

Resistance of Nineteen Major Caladium Commercial Cultivars to *Pythium* Root Rot ¹

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Caladiums (*Caladium xhortulanum*) are popular ornamental plants widely grown for their bright colorful leaves. *Pythium* root rot, caused by *P. myriotylum*, is one of the few soil-borne diseases in caladium that can dramatically reduce plant growth, aesthetic value, and tuber yield. Identification and use of disease-resistant cultivars has proven to be an important and economically viable strategy for integrated management of major diseases in crops and for reducing the use of pesticides. This strategy will be particularly useful for caladiums in the landscape and home gardens, because in such cases choices of root rot control measures are limited. However, information on the resistance level of commercial caladium cultivars has been lacking.

Pythium Isolates

Three *P. myriotylum* isolates, 97-439B, P1, and P2, were collected from rotting roots of field- or greenhouse-grown plants, and their pathogenicity was tested on three cultivars, 'Florida Elise', 'Florida Fantasy' and 'Florida Red Ruffles'. All three isolates were found to be pathogenic and very aggressive on caladium roots. When tissue-culture-derived plants of

these cultivars were inoculated with *Pythium* oogonia at a density of 10,000 per mL, root rotting and lesions appeared within 3 days after inoculation. By the 10th day after inoculation, 30-75% of the roots rotted. Rotting continued to develop on roots from 10 to 17 days after the inoculation, but at a much slower rate. After this period of time, the majority of the roots were rotted. Difference in the mycelial growth rate was noticeable among the isolates, but no significant differences were observed among them in inducing root rot on the three cultivars.

Resistance Evaluation

Two experiments were conducted to evaluate the resistance level of 19 major commercially grown cultivars (Table 1). The majority of these cultivars are among the top 15 grown by the caladium tuber producers and greenhouse growers, and they may represent the best genetic resources in *C. xhortulanum* in terms of horticultural characteristics and performance. The resistance evaluation was based on artificial inoculation of tissue-culture-derived plants with *Pythium* oogonia followed by visual assessment of tissue rotting on

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roots. The tissue culture plants were initially derived from shoot tips of caladium buds on tubers, and they were grown in 6-pack plastic cells (each with a volume of 67 ml) in greenhouses. When plants were approximately 8 weeks old and 6 to 12 inches tall, with 3 to 6 leaves, they were inoculated with *Pythium* oogonia. Five mL of an oogonium suspension, from the above three isolates and adjusted to 1,000 – 6,000 oogonia per mL, were applied to the root media (vermiculite, ~50 mL in volume) surface of each plant. Control plants each received 5 mL of sterile water to their root media. To promote root rot after inoculation, continuous moisture saturation of the root media and warm day and night temperatures (90-99°F and 79-82°F) were provided. Ten days after inoculation, root rotting and plant leaf losses were visually rated for each plant on a scale of 1 to 5. For the root rot rating: 1 = 100%, 1.5 = 95-99%, 2 = 85-94%, 2.5 = 84-55%, 3 = 35-54%, 3.5 = 15-34%, 4 = 5-14%, 4.5 = 1-4% of root tissue on the root ball surface rotted, and 5=all root tissue appeared healthy without any rotting compared to the control plants. To help categorize the levels of root rot resistance, the following scale was also used: ≥ 4.5 : resistant; < 4.5 but ≥ 4 : moderately resistant; < 4 but ≥ 3 : susceptible; and < 3 : very susceptible. The scale for rating plant leaf losses was: 1=all leaves wilted or lost; 2=most (>50%) leaves wilted or lost; 3= some leaves wilted (~30%) and showing chlorosis; 4=almost normal, but showing chlorosis and some stunting; and 5=all leaves growing normally, compared to the control plants. After evaluation, re-isolations of *Pythium* were made from representative roots of rotted plants to verify the presence of the causal disease agent. The 19 cultivars showed similar levels of resistance in both experiments and their data were averaged and shown in Table 1.

Cultivar Differences

The majority of the cultivars (15 out of 19) were susceptible or highly susceptible to *Pythium* root rot. Within 10 days after inoculation, seven cultivars, 'Fannie Munson', 'Gingerland', 'Gray Ghost', 'Red Flash', 'Red Frill', 'Texas Beauty', and 'White Queen', had 35% to 94% of their root tissue rotted and a rating of 2.9 to 2.1. Eight cultivars, 'Aaron', 'Carolyn Whorton', 'Florida Elise', 'Florida

Fantasy', 'Florida Red Ruffles', 'Florida Sweetheart', 'Miss Muffet', and 'Pink Beauty' lost 15% to 35% of their roots to rotting and had a rating of 3.8 to 3.0. 'Red Frill' seems to be extremely susceptible to *Pythium* root rot; it lost more than 85% of its roots to rotting by 10 days after inoculation. Four cultivars, 'Candidum', 'Candidum Jr.', 'Frieda Hemple', and 'White Christmas' had a moderate level of resistance to *Pythium* root rot. Plants of these cultivars had only 5-14% of their roots rotted by the 10th day after inoculation (Fig. 1).

These plants were maintained for an extended period (6-7 weeks after inoculation) and were able to maintain a rating of 2.1 to 2.9 for root rot and leaf losses and kept 10 to 50% of their roots healthy. Control plants for each cultivar did not show signs of rotting during the 10 day period of evaluation.

In addition to reddish lesions and rotting on roots, several leaf symptoms appeared soon after inoculation. These symptoms included tan, necrotic blotches on leaves, especially along leaf edges, yellowing on entire leaves, epinastic petioles, and leaf wilting, collapse and losses (defoliation) (Fig. 2).



Fig. 2. Plant leaf losses on 'Gray Ghost' (GG), as compared to normal leaf growth on 'Frieda Hemple' (FH), 13 days after inoculation.

These symptoms occurred as early as 3 days after inoculation and became more severe 7 days after inoculation. When a rating of plant leaf losses was made on a scale of 1 to 5, leaf losses were highly correlated to the severity of root rotting. Regression analysis showed a linear relationship between plant

leaf loss and root rot severity. The four cultivars that had a moderate level of resistance to root rot maintained an average leaf loss rating of 4.0, while the eight susceptible and the seven very susceptible cultivars maintained an average leaf loss rating 3.4, and 2.8, respectively (Table 1).

Literature Cited

Hartman, R.D. 1974. Dasheen mosaic virus and other phytopathogens eliminated from caladium, taro, and cocoyam by culture of shoot tips. *Phytopathology* 64:237-240.

Ridings, W.H. and R.D. Hartman. 1976. Pathogenicity of *Pythium myriotylum* and other species of *Pythium* to caladium derived from shoot-tip culture. *Phytopathology* 66:704-709.

Table 1. Resistance levels of 19 major commercial caladium cultivars to *Pythium*.

Cultivar	Leaf shape	Impact color	Root rotting rating	Root rot resistance	Plant leaf loss rating
Frieda Hemple	Fancy	Red	4.4	MR	4.2
Candidum	Fancy	White	4.3	MR	4.0
Candidum Jr.	Fancy	White	4.0	MR	4.0
White Christmas	Fancy	White	4.0	MR	3.8
Carolyn Whorton	Fancy	Pink	3.8	S	4.0
Florida Fantasy	Fancy	Multicolor	3.4	S	3.3
Florida Elise	Fancy	Pink	3.3	S	2.9
Florida Red Ruffles	Lance	Red	3.3	S	3.6
Florida Sweetheart	Lance	Pink	3.2	S	3.6
Aaron	Fancy	White	3.2	S	3.3
Miss Muffet	Fancy	Multicolor	3.0	S	3.3
Pink Beauty	Fancy	Pink	3.0	S	3.2
Red Flash	Fancy	Red	2.9	VS	2.9
Fannie Munson	Fancy	Pink	2.8	VS	2.9
Gingerland	Fancy	Multicolor	2.8	VS	3.1
Gray Ghost	Fancy	White	2.8	VS	2.7
White Queen	Fancy	Multicolor	2.8	VS	3.1
Texas Beauty	Fancy	Red	2.6	VS	2.6
Red Frill	Strap	Red	2.1	VS	2.5