Etiological Aspects of Bacterial Blight of Philodendron selloum caused by Erwinia chrysanthemi

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ABSTRACT

Erwinia chrysanthemi was isolated from rotted roots, symptomless basal stems, and petioles of 6- to 10-mo-old *Philodendron selloum* and from mature fruit of 4- to 5-year-old seed-producing plants. Experimentally, *E. chrysanthemi* produced a root rot of *P. selloum*. Disease does not appear to be limited to leaves and petioles as published previously. The apparent systemic nature of *E. chrysanthemi* in *P. selloum* probably accounts for the poor disease control often experienced by growers after using antibiotic sprays.

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Additional key words: Chrysanthemum, root rot, ornamentals, foliage plants, bacteria.

Erwinia chrysanthemi Burkholder et al., first reported in 1953 (3), is an important pathogen of many ornamental plants (2). Probably the most important hosts today are the ornamental tropical foliage plants. One of these, *Philodendron selloum* Koch, was found in 1961 (5) to be highly susceptible to *E. chrysanthemi*. The bacterium was reported to invade leaves, with petiole invasion only occurring from affected leaf blades. The stems, crowns, and roots were reportedly free of disease (5).

Studies on etiology and control were undertaken when extremely uniform and rapid development of the Erwinia disease in acres of potted *P. selloum* could not be explained on the basis of leaf invasion alone.

MATERIALS AND METHODS.—Isolations for *E. chrysanthemi*, except from root-inoculated plants and rotted fruits, were made from 6- to 10-month-old, commercially-grown *P. selloum*. Isolations from rotted roots and fruits were made employing a technique described previously (4). Isolations from petioles of symptomless leaves were made by disinfesting 5-6 cm sections (1 section per petiole, three petioles per plant), 10 minutes in a 0.525% sodium hypochlorite solution, and placing three cross sections per plant (1 from each separate petiole section) into vials containing autoclaved yeast extract-dextrose (10 g of each per liter) solution. Vials were held 2 weeks at 30 C and observed periodically for bacterial growth. Loop dilutions were made from turbid vials and streaked onto lima bean agar (LBA, Difco). Basal stem isolations were similar except the tissue was extracted as a transverse core with a flamed No.

TABLE 1. The effect of soil infestation with *Erwinia chrysanthemi* upon the subsequent growth of *Philodendron selloum* seedlings

Treatment	Fresh top wt (g)[a]		No. leaves[a]	Root rot[a,b]
	Test 1 (70 days)	Test 2 (39 days)	Test 2 (39 days)	Test 2 (39 days)
Soil infested	9.7	12.0	4.1	2.8
Control	16.3	16.7	5.8	1.3

[a]Avg/pot. Ten pots/treatment, Test 1; 9 pots/treatment, Test 2.
[b]Root rot grade: 1 = healthy; 2 = slight, 1-25%; 3 = moderate, 26-75%; and 4 = severe, 76-100% of outer root ball rotted.

TABLE 2. The effect of root dip inoculation with *Erwinia chrysanthemi* upon the subsequent growth of *Philodendron selloum* seedlings. Test 3, 41 days

Treatment	Fresh top wt (g)[a]	No. leaves[a]
Control, inoculated	6.6	4.2
Streptomycin[b], inoculated	8.7	5.4
Streptomycin[b], noninoculated	15.3	7.4
Control, noninoculated	16.2	7.8

[a]Avg/pot, 10 pots/treatment.
[b]200 mg/liter solution dip for 5 minutes after inoculation.

4 cork borer. Prior to disinfestation, approximately 5 mm was aseptically cut from each end of the core. In addition, petiole isolations were made from yellowed leaves of 5- to 6-year-old seed-producing plants. Isolation of *E. chrysanthemi* was attempted from the basal stems, root systems, petioles of symptomless leaves, petioles of yellowed leaves, and rotted fruits from 93, 13, 65, 4, and 3 individual plants, respectively.

Susceptibility of the roots of commercially-produced *P. selloum* seedlings to *E. chrysanthemi* was investigated in three tests. The isolate of *E. chrysanthemi* which was used was originally isolated from rotting roots of *P. selloum* and confirmed to be *E. chrysanthemi* by R. S. Dickey, Cornell University. Seedlings were planted in a steam-sterilized mix. Each seedling was planted in a new 10-cm diameter plastic pot, with 10 pots (Tests 1, 3) and 9 pots (Test 2) per treatment. Inoculum was prepared by centrifuging for 15 minutes a 6-hour-old nutrient broth shake culture grown at 25 ± 2 C, pouring off the supernatant liquid, and resuspending the bacterial cells to the original volume with sterile distilled water (SDW). In Tests 1 and 2, 50 ml of inoculum was poured over the soil surface of the pot 1 week after transplanting. Fifty milliliters of SDW was applied to control pots. Two hundred milliliters of tap water was applied to each pot after infestation.

In Test 3, roots of *P. selloum* seedlings were inoculated by dipping for 5 minutes in 200 ml of inoculum. Control seedlings were dipped in SDW. Ten seedlings from each were dipped 5 min in a 200 mg/liter streptomycin solution and 10 control seedlings dipped in SDW. After removal, each treatment was placed on separate paper toweling to drain. Care was taken to avoid cross-contamination during potting.

In all tests, pots were watered carefully by hand five times a week and fertilized once a week with a soluble fertilizer in solution. Data on one, or all of the following were taken in each test: fresh weight of top above the soil line, number of leaves, and severity of root rot.

RESULTS.—Colonies identified as *E. chrysanthemi* were white, gram-negative with peritrichous flagella and pathogenic to cuttings of *Chrysanthemum morifolium* (Ramat.) Hensl. 'Iceberg' by toothpick inoculation. *Erwinia chrysanthemi* was isolated from rotted roots, basal stems, and petioles of symptomless leaves from 12 of 13, 70 of 93, and 13 of 65 commercially produced plants of *P. selloum*, respectively. The pathogen was recovered from the fleshy seed covering of rotted fruits taken from all four seed-producing plants. Petioles of yellowed leaves from three seed-producing plants yielded *E. chrysanthemi*. Of these preceding isolates, three, three, and seven from hypocotyls, roots, and rotted fruits, respectively, were sent to R. S. Dickey and identification as *E. chrysanthemi* further confirmed.

Both soil infestation (Tests 1, 2) and root-dip inoculation (Test 3) with *E. chrysanthemi* produced a root rot accompanied by decreased leaf number and top weight (Tables 1, 2). Reisolation for *E. chrysanthemi* from one rotted root from each infested control pot in Test 1 yielded *E. chrysanthemi* from 7 to 10 pots. Streptomycin dip was nonphytotoxic but ineffective in control of Erwinia root rot (Table 2).

DISCUSSION.—*Erwinia chrysanthemi* causes a root rot of *P. selloum* closely resembling that caused by *Pythium* spp. Petiole infection occurs from diseased leaves, but the fact that *E. chrysanthemi* was isolated 13 of 65 times from petioles of symptomless leaves indicates this is not the only method of petiole invasion. The senior author also has seen numerous cases where petiole decay occurs on healthy-appearing leaves. The pathogen is present also in symptomless basal stems and decaying seed-bearing fruits of *P. selloum*.

Erwinia chrysanthemi is more than a localized foliar pathogen of *P. selloum*. Past attempts to control this pathogen on *P. selloum* with antibiotic sprays based on the premise of leaf invasion alone, have met with limited success. The possibility that *P. selloum* becomes systemically invaded by *E. chrysanthemi* appears likely. Further attempts at control should utilize *E. chrysanthemi*-free seed of *P. selloum* in a cultural program (1) designed to maintain pathogen-free plants.

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