Research Reports:

Effect of Fertilizer Level on Severity of Xanthomonas Leaf Spot of *Pilea spruceana*[1]

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Abstract

Severity of Xanthomonas leaf spot of *Pilea spruceana* was highest for plants receiving intermediate fertilizer rates (recommended to 5 times the recommended rate) and decreased at rates of 6–9 times recommended rate. Plant growth responded similarly with highest quality plants most susceptible to *Xanthomonas campestris*. Tissue nutrient content for highest quality plants was as follows: N (2.2%), P (0.37–0.38%), K (1.2–1.4%), S (1.00–1.06%), Mg (1.03–1.24%), Ca (2.07–2.30%), Fe (62–76 mg/kg), Mn (358–370 mg/kg), B (50–55 mg/kg), Cu (10 mg/kg), and Zn (348–357 mg/kg). Leachate electrical conductivity for highest quality plants was approximately 200 μmhos/cm. The results indicate that optimizing the nutrient status for highest quality foliar growth of *P. spruceana* may result in conditions which maximize severity of Xanthomonas leaf spot.

Index words: angelwing pilea, foliage plant, nutrient content, *Xanthomonas campestris*

Introduction

Pileas are foliage plants used in dish gardens and are popular because of their leaf textures, shapes, colors and compact structures. Of the diseases reported on these plants only Xanthomonas leaf spot has been a continuing and serious problem over the past 20 years (7). Chemical control of Xanthomonas leaf spot of pileas is not always successful and alternative control techniques are needed to limit losses (1). Nutritional control of Xanthomonas diseases of several foliage plants has been reported (2, 3, 4, 6). In general, increased fertilizer resulted in decreased disease severity (2, 4, 6) although Xanthomonas blight of anthurium is most severe on plants fertilized with rates optimum for plant growth (3). The work reported here was initiated to determine the effect of fertilizer rate on severity of Xanthomonas leaf spot of *Pilea spruceana* (angelwing pilea) and on plant quality.

Materials and Methods

Plant production. Cuttings of angelwing pilea were obtained from a commercial producer and rooted in a potting

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medium consisting of Canadian peat and pine bark (1:1 by vol) amended with 2.7 kg/m^3 (7.5 lb/yd^3) of dolomite and 0.5 kg/m^3 (1.5 lb/yd^3) of Micromax (micronutrient source from Sierra Chemical Co., Milpitas, CA 95035). The medium was steam-treated at 90°C (194°F) for approximately 1.5 hr prior to adding these amendments. Well-rooted cuttings were transplanted to 12.5 cm (5 in) pots containing the same potting medium and grown for approximately 4 wk prior to fertilization. Fifteen single plant replicates were included for each fertilizer level tested. Plants were top-dressed with Osmocote 19N-3P-10K (19-6-12) 3 month slow-release fertilizer from Sierra Chemical Co.) at the following rates: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5 ,12.0, and 13.5 g/12.5 cm pot. The recommended rate for pileas under these conditions is 1.5 g/12.5 cm (5 in) pot (5).

The first six rates were included in the first test with all nine rates included in subsequent tests. Fertilizer was applied once at initiation of each test. Light levels and temperatures varied between tests and are given below for each test. Plants were irrigated by hand two or three times weekly as needed. Tests were conducted in a glasshouse at the CFREC-Apopka, FL.

The first test was conducted for approximately 2 months (December 1, 1986 to February 11, 1987) with temperatures of 18–30°C (65–86°F) and relatively low light levels (200 $\mu mol \cdot m^{-2}s^{-1}$ maximum). The second test was conducted from August 21 to October 23, 1987 with temperatures of 22–32°C (72–90°F) and a maximum light level of 300 $\mu mol \cdot m^{-2}s^{-1}$. The third test was conducted from December 23, 1987 to March 28, 1988 with conditions similar to those for Test 1.

Leachate electrical conductivity (EC) was recorded monthly for five replicates per treatment using the pour-through method (9). Deionized water was added to the surface of the potting medium until 100 ml of the resulting leachate was collected in a beaker beneath the pot. Leachate EC was evaluated using a Hach Conductivity Meter #2511 (Hach Chemical Company, Ames, IA 50010).

The following growth characteristics were recorded: number of shoots, fresh weight of tops and plant quality. Plant quality was determined visually on the following scale: 1 = dead; 2 = poor, unsalable; 3 = marginal, salable; 4 = good, salable; and 5 = excellent, salable. Elemental tissue content of mature leaves for five replicates per treatment was determined for each test. Mature leaf tissue was harvested, dried at 60°C (140°F), and ground. Tissue analyses were performed by A & L Southern Agricultural Laboratories in Pompano Beach, FL 33064 (8). Plants were inoculated with the bacterial suspension as described following all data collection except fresh weight of tops.

Inoculum preparation and inoculation. A strain of *Xanthomonas campestris* shown to be pathogenic on *Pilea* spp. (7) was grown on Difco nutrient agar at 28°C (82°F) for 2 days. Bacteria were removed from plates by flooding with sterilized 0.01 M $MgSO_4$ and gently rubbing with a sterilized cotton swab. Suspensions were collected and adjusted to approximately 1×10^8 colony forming units/ml using a spectrophotometric method. Inocula were applied to plants within 30 min of preparation. Plants were treated under intermittent mist (5 sec/30 min from 0800 to 2000 hr daily) for 24 hr prior to inoculation and maintained under mist until final disease ratings. Plants were inoculated by spraying the bacterial suspension onto leaf surfaces with a pump action hand sprayer and immediately covered with polyethylene bags for 48 hr. Numbers of lesions per plant were recorded approximately 2 to 3 wk after inoculation.

Results and Discussion

Plant growth responses were similar for the three tests and only data from Test 2 are presented. Best plant growth, as determined by fresh weight of tops and number of shoots, occurred for plants fertilized with 3 g Osmocote/pot (Table 1). The highest quality plants were also produced at this fertilizer rate. Increasing the fertilizer level above the 4.5 g rate significantly reduced all growth parameters. Although plants fertilized at rates above 4.5 g were stunted, no obvious foliar necrosis was noted.

Leachate EC ranged from less than 100 to slightly more than 5000 µmhos/cm with approximately 200 µmhos/cm corresponding to highest quality plants (Table 1). Tissue analysis indicated that nitrogen (N), phosphorous (P), potassium (K), and copper (Cu) increased as fertilizer level increased while magnesium (Mg) decreased as fertilizer level increased (Table 2). Elemental tissue levels for highest quality plants were as follows: N (2.2%), P (0.37–0.38%), K (1.2–1.4%), S (1.00–1.06%), Mg (1.03–1.24%), Ca (2.07–2.30%), Fe (62–76 mg/kg), Mn (358–370 mg/kg), B (50–55 mg/kg), Cu (10 mg/kg), and Zn (348–357 mg/kg).

Disease severity was significantly and similarly affected by fertilizer rate in each of the three tests (Figure 1). The highest numbers of lesions occurred on plants fertilized with rates between 1.5 and 7.5 g, with plants fertilized at the 4.5 g rate were most susceptible to the pathogen. Only obviously overfertilized plants showed a reduction in number of lesions.

Fertilizer level significantly affected number of lesions on pilea caused by *Xanthomonas campestris*. Unfortunately, the reaction was significant only at fertilizer levels which also reduced quality of the host. Although the pattern of disease response to nutritional status differed from that of schefflera, dwarf schefflera, heart-leaf philodendron and syngonium, it is the same as that of anthurium. For both anthurium and pilea, disease severity paralleled plant quality. Thus, damage from Xanthomonas leaf spot cannot be

Table 1. Effect of fertilizer rate on growth of *Pilea spruceana*. (Data were taken October 14, 1987 for Test 2).

Osmocote per 12.5 cm pot (g)	Leachate electrical conductivity (µmhos/cm)	Number shoots	Fresh weight of tops (g)	Plant quality[z]
1.5	82**[y]	18.6**	33.8**	3.7**
3.0	178	21.9	39.6	4.4
4.5	928	17.8	33.1	4.2
6.0	1850	16.1	32.4	3.3
7.5	2870	13.2	25.7	3.2
9.0	3110	12.2	19.1	3.2
10.5	4600	11.7	19.8	2.5
12.0	4910	9.5	19.9	2.8
13.5	5100	7.9	17.3	2.7

[z]Plant quality was rated on the following scale: 1 = dead; 2 = poor, unsalable; 3 = marginal, salable; 4 = good, salable; and 5 = excellent, salable.

[y]F values for analysis of variance are denoted as significant at the 1% level (P = 0.01).

Table 2. Nutrient content for leaf tissue from *Pilea spruceana* fertilized with different levels of fertilizer. (Data are for Test 2).

Osmocote per 12.5 cm pot (g)	% dry weight						mg/kg				
	N	P	K	S	Mg	Ca	Fe	Mn	B	Cu	Zn
1.5	2.0**[z]	0.31**	1.7*	1.01ns	1.29*	2.40**	99ns	313ns	51ns	12**	362ns
3.0	2.2	0.37	1.4	1.06	1.24	2.07	76	358	50	10	357
4.5	2.2	0.38	1.2	1.00	1.03	2.30	62	370	55	10	348
6.0	2.4	0.39	1.3	1.27	1.04	2.30	65	525	63	11	363
7.5	2.9	0.48	1.5	1.34	1.07	3.13	67	440	67	12	340
9.0	2.8	0.49	1.5	1.37	0.97	2.37	73	563	60	17	287
10.5	2.6	0.39	1.5	1.34	0.92	2.10	71	391	68	15	288
12.0	2.8	0.46	1.7	1.36	0.88	2.25	70	425	63	16	223
13.5	3.0	0.45	1.7	1.47	0.86	2.07	75	432	83	17	245

[z]F values for analysis of variance were denoted as not significant (ns), or significant at P = 0.05 (*) or P = 0.01 (**).

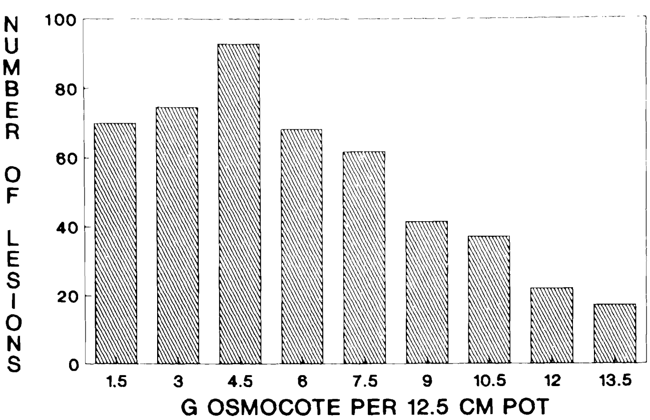

Fig. 1. Effect of fertilizer rate on severity of Xanthomonas leaf spot of *Pilea spruceana* caused by *X. campestris*. (F value for AOV was significant at P = 0.01).

minimized by manipulating fertilizer level without a concomitant loss in plant quality.

Significance to the Nursery Industry

Production of optimal quality angelwing pilea can be achieved with 3.0–4.5 g (5.5 g = 0.01 lb) Osmocote 19N:3P:10K (19-6-12) per 12.5 cm (5 in pot) pot every 3 months with leachate EC of 200 μmhos/cm signaling optimal fertilization rates. Foliar nitrogen content should be approximately 2.2% (dry weight). Growers should depend upon methods other than nutrition to reduce levels of *Xanthomonas campestris* in pilea plantings. Exclusion and preventive applications of bactericides should be used to minimize disease since optimal quality plants are most susceptible to the pathogen.

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