New Disease of *Pellionia* and *Pilea* spp. Caused by *Xanthomonas campestris*

JOHN W. MILLER, Plant Pathologist, Florida Department of Agriculture and Consumer Services Division of Plant Industry, P.O. Box 1269, Gainesville 32602, and A. R. CHASE, Associate Professor of Plant Pathology, University of Florida, IFAS, Agricultural Research and Education Center, 2807 Binion Road, Apopka 32703

ABSTRACT

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Since about 1975, a bacterial disease of *Pilea* and *Pellionia* spp. caused by a species of *Xanthomonas* has increased in severity in Florida. Cross-inoculations with strains from these two genera as well as several pathovars of *Xanthomonas campestris* from other foliage plant hosts showed that the new pathogen was pathogenic only on species of *Pilea* and *Pellionia* tested. The bacterium conformed to the physiological and biochemical characteristics of *X. campestris*.

During the mid-1970s, the foliage plants *Pellionia pulchra* N. E. Br. (satin pellionia) and *P. daveauana* (Godefr.) N. E. Br. (trailing watermelon begonia) were widely grown in Florida nurseries for use in hanging baskets. *Pilea cadieri* Cagn. & Guill. (aluminum plant) is presently used in terrariums and dish gardens. All three are members of the Urticaceae.

A serious leaf spot was first noted in the mid-1970s and continues to occur in many central Florida nurseries on these three species. Lesions on satin pellionia are initially green to yellow, later becoming irregularly shaped, tan, and dry (Fig. 1). Water-soaking around margins of young lesions is most apparent on the undersurface of the leaf. On trailing watermelon pellionia, leaf lesions are circular, tan, and also show water-soaking on the undersurface of the leaf. Aluminum plants develop dry, tan, irregularly shaped lesions primarily within the silver area of the variegated leaves (Fig. 2). In advanced infections, the lesions frequently fall out, leaving ragged holes in the leaf blades. In 1983, a fourth member of this family, *Pilea serpyllacea* (Poir. Wedd. (creeping charlie), was found affected with dark gray to black angular lesions on the leaves.

A yellow, aerobic bacterium was consistently isolated from diseased plants of each species (3). This paper reports on the causal agent and its host range.

MATERIALS AND METHODS

Isolation and pathogenicity of suspect pathogen. Symptomatic tissue was washed in tap water, then ground in a sintered glass tissue grinder with sterilized deionized water (SDW). The resulting suspension was streaked onto either lima bean agar (LBA; infusion from 283 g of frozen lima beans and 18 g of Bacto agar per liter; 1976 test only) or nutrient agar (Difco). Colonies of the suspect pathogen were isolated and purified by serial transfers.

Two tests were conducted in 1976. Strains to be used as inocula were grown on LBA prepared and adjusted to 1×10^8 cfu/ml (50% transmittance at 600 nm in a spectrophotometer). Plants were inoculated with a pump-action hand sprayer until runoff, then enclosed in polyethylene bags for 72 hr. Nine strains were employed in this trial: five from *Pellionia* spp. and four from *Pilea* spp. Control plants were treated with SDW. Three plants of each of the following species were included in the trial: creeping charlie, aluminum plant, satin pellionia, and trailing watermelon pellionia. Reisolations from symptomatic plants were performed using NA as described.

Host range of suspect pathogen. The host range of two strains of the suspect pathogen (one from *Pellionia pulchra* and one from *Pilea cadierei*) was compared with those of pathovars of *X. campestris* from other ornamental plants. The following strains were included in one to four tests: *X. campestris* pv. *dieffenbachiae* McCull. & Pirone (one each from *Anthurium andreanum* Lind and *A. scherzeranum* Schott.), *X. campestris* pv. *hederae* (Arnaud & Dowson) Dowson (one each from *Brassaia actinophylla* Endl. and *Schefflera arboricola* Hayata ex Kanehira), and *X.*

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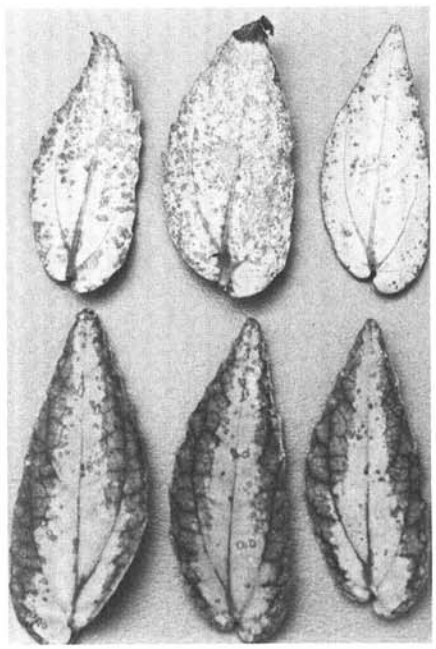

Fig. 1. Typical symptoms of disease on *Pellionia pulchra* after artificial inoculation with *Xanthomonas campestris*. (Courtesy J. M. F. Yuen)

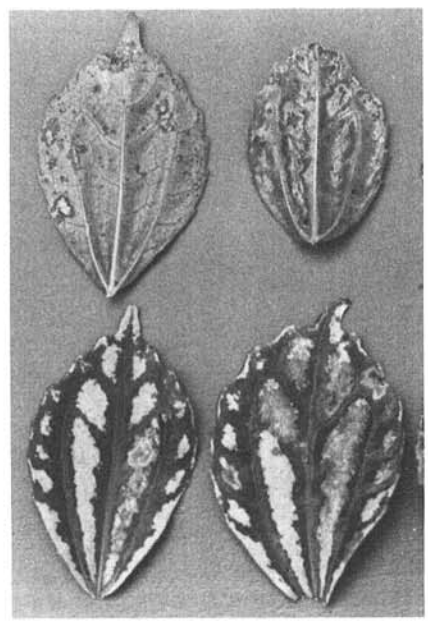

Fig. 2. Leaves of *Pilea cadieri* infected with *Xanthomonas campestris*. Lesions were frequently more severe in the silver-white variegated portion of the leaves. (Courtesy J. M. F. Yuen)

campestris pv. *malvacearum* (E. F. Sm.) Dowson (two from *Hibiscus rosa-sinensis* L.). The following plants were inoculated: *A. andreanum* (four trials), *B. actinophylla* (four trials), *C. variegatum* (two trials), *H. rosa-sinensis* (one trial), and *P. cadierei* (four trials). Three plants of each species were used per trial for each strain tested. Inocula were prepared and employed as described for the 1983 pathogenicity trials. Reisolation from symptomatic plants was also performed as described. The percentage of adaxial foliar surface symptomatic after 10–14 days was recorded

Plants in all trials were arranged in randomized complete block designs, and data were analyzed using an F test and Duncan's new multiple range test.

Identification of suspect pathogen. Oxygen requirement was determined using Hugh-Leifson's medium (4). Growth in asparagine broth was tested according to Dye (1). Gram reaction, gelatin liquefaction, aesculin and casein hydrolysis, mucoid growth, urease production, growth at 36 C, and growth on starch medium (SX) were tested (4). Xanthomonadin pigment production was evaluated (2). In addition to the nine strains of the suspect pathogen, one strain of each of four known pathovars was included for comparison (Table 1).

RESULTS

Isolation and pathogenicity of suspect pathogen. An aerobic, gram-negative yellow bacterium was consistently isolated from symptomatic tissue from each of the four host plants. Inoculations on healthy plants reproduced the symptoms noted on naturally infected plants. Cross-inoculations of the four hosts with strains of the *Xanthomonas* sp. showed that no host specificity occurred (Table 2), although the virulence level of the strains varied considerably. Generally, the most severe disease occurred on creeping charlie, whereas the other three plants showed lower levels of susceptibility. Reisolation attempts from representative plants in each of three trials yielded bacteria identical to those used for the inculation.

Host range of suspect pathogen. Because of extreme variation in results between trials and strains of the same pathovar, these data were not analyzed statistically. In trial 4, all plants of *P. cadierei* were apparently contaminated before use because all became uniformly symptomatic after inoculation. Although the highest percentage of infection for each host plant occurred when the plants were inoculated with the pathovar or strain isolated from the same group of plants, a significant amount of cross-infection occurred. Therefore, the results do not completely support pathover designations (Table 3). The designation of a pathovar for the strains from *Pilea* and *Pellionia* spp. cannot be determined without further testing for the entire group of strains commonly isolated from these ornamental plants.

Identification of suspect pathogen. For each physiological or biochemical test, the pathogen behaved as *X. campestris* (Table 1). No variation was noted between strains from *Pilea* and *Pellionia* spp. and the known strains from other plants.

DISCUSSION

This paper describes a serious foliar disease of *Pilea* and *Pellionia* spp. caused by *X. campestris*. Biochemical and pathogenicity comparisons with other *X. campestris* pathovars indicate that strains from *Pilea* and *Pellionia* spp. conform to the *X. campestris* classification. Other pathovars of *X. campestris* from foliage plants are also family-specific (A. R. Chase, *unpublished*).

Controlling this disease is not easily accomplished, and observations indicate that disease may occur even under conditions of apparently low free surface water on leaves. The use of disease-free

Table 1. Results of physiological and biochemical tests of nine strains of *Xanthomonas* from *Pellionia* and *Pilea* spp. compared with one strain of each of four known pathovars

	Strains From *Pellionia* and *Pilea*[a]									Standard strains[b]			
Diagnostic criterion	083-4564	078-2084	078-2196	B-122	078-2082	078-2074	078-2080	078-2085	480	21	8	083-1839	083-1335
Gram reaction	−	−	−	−	−	−	−	−	−	−	−	−	−
Growth at 36 C	+	+	+	−	+	+	+	−	+	+	+	−	+
Aesculin hydrolysis	+	+	+	+	+	+	+	+	+	+	+	+	+
Mucoid growth	+	+	+	+	+	+	+	+	+	+	+	+	+
Gelatin hydrolysis	+	+	+	+	+	+	+	+	+	+	+	+	+
Casein hydrolysis	+	+	+	+	+	+	+	+	+	+	+	+	+
Growth in asparagine broth	−	−	−	−	−	−	−	−	−	−	−	−	−
Growth on SX medium	+	+	+	+	+	+	+	+	+	+	+	+	+
Production of xanthomonadin	+	+	+	+	+	+	+	+	+	+	+	+	+
Urease production	−	−	−	−	−	−	−	−	−	−	−	−	−

[a] Same strains and hosts as in Table 2.
[b] 21 = *X. campestris* pv. *vesicatoria* from *Capsicum annuum*, 8 = *X. campestris* pv. *dieffenbachiae* from *Philodendron scandens* subsp. *oxycardium*, 083-1839 = *X. campestris* pv. *campestris* from *Brassica oleracea*, and 083-1335 = *X. campestris* pv. *hederae* from *Brassaia actinophylla*.

Table 2. Results of cross-inoculation using nine *Xanthomonas* strains on species of *Pilea* and *Pellionia*

		Number of lesions per plant				
Strain	Host of origin	*Pilea serpyllacea*	*Pilea cadieri*	*Pellionia pulchra*	*Pellionia daveauana*	Mean[y]
B-122	*Pellionia* sp.	10.3[z]	0.3	0.0	7.3	4.5 abc
480	*Pilea serpyllacea*	3.7	0.0	1.0	0.0	1.2 ab
078-2080	*Pellionia pulchra*	8.3	1.0	2.7	10.7	5.7 bc
078-2082	*Pilea cadieri*	13.0	7.0	1.0	2.7	5.9 c
078-2084	*Pellionia daveauana*	18.3	1.0	2.0	10.3	7.9 c
078-2074	*Pellionia pulchra*	1.0	0.0	0.3	0.0	0.3 a
078-2085	*Pellionia pulchra*	13.3	0.0	0.3	12.0	6.4 c
078-2196	*Pilea* sp.	5.0	5.3	0.0	1.3	2.9 abc
083-4564	*Pilea cadieri*	5.3	7.3	0.7	6.7	5.0 abc
Mean		8.0 b	2.2 a	0.8 a	5.1 ab	

[y] Means followed by the same letter are not significantly different ($P = 0.05$) according to Duncan's new multiple range test.
[z] Mean number lesions per plant, average of three replicates.

Table 3. Pathogenicity of various strains and pathovars of *Xanthomonas campestris* to five ornamental plants

Host of origin Pathovar or strain	Mean percentage of foliar surface infected[a]														
	Anthurium				Brassaia				Codiaeum		Hibiscus	Pilea			
	1	2	3	4	1	2	3	4	1	2	1	1	2	3	4
Anthurium andreanum *X. c. dieffenbachiae*	82[b]	0	10	0	0	0	0	20	0	0	27	22	37	0	*[c]
A. scherzeranum *X. c. dieffenbachiae*	nt[d]	60	57	30	nt	0	0	0	0	0	0	nt	7	0	*
Brassaia actinophylla *X. c. hederae*	0	47	0	0	93	100	0	27	0	0	0	0	0	0	*
Schefflera arboricola *X. c. hederae*	nt	0	0	0	nt	80	18	47	0	0	0	nt	0	0	*
Codiaeum variegatum *X. c. poinsettiicola*-1	nt	nt	0	0	nt	0	0	13	0	0	20	nt	nt	27	*
C. variegatum *X. c. poinsettiicola*-2	nt	nt	0	0	nt	nt	0	0	6	13	27	nt	nt	7	*
Hibiscus rosa-sinensis *X. c. malvacearum*-1	nt	nt	nt	0	nt	nt	nt	0	nt	0	40	nt	nt	nt	*
H. rosa-sinensis *X. c. malvacearum*-2	nt	nt	nt	0	nt	nt	nt	0	nt	0	13	nt	nt	nt	*
Pellionia pulchra *X. c.* 078-2080	0	0	8	13	0	0	0	33	0	0	0	53	0	0	*
Pilea cadierei *X. c.* 083-2196	0	20	0	0	0	0	0	0	0	0	0	88	0	50	*

[a] Means are given for three plants in each trial, one to four trials per plant type.
[b] Each column under a host indicates a separate trial.
[c] *Pilea* plants in this trial were contaminated and data were discarded.
[d] nt = Not tested.

stock plants and minimization of leaf wetting must be the basis of disease control programs. Use of streptomycin sulfate on these plants for disease control seems feasible, although the question of resistant strains developing remains a consideration (5). In addition, many foliage plants that are sensitive to streptomycin sulfate react only when sprayed several times, and thus the safety of the product on these plants is not certain.

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