 by	3.6 cy	2.8 by	1.6 ax	1.6 ax	1.6 ax	3.2 by
<i>Columnnea gloriosa</i>	1.0 ax	1.2 ax	3.6 cy	3.8 cy	1.0 ax	1.2 ax	1.2 ax	3.6 by

<sup>a</sup>Average disease ratings of five plants in a treatment. 1 = no disease; 2 = slight disease, > 25% of total leaf surface necrotic, no detectable stem necrosis; 3 = moderate disease, 25–50% of total leaf surface necrotic, stem partially girdled; 4 = severe disease, 50–75% of total leaf surface necrotic, stem almost completely girdled; 5 = dead, 75–100% total leaf surface necrotic, stem completely girdled. Disease means within a row or column followed by the same letter are not significantly different at the 5% level according to DMRT. Host responses to a given isolate are separated using the letters a–d, and isolate effects on a given host are separated using the letters x–z.

on the three remaining gesneriads ranged from moderate to nonexistent. *Episcia* Frosty was slightly susceptible to one of the isolates (3967). All other isolates were nonpathogenic to this plant. Slight to moderate virulence was shown by four isolates (560, 3967, 4375, and 4377) on one or both of the columnnea hosts, but the remaining three (4203, 077-852, and 4376) were nonpathogenic on these plants. Isolations from representative plants of each of the seven hosts consistently yielded *P. parasitica*.

## DISCUSSION

*P. parasitica* is a tremendously versatile pathogen known to affect at least 58 families of plants (24). The list of known hosts includes a large group of

plants grown as flower and foliage ornamentals in Florida, including *Peperomia* (10,22), poinsettia (7), azalea (9), pothos (22), Christmas cactus (2), carnation (24), *Petunia* (15), *Calendula* (2), and *Gypsophila* (6). Because of this wide host range and its ability to flourish under high temperature and moisture conditions (20), *P. parasitica* is a severe threat to the diversified ornamental industry in the state.

Pathogenic variation in *P. parasitica* was reviewed by Erwin et al (8). The differences in virulence among the isolates used in our experiments are consistent with the results previously reported. Our data illustrate the high susceptibility of the florist gloxinia and African violet to these isolates obtained

from hosts routinely grown in Florida greenhouses. The data primarily demonstrate the need for some form of efficacious disease control in the culture of these plants, especially when they are grown adjacent to other hosts of *P. parasitica*.

The data also suggest the selection and use of strains of *P. parasitica* of a consistently high virulence when, as Strider (19) suggested, new breeding lines of African violet are screened for resistance or tolerance to this pathogen. In experiments in North Carolina (19), the African violet cultivars Erica and Lisa displayed marked differences in susceptibility to an isolate of *P. parasitica*. In our experiments, however, the same cultivars differed in susceptibility to only one of the seven isolates tested. These inconsistencies indicate a need for further work on the variation in pathogenicity inherent in *P. parasitica* and its effect on the appearance of resistance or tolerance in lines of African violet. Contingent to these studies should be the establishment of inoculum levels necessary for infection and the determination of how these levels relate to host susceptibility and levels one might find in greenhouse operations typical of growing the flower.

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Fig. 1. Crown infection of gloxinia incited by *Phytophthora parasitica*.

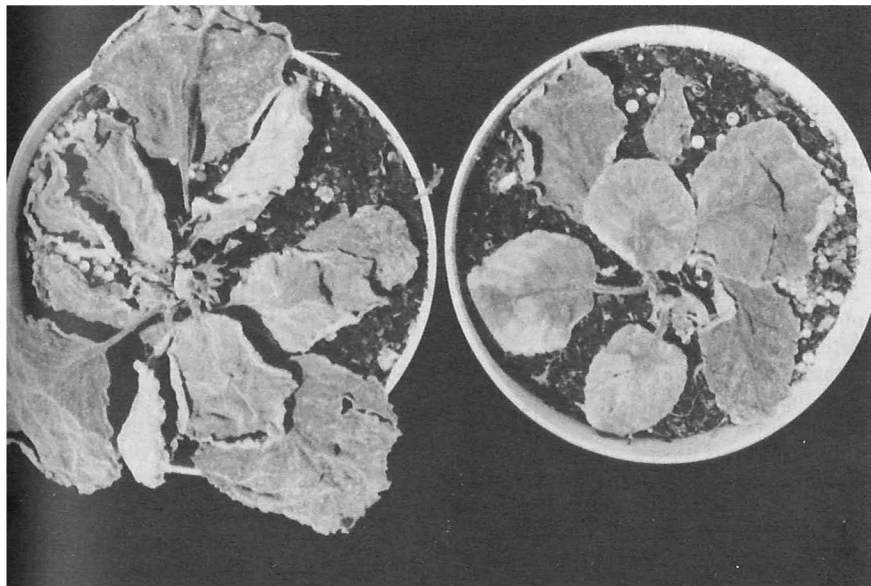


Fig. 2. Characteristic dried form of necrotic tissue on gloxinia seedlings infected with *Phytophthora parasitica*.

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