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BASAL ROT OF GERANIUM CUTTINGS IN PROPAGATION CAUSED BY PSEUDOMONAS CICHORII

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Abstract. **A new disease with severe basal rot symptoms on geranium** (Pelargonium **X** hortorum **Bailey) cuttings was observed in propagation. Stems of cultivars 'Dark Red Irene' and 'Improved Minnetonka' were soft and blackened upward 3 to 4 days after stick and the leaf margins of the affected cuttings were chlorotic and showed wilting. Isolations were made with surface sterilized stem tissue on various media. Fluorescent bacterial colonies were consistently isolated from the affected, but not healthy, stems on King's medium B. The bacterium was identified as** Pseudomonas cichorii **(Swing.) Stapp based on biological and biochemical tests. Typical basal rot symptoms developed on geranium cuttings inoculated with pure cultures of** P. cichorii, **whereas the non-inoculated controls showed no symptoms. The same bacterium caused leaf spot in the inoculated chrysanthemum** (Chrysanthemum **X** morifolium **Ramat.) cv. Mountain Peak.** Pseudomonas cichorii **was reisolated from symptomatic geranium and chrysanthemum. Isolates from leaf spot affected chrysanthemums in the field were pathogenic to geranium cuttings.**

Bacterial diseases of geranium have been reported as early as 1890 (4). However, most of the reports, including the most recent one by Englehard, et al. (3), dealt with leaf spots. A stem rot disease of geranium had been reported in 1932 (2) and in 1954 (8) and the causal bacterium was identified as *Xanthomonas pelargonii* (N.A. Brown) Starr & Burkh.

Geranium cuttings in propagation were observed with severe basal rot that was soft and black and extended up the stem. Leaf margins of the affected cuttings were chlorotic and the cuttings wilted 4 to 5 days after stick (Fig. 1).

Here we report the isolation of the organism, *Pseudomonas cichorii,* from the diseased tissue, pathogenicity testing, and the reisolation of the agent from symptomatic cuttings. This is the first report of *P. cichorii* causing basal rot of geranium cuttings in propagation.

Materials and Methods

Stem tissue from naturally disease-affected cuttings was thoroughly washed, surface sterilized in 0.5% sodium hypochlorite solution for 1 min., and rinsed in sterile water. Isolations were made on numerous selective media using standard techniques. Plates were incubated for 24 hr at 22°C and then examined for growth.

Bacterial identification. Axenic subcultures of the bacterium isolated from geraniums with basal rot symptoms were tested for oxidase reaction, arginine dihydrolase utilization, and production of fluorescent pigment on King's medium B. In addition to the biochemical tests, the bacterium was evaluated for hypersensitive response on tobacco, and growth on *Erwinia* and *Xanthomonas* selective media (1, 9).

Pathogenicity studies. Geranium cuttings of 'Dark Red Irene' and 'Improved Minnetonka', 5 per variety per isolate, were harvested from stock plants and immediately inoculated by stabbing the base with a sterile toothpick

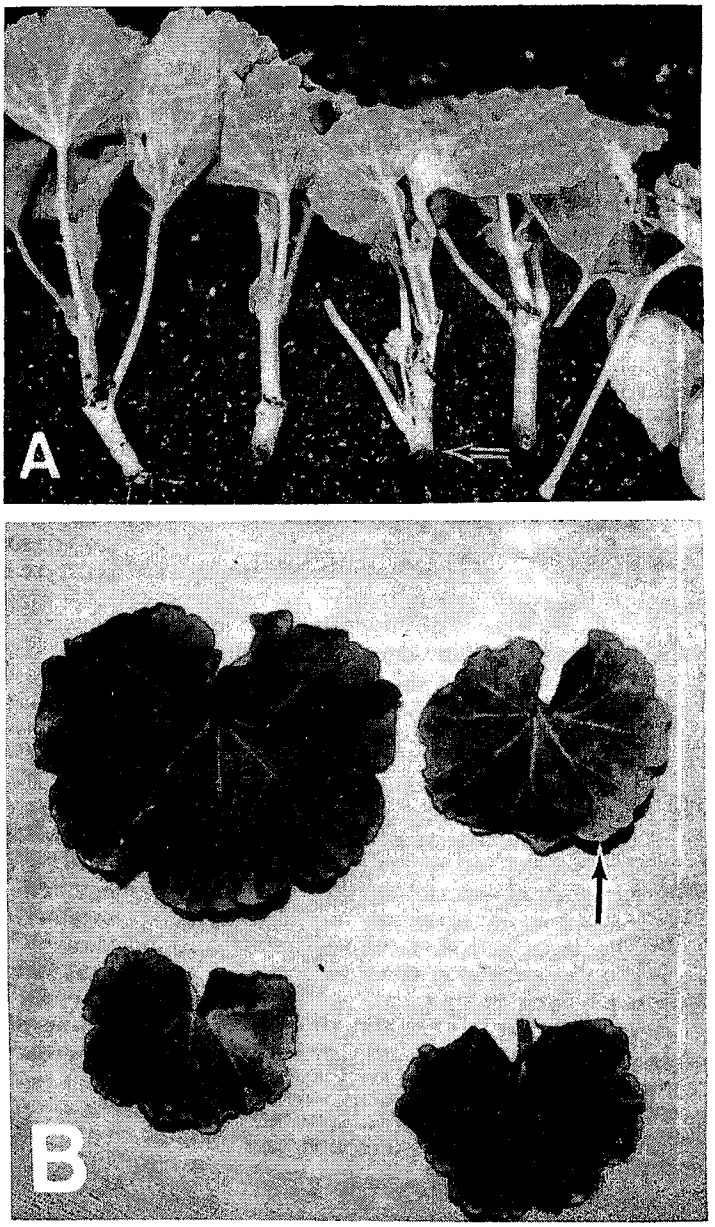

Fig. 1. Symptoms of basal rot disease on naturally affected cuttings. A) stem with necrosis, water soaking and rot symptoms; B) leaves with chlorotic margins.

covered with the bacteria. The stab inoculated cuttings were then placed into tubes of sterile water, bagged, and incubated for 5 days at room temperature. Appropriate checks were included and the test was repeated 3 times with 5 isolates. In a second study, 10 cuttings per variety were harvested, inoculated as previously described, and placed under mist in the propagation area. Appropriate checks were included and the test was repeated 3 times.

Another test was carried out wherein healthy leaves of geraniums were injured by pinpricking with a sterile needle and inoculated by the application of one drop of a bacterial suspension containing 10^8 colony forming units onto the injured leaf and incubating in a moist chamber. Five leaves per variety per isolate were inoculated in each of 3 tests and the checks were treated with sterile water.

In another study, the infected plant material was

washed, homogenized in sterile water and used as inoculum. Freshly harvested cuttings were injured with a sterile toothpick, then dipped into the homogenate, and placed into test tubes of sterile water, bagged, and incubated for 5 days at room temperature or placed in the propagation area. Cuttings not inoculated with the homogenate served as controls.

Leaf and stem inoculations with the bacterium isolated from geraniums were also made on 'Mountain Peak' chrysanthemum. Leaves were surface sterilized in 0.5% sodium hypochlorite, washed in sterile water, and blotted dry. The prepared leaves were placed in moist chambers consisting of sterile petri plates lined with moistened sterile towels and inoculated as previously described. After the leaves were removed, stems of 'Mountain Peak' were inoculated with a sterile toothpick covered with the bacteria, incubated in moist chambers for 48 hr at 22°C, and then examined for symptoms. Isolations from leaf spot affected chrysanthemums were made on King's medium B and the isolated bacterium was tested for pathogenicity on geranium as previously described.

Results

Isolations from 50 naturally diseased geraniums with basal rot symptoms consistently recovered a fluorescent bacterium on King's medium B. No fungi were recovered from diseased cuttings on any of the media tested.

Identification tests showed that the isolated bacterium was fluorescent on King's medium B and positive for oxidase reaction, arginine dihydrolase utilization, and hypersensitive response on tobacco. The bacterial growth on Crystal Violet Pectate, Miller-Scroth, and SV media were not characteristic of *Erwinia* sp. or *Xanthomonas* sp.

Reinoculations of healthy geranium cuttings with the fluorescent bacterium and with the infected plant material consistently produced basal rot symptoms on stems (Table 1) and spots on leaves. None of the controls showed any symptoms. Inoculations of chrysanthemum leaves and stems with the bacterium from geranium consistently produced typical leaf spot and stem rot respectively. Similarly, geranium cuttings inoculated with the mum isolates consistently showed basal rot symptoms.

Reisolations from symptomatic stem and leaf tissue of geranium and chrysanthemum yielded *P. cichorii*. No bacterium was recovered from the asymptomatic tissue.

Discussion

Numerous ornamental hosts of *P. cichorii* have been reported (5, 6, 7). This study reports a basal rot on geranium cuttings in propagation. A report of stem rot of geranium caused by bacterium isolated from a leaf spot was made in 1932 (2), however, the bacterium was not identified. A study in 1954 (8) showed that a *Xanthomonas* sp. was the causal agent of a leaf spot and stem rot. The isolation, identification and pathogenicity studies presented here indicate that the bacterium causing basal rot of geranium cuttings in propagation is *P. cichorii*. Further, with cross-inoculation studies, we have demonstrated that the chrysanthemum and geranium isolates of *P. cichorii* are pathologically similar.

Table 1. Inoculation of geranium and chrysanthemum with the bacterium isolated from naturally basal rot affected geranium cuttings.[z]

Treatment	Number of stems or leaves with symptoms			
	Geranium[y]		Chrysanthemum[x]	
	DRI	IM	Leaves	Stems
Untreated check	0	0	0	0
Injured check	0	0	0	0
Injured, inoculated with geranium bacterial isolates	15	15	15	15
Injured, inoculated with diseased tissue	15	15	15	15

[z]All inoculation tests were carried out 3 times with 5 replicates in each treatment.
[y]'Dark Red Irene' (DRI), 'Improved Minnetonka' (IM). Only stems were inoculated.
[x]'Mountain Peak' chrysanthemums were used.

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CONTROLLING ALGAE IN FOLIAGE PLANT PRODUCTION[1]

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Additional index words. soil treatment, dodine, mancozeb, zineb, quaternary ammonium, sodium hypochlorite, phytotoxicity, foliage plants.

Abstract. **Fungicides and disinfectants were tested in the greenhouse for algae control on potting medium surfaces and toxicity to foliage plants. Although sodium hypochlorite (10% commercial bleach) provided good short-term control of algae, regrowth occurred within 3 days. Dodine (Cyprex 65 WP), mancozeb 2 (Dithane M45), and zineb 2 (Dithane Z78) provided the best control for 5 weeks following a single application. Other formulations of carbamate fungicides provided equal control to mancozeb 2 and zineb 2. Sodium hypochlorite was very toxic when applied directly to leaves of 8 species of foliage plants causing severe necrosis, chlorosis and leaf abscission following a single ap-**

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