Effects of Host Nutrition, Leaf Age, and Preinoculation Light Levels on Severity of Leaf Spot of Dwarf Schefflera Caused by *Pseudomonas cichorii*

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ABSTRACT

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The roles of preinoculation light level, nutrition, and age of tissue in susceptibility of *Schefflera arboricola* to bacterial leaf spot caused by *Pseudomonas cichorii* were tested. Lesion numbers and size were reduced significantly as fertilizer levels were increased up to 12 g/10-cm pot (about 6× recommended rate). Lesion number and size decreased as leaf age increased from the top to the bottom of the plant. These fertilizer levels did not affect plant height, color, number of leaves, or fresh weight of tops. Light intensities (125–800 μmol m^{-2} s^{-1}) for plant production before inoculation did not affect the number of lesions that formed.

Bacterial leaf blight of *Schefflera arboricola* Hayata ex Kanehira (dwarf schefflera) is a serious problem (4). Disease control with bactericides is at best slightly successful, making cultural controls important for diseases caused by *Pseudomonas cichorii* (Swingle) Stapp. The effects of nutrition on severity of bacterial diseases are known for many crop-disease combinations including bacterial leaf spot of peach (2), Xanthomonas bacterial spot of tomato (9), and *Pseudomonas* and *Xanthomonas* diseases of sesame (11). In addition, the role of nutrition in several bacterial diseases of foliage plants also has been studied (6,7). Although the effects of light on fungal (3,10) diseases have been studied occasionally, little research is reported concerning the effects of light on severity of bacterial diseases (8,11).

The research reported in this paper was performed to elucidate effects of host nutrition, tissue age, and preinoculation light levels on severity of bacterial leaf spot of dwarf schefflera caused by *P. cichorii* under shadehouse and greenhouse conditions.

MATERIALS AND METHODS

Plants were produced as rooted cuttings or seedlings depending on the test. Cuttings were rooted under intermittent mist (5 sec/30 min from 0800 to 2000 hours daily) in 12.5-cm plastic pots containing Canadian peat (50%), cypress shavings (25%), and pine bark (25%). After steam-treatment, the potting medium was amended with 4.4 kg of Osmocote 19-6-12 slow-release fertilizer (Sierra Chemical Co., Milpitas, CA), 4.2 kg of dolomite, and 0.9 lb of Micromax (micronutrient source also from Sierra) per cubic meter. Nutritional tests were performed in a glasshouse with a temperature range of 18–33 C and a maximum of 200 μmol m^{-2} s^{-1} natural light. Light levels were measured monthly in the upper plant canopy with a Gosson Paualux photometer at 1300 hours on days when clouds were not present. Light-level tests were performed either under these conditions or in a shadehouse with similar temperatures and varying light levels. Plants in nutritional tests were repotted into potting medium as described, except Osmocote was omitted. Inoculum was prepared from a culture of *P. cichorii* pathogenic to *S. arboricola* (4). Cultures were streaked onto nutrient agar plates (Difco) and grown for 2 days at 32 C. Bacterial suspensions were adjusted to 1×10^8 colony-forming units (cfu) per milliliter with sterilized, deionized water and a spectrophotometer (50% transmittance at 600 nm). Ten plants per treatment were wound-inoculated for nutritional tests with a sterilized dissecting needle by puncturing three leaflets in each of five leaves from the youngest to oldest plant leaves. The plants were sprayed to runoff with the bacterial suspension and placed in polyethylene bags for 48–72 hr, then removed and arranged in a randomized complete block design with single-pot experimental units and 10 replicates per treatment. Plants in other tests were inoculated by premisting for 24 hr (same conditions as for rooting), then spraying to runoff without wounding.

Effects of host nutritional level and tissue age on disease expression. Rooted cuttings were planted in 10-cm plastic pots with the potting medium described. Ten plants each were fertilized with Osmocote 19-6-12 as a topdressing at 2, 4, 6, 8, 10, or 12 g/10-cm pot. The recommended rate is about 2 g/10-cm pot (5). Plants were then grown in a glasshouse for 2 mo before inoculation. Plant height, number of leaves, and top weight were determined after the number and size of lesions were recorded. This test was performed consecutively four times between 28 September 1983 and 9 August 1985.

Effect of preinoculation light intensity on disease expression. The effect of preinoculation light level was tested in a greenhouse and a shadehouse with different types of shadecloth to achieve different light levels. Light levels varied from test to test because they were run at different times of the year. In test 1, the light levels included 125, 250, and 500 μmol m^{-2} s^{-1}, and the test was performed in a glasshouse from 15 January to 2 March 1984. Test 2 was performed in a shadehouse from 25 May to 13 July 1984 with light intensities of about 300, 400, 550, and 800 μmol m^{-2} s^{-1}. Test 3 was performed in a glasshouse from 1 June to 7 July 1984 with light intensities of 190, 375, and 750 μmol m^{-2} s^{-1}. Test 4 was performed in a shadehouse from 2 October to 30 November 1984 with light intensities of 150, 300, 400, and 500 μmol m^{-2} s^{-1}. In tests 1–3, initial and final plant heights and fresh weights of tops were determined. Number of lesions or percent infection was recorded on the last day of the test (1–2 wk after inoculation).

RESULTS

Effects of host nutritional level and tissue age on disease expression. Data in the four tests were analyzed in a factorial fashion to evaluate both interactive and main effects. Because interactions between fertilizer level and leaf age were not significant in any tests for either mean number of lesions or lesion size, the main effects are presented and discussed. The nutritional level of the host did not affect the height, number of leaves, or fresh weight of tops in any of the four tests. In addition, color and overall quality was unaffected by fertilizer rate. In contrast,

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number of lesions and average lesion diameter were both affected by fertilizer level. Increases in fertilizer level resulted in linear decreases in the mean number of lesions per plant in three of four tests (Table 1). In test 2, a quadratic response to fertilizer increases developed with greatest numbers of lesions produced on plants fertilized at an intermediate rate. This could have been due to such factors as temperature or light level, which could alter the plant's response to fertilizer and thus influence the optimum rate of fertilizer required. At rates higher than 6 g, numbers of lesions decreased. Lesion size also responded to fertilizer level with a primarily linear decrease as fertilizer rate was increased in three of four tests (Table 2). In test 2, the response was characterized by a significant linear component, although most of the response was not linear, quadratic, or cubic.

Leaf age also affected number and size of lesions. Mean number of lesions decreased linearly as leaf age decreased in three of four tests (Table 1). In test 4, leaf age did not influence number of lesions formed, although there was a general trend for fewer lesions on youngest leaves. Similarly, lesion size decreased linearly as leaf age decreased in three of the tests (Table 2). Although the linear component was significant at $P=0.01$ for tests 1, 2, and 4, there was also a significant cubic element in the response in all three tests.

Effect of preinoculation light intensity on disease expression. Varying preinoculation light intensity from 125 to 800 μmol m^{-2} s^{-1} did not consistently affect either plant growth or expression of Pseudomonas leaf spot (Table 3). Although light intensity affected disease expression in one of four tests, results were generally not signficantly different.

Table 1. Effect of fertilizer level and leaf age on number of lesions for *Schefflera arboricola* inoculated with *Pseudomonas cichorii*

Fertilizer level (g/10-cm pot)	Mean no. of lesions per leaf (three possible)			
	Test 1	Test 2	Test 3	Test 4
2	1.4	1.4	1.4	2.2
4	0.6	1.3	1.3	2.3
6	1.0	2.0	1.1	1.5
8	0.7	1.6	1.0	1.3
10	0.4	1.1	1.1	1.6
12	0.3	1.2	0.5	1.6
Significance[y]	**%TrSS**	**%TrSS**	**%TrSS**	**%TrSS**
Linear	66.78**	8.80^{ns}	81.35**	44.13**
Quadratic	0.94^{ns}	32.54**	3.85^{ns}	25.37**
Cubic	8.67*	5.18^{ns}	8.31^{ns}	5.99^{ns}
Residual	23.61*	53.48**	6.49^{ns}	24.51**
Leaf position				
1 (oldest)	1.2	2.0	1.1	1.9
2	0.7	1.7	1.1	1.9
3	0.9	1.6	1.3	1.8
4	0.6	1.1	1.0	1.7
5 (youngest)	0.4	0.6	0.7	1.5
Significance	**%TrSS**	**%TrSS**	**%TrSS**	**%TrSS**
Linear	36.28**	94.95**	49.75**	NS[z]
Quadratic	0.19^{ns}	2.54^{ns}	42.70*	...
Cubic	9.07*	1.35^{ns}	4.33^{ns}	...
Residual	54.46**	1.16^{ns}	3.05^{ns}	...

[y] Regression analyses were performed for tests in which a significant difference between treatments was indicatd by an *F*-test. Analyses are given as the percentage of the treatment sum of squares (%TrSS) for which each term accounts, followed by the corresponding *F* value denoted as follows: ns = not significant, * = $P = 0.05$, and ** = $P = 0.01$.
[z] NS = *F*-test not significant.

Table 2. Effect of fertilizer level and leaf age on lesion size for *Schefflera arboricola* inoculated with *Pseudomonas cichorii*

Fertilizer level (g/10-cm pot)	Mean lesion size (cm)			
	Test 1	Test 2	Test 3	Test 4
2	1.8	3.5	3.4	2.7
4	0.9	2.5	2.0	3.5
6	1.3	3.6	1.8	2.0
8	1.0	3.5	1.6	1.9
10	0.6	1.5	2.6	1.5
12	0.4	2.3	1.2	1.6
Significance[y]	**%TrSS**	**%TrSS**	**%TrSS**	**%TrSS**
Linear	74.77**	26.78*	37.74*	55.96**
Quadratic	0.07^{ns}	1.34^{ns}	10.17^{ns}	...
Cubic	6.66^{ns}	0.16^{ns}	39.78*	8.79^{ns}
Residual	18.50*	71.72**	12.31^{ns}	35.25**
Leaf position				
1 (oldest)	1.4	4.4	2.2	3.1
2	0.8	2.9	1.7	1.9
3	1.1	2.6	1.8	2.1
4	1.0	2.6	2.6	2.3
5 (youngest)	0.6	1.6	2.3	1.5
Significance	**%TrSS**	**%TrSS**	**%TrSS**	**%TrSS**
Linear	63.46**	85.64**	NS[z]	51.21**
Quadratic	...	2.25^{ns}	...	4.43^{ns}
Cubic	31.58**	12.04*	...	44.29**
Residual	4.96^{ns}	0.07^{ns}	...	0.07^{ns}

[y] Regression analyses were performed for tests in which a significant difference between treatments was indicated by an *F*-test. Analyses are given as the percentage of the treatment sum of squares (%TrSS) for which each term accounts, followed by the corresponding *F* value denoted as follows: ns = not significant, * = $P = 0.05$, and ** = $P = 0.01$.
[z] NS = *F*-test not significant.

DISCUSSION

Controlling disease severity by altering host nutrition is an attractive alternative to chemical disease control on dwarf schefflera. Applying fertilizer in excess of recommended levels did not affect the quality of the host but did decrease its susceptibility to *P. cichorii*. These results were similar to those obtained with Xanthomonas leaf spot on dwarf schefflera (A. R. Chase, *unpublished*) but contrast with those obtained with Pseudomonas leaf spot on chrysanthemum (8). As fertilizer was increased, the number of lesions on chrysanthemum also increased. The cultures of *P. cichorii* tested in our study and that performed on chrysanthemum (8) were indistinguishable on the basis of host reaction (4). These tests may indicate that the host plant tested is more important in determining the reaction to bacterial leaf spot than the pathogen tested. Work conducted by Harkness and Marlatt (6) on Xanthomonas leaf spot of heart-leaf philodendron showed that bacterial leaf spot severity decreased as nitrogen level was increased. Haygood et al (7) found similar results with *Erwinia chrysanthemi* McFadden, Burkholder, & Dimock on another philodendron (*P. selloum* Koch). However, *P. sesami* Malkoff and *Xanthomanas sesami* showed differential reactions to increasing nitrogen, depending on light level (11). Obviously, each pathogen-suscept combination must be evaluated separately, and the

Table 3. Effect of light level on severity of Pseudomonas leaf spot of *Schefflera arboricola*

Light level (μmol m^{-2} s^{-1})	Arc sine of % infection	Mean no. of lesions		
	Test 2 (13 July)	Test 1 (2 March)	Test 3 (31 July)	Test 4 (30 November)
125	nt[a]	2.2	nt	nt
150	nt	nt	nt	4.9
190	nt	nt	6.4	nt
250	nt	2.4	nt	nt
300	10.8	nt	nt	8.7
375	nt	nt	13.4	nt
400	16.5	nt	nt	5.4
500	nt	2.0	nt	6.4
550	29.1	nt	nt	nt
750	nt	nt	6.0	nt
800	16.6	nt	nt	nt
Significance	**[b]	ns	ns	ns

[a] nt = Not tested.
[b] Degree of significance for the *F*-test: ** = significant at $P = 0.01$ and ns = not significant.

likelihood of accurate generalizations is slight. At least for dwarf schefflera, two bacterial diseases can be minimized by applying higher than recommended rates of fertilizer.

The lack of significance of the preinoculation light intensity was unexpected, because previous trials with *P. cichorii* on chrysanthemum showed a significant effect of light intensity on disease development (8). In contrast, light intensity also failed to affect severity of Xanthomonas leaf spot of dwarf schefflera (A. R. Chase, *unpublished*), again indicating that the results of each host-pathogen interaction cannot be predicted a priori but must be determined experimentally. Older dwarf schefflera leaves were more susceptible to bacterial leaf spot than younger leaves, whereas older chrysanthemum leaves were less susceptible to the same organism than were younger, immature leaves (8). Similar increases in disease development were noted on onion infected with Botrytis blight, with older leaves more severely affected than younger leaves (1). Clearly, few accurate generalizations can be made regarding even the same bacterial pathogen on different host plants.

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LITERATURE CITED

1. Alderman, S. C., and Lacy, M. L. 1984. Influence of leaf postion and maturity on development of *Botrytis squamosa* in onion leaves. Phytopathology 74:1461-1463.
2. Bachelder, S., Daines, R. H., and Bartley, C. E. 1956. Effect of nutrition on the incidence of bacterial spot of peach. (Abstr.) Phytopathology 46:240.
3. Benedict, W. G. 1971. Differential effect of light intensity on the infection of wheat by *Septoria tritici* Desm. under controlled environmental conditions. Physiol. Plant Pathol. 1:55-66.
4. Chase, A. R., and Brunk, D. D. 1984. Bacterial leaf blight incited by *Pseudomonas cichorii* in *Schefflera arboricola* and some related plants. Plant Dis. 68:73-74.
5. Conover, C. A., and Poole, R. T. 1984. Light and fertilization recommendations for production of acclimatized potted foliage plants. Foliage Dig. 7(8):1-6.
6. Harkness, R. W., and Marlatt, R. B. 1970. Effect of nitrogen, phosphorus and potassium on growth and Xanthomonas disease of *Philodendron oxycardium*. J. Am. Soc. Hortic. Sci. 95:37-41.
7. Haygood, R. A., Strider, D. L., and Nelson, P. V. 1982. Influence of nitrogen and potassium on growth and bacterial leaf blight on *Philodendron selloum*. Plant Dis. 66:728-730.
8. Jones, J. B., Chase, A. R., Harbaugh, B. K., and Raju, B. C. 1985. Effect of leaf wetness, fertilizer rate, leaf age, and light intensity before inoculation on bacterial leaf spot of chrysanthemum. Plant Dis. 69:782-784.
9. Nayudu, M. B., and Walker, J. C. 1960. Bacterial spot of tomato as influenced by temperature and by age and nutrition of the host. Phytopathology 50:360-364.
10. Pandey, M. C., and Wilcoxson, R. D. 1970. The effect of light and physiologic races on Leptosphaerulina leaf spot of alfalfa and selection for resistance. (Abstr.) Phytopathology 60:1456-1462.
11. Thomas, C. A. 1965. Effect of photoperiod and nitrogen on reaction of sesame to *Pseudomonas sesami* and *Xanthomonas sesami*. Plant Dis. Rep. 49:119-120.