Development of Myrothecium Leaf Spot of *Dieffenbachia maculata* 'Perfection' at Various Temperatures

A. R. CHASE, Associate Professor of Plant Pathology, and R. T. POOLE, Professor of Ornamental Horticulture, IFAS, University of Florida, Agricultural Research Center, Apopka 32703

ABSTRACT

Chase, A. R., and Poole, R. T. 1984. Development of Myrothecium leaf spot of *Dieffenbachia maculata* 'Perfection' at various temperatures. Plant Disease 68:488-490.

The influence of temperature on development of Myrothecium leaf spot was tested on the foliage plant *Dieffenbachia maculata* 'Perfection' in the greenhouse and in growth chambers with temperatures between 16–33 C and 18–32 C, respectively. Temperatures along a greenhouse bench varied as much as four degrees from the pad end to the fan end. The number of leaf spots was highest near the pads, where temperatures were the lowest. Depending on the time of year, incidence of leaf spot varied as much as 200%. In growth chambers, the optimum temperature range for disease development was 21–27 C, with temperatures of 30 C or higher inhibitory to lesion formation. Plants grown at 32 C for 4 hr/day and at 24 C for 20 hr/day failed to develop lesions in most trials. In vitro optimum growth of the pathogen occurred at 28 C, with good growth also at 32 C.

Additional key words: *Myrothecium roridum*

Myrothecium roridum Tode ex Fr. causes serious leaf spot diseases of numerous foliage plants (1) and ornamental (4,6,8) and agronomic (3,5,7) crops. Myrothecium leaf spot occurs on foliage plants throughout most of the year but peaks in severity during the cooler late fall and winter months in Florida. Some early observations of this disease indicated that temperature was an important factor in disease severity on two foliage plants (1). The role of temperature in severity of Myrothecium leaf spot on other plants has been reported several times with determinations of optimal temperatures for in vitro growth of the pathogen and development of disease on the host. In vitro *M. roridum* isolates from red clover grew best at 27 C (3), gloxinia isolates at 27–32 C (6), and cotton (7) and gardenia (4) isolates at 25–30 C. Disease was most severe on soybean in India near 30 C (5) and disease severity on red clover was highest at 28–30 C (3). This paper reports tests on the role of temperature in development of Myrothecium leaf spot of *Dieffenbachia maculata* (G. Don) Lodd. 'Perfection.'

Florida Agricultural Experiment Stations Journal Series No. 4987.

Accepted for publication 9 December 1983.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

MATERIALS AND METHODS

An isolate of *M. roridum* from *Aglaonema commutatum* Schott 'Silver Queen' was the source of inoculum for these trials (1). Inoculum was grown on potato-dextrose agar (PDA) (infusion from 250 g boiled potatoes, 15 g dextrose, and 15 g agar per liter) at 24–26 C for 7–10 days under about 25 μE m^{-2} s^{-1} fluorescent light for 12 hr/day before use. Conidia were removed from culture plates with a sterilized rubber spatula and sterilized deionized water (SDW) and adjusted to 1×10^6 conidia per milliliter with SDW.

Dieffenbachia plants were produced from cuttings of pathogen-free stock plants (2) rooted in steam-sterilized potting medium consisting of Canadian peat, cypress shavings, and pine bark (2:1:1, v/v). The medium was amended with 4.4 kg Osmocote (19-6-12 slow-release fertilizer, Sierra Chemical Co., Milpitas, CA 95035), 4.2 kg dolomite, and 0.9 kg Micromax (micronutrient source, Sierra Chemical Co.) per cubic meter. Plants were grown in 10 or 12.5-cm plastic pots in a greenhouse at 18–33 C and received a maximum of 200 μE m^{-2} s^{-1} natural light.

Greenhouse trials. Effect of bench position with respect to a fan and pad cooling system was evaluated using the entire length of a greenhouse, with 13-m benches running lengthwise from the fans to the pads. Plants were placed 2 m apart on both sides of three benches for a total of six plants at each of seven locations along the benches. Temperatures at the abaxial leaf surface taken in the middle of one plant at each position along each bench were recorded hourly using a remote sensing temperature recorder (PD 2064 Data Logger, Esterline Angus Instruments Corp., Indianapolis, IN 46224) throughout the trial. Relative humidities were recorded in one trial with a Bendix hygrothermograph set at five positions equidistant along the central bench. Plants were inoculated the first day of the trial by wounding three leaves per plant three times each with a sterilized dissecting needle and spraying to runoff with the conidial suspension. Each plant

was placed individually in a polyethylene bag for 48 hr to maintain a high relative humidity, regardless of treatment. The number of lesions per plant was recorded 8 days after inoculation. This test was performed twice (1–10 July and 29 October–4 November 1982) using the temperature recorder and once (18–26 April 1983) without temperature recordings.

Growth chamber trials. The effect of temperature on Myrothecium leaf spot disease was tested in growth chambers (Plant Growth Chamber E 30B from Percival Manufacturing Co., Boone, IA 50036), using varying temperature regimes with one growth chamber for each treatment and either five or six plants per treatment. Relative humidities were 67 ± 10% with light (fluorescent and incandescent) levels of 75 μE m^{-2} s^{-1} (12 hr/day). Plants were placed in growth chambers 1 day before inoculation using the method described before, except 12 wounds were made per plant. The first test involved the following treatments: constant temperatures of 18, 21, 24, 27, 30, or 33 C. The second test employed varying day (8 hr) and night (16 hr) temperatures: 19 C constant, 24 C (day) and 19 C (night), 24 C constant, 32 C (day) and 18 C (night), 32 C (day) and 24 C (night), and 32 C constant. The final test was performed with night temperatures of 24 C and day temperatures of 24 or 32 C, with the length of 32 C exposure each day varying 0, 2, 4, 6, 8, or 10 hr. Time of high temperatures was designed to be concurrent with light conditions. All tests were inoculated between 10:00 a.m. and 2:00 p.m. during day temperatures and in lighted chambers. The number of lesions (12 possible) per plant was recorded 1 wk after inoculation. Each of these three tests was performed three separate times.

In vitro growth of the pathogen. The influence of temperature on the growth (colony diameter) of 10 isolates of *M. roridum* from different foliage plants grown in Florida was evaluated using the growth chambers (1). The isolates were grown for 1 wk on PDA medium before inoculation of PDA plates with a 7-mm diameter disk cut from the advancing edge of a colony. Growth of each colony was recorded after 7 days. This test was performed once using five replicated plates of each of the 10 isolates and once using the isolate employed as the pathogen in the other trials on 10 replicated plates.

RESULTS

Greenhouse trials. In two of three tests, the number of lesions forming on plants inoculated with *M. roridum* was greatest near the pads, where the temperature was usually two to four degrees cooler than at the end of the bench near the fans. In two of three tests, the number of lesions increased linearly as the temperature decreased and the plants were closer to the pads (Table 1). The first test was conducted during the summer, when temperatures were higher than 28 C except at the position closest to the pads. Humidity ranged from 85% near the pads to 90% near the fans and was 95–100% in all bagged plants in this test. The number of lesions per plant as affected by temperature was not significant during this trial and the overall number of lesions occurring was much reduced compared to the other two tests performed during cooler times of the year.

Growth chamber trials. The optimum constant temperature for lesion development was 24 C, with overall maximum development occurring between 21 and 27 C in most tests (Table 2). Few lesions developed on plants inoculated at either 30 or 33 C. In the second test series, no lesions formed in any treatment, including day temperatures of 32 C, regardless of the night temperature (Table 3). Again, the highest lesion numbers were obtained on plants grown continuously at 24 C. The final set of tests was performed to determine the amount of time at 32 C that affected lesion formation. A 2-hr exposure at 32 C decreased lesion number; 4 hr at 32 C resulted in inhibition in two of three tests (Table 4). The response was primarily linear.

In vitro growth of the pathogen. Both temperature and isolate were significant factors in determining the growth of *M. roridum* on artificial medium. Each isolate had a slightly different growth rate. The optimum temperature for growth of all isolates occurred between 24 and 32 C (Fig. 1). Sporulation occurred at temperatures at and above 20 C for three isolates and at and above 24 C for the remaining seven isolates.

Table 1. Effect of bench position on temperature and development of Myrothecium leaf spot of *Dieffenbachia maculata* 'Perfection' in a greenhouse

Bench position	Test 1		Test 2		Test 3
	Lesions/plant[a]	Temp. (C)[b]	Lesions/plant	Temp. (C)	Lesions/plant
Pads					
1	2.7	28	6.5	27	6.3
2	0.5	29	7.7	27	6.2
3	1.5	30	5.2	27	3.5
4	0.7	32	4.8	27	4.3
5	0.7	31	5.2	29	3.0
6	0.8	31	5.5	28	2.3
Fans					
7	0.8	32	4.0	29	1.2
Significance[c]	**%TrSS**		**%TrSS**		**%TrSS**
Linear	F = ns		61.2*		90.5*
Quadratic	···		0.7 ns		1.4 ns
Cubic	···		0.1 ns		0.5 ns
Residual	···		38.0 ns		7.6 ns

[a] Nine lesions were possible per plant at wound sites.
[b] Temperatures given are the mean of 3 days' recordings at 1200 hours during the infection period.
[c] Regression analyses were performed for tests in which a significant difference between treatments was indicated by the 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: * = 0.01 and ns = not significant.

Table 2. Effect of temperature on number of lesions of Myrothecium leaf spot of *Dieffenbachia maculata* 'Perfection' in a growth chamber

Temperature (C)	Mean no. lesions/plant[a]		
	Test 1	Test 2	Test 3
18	5.2	6.0	0.4
21	7.8	4.8	1.2
24	6.6	7.4	6.4
27	4.6	3.4	5.8
30	3.8	1.4	0.0
33	0.4	1.8	0.0
Significance[b]	**%TrSS**	**%TrSS**	**%TrSS**
Linear	62.3*	63.1*	1.2 ns
Quadratic	29.3**	4.6 ns	61.7*
Cubic	2.4 ns	7.0 ns	1.0 ns
Residual	6.0 ns	25.3**	36.1*

[a] Twelve lesions were possible per plant at wound sites.
[b] Regression analyses were performed for tests in which a significant difference between treatments was indicated by the 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: * = 0.01, ** = 0.05, and ns = not significant.

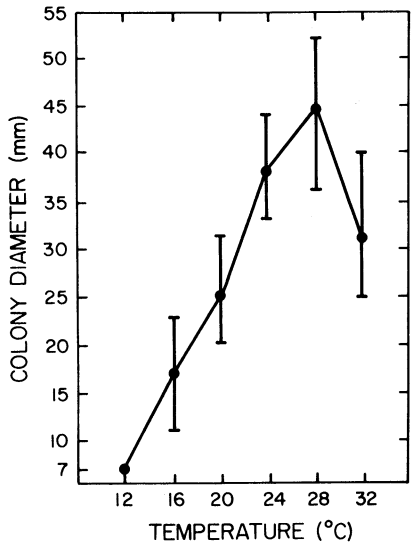

Fig. 1. Growth response for *Myrothecium roridum* on potato-dextrose medium at various temperatures. Means for 10 isolates (five plates each) are given with the range. No growth occurred for any isolate at 12 C (7 mm diameter = original disk size).

Table 3. Influence of varying day and night temperatures on development of Myrothecium leaf spot of *Dieffenbachia maculata* 'Perfection' in growth chambers

Day temperature (8 hr, C)	Night temperature (16 hr, C)	Mean no. lesions/plant[y]		
		Test 1	Test 2	Test 3
18	18	5.4 b[z]	0.6 a	1.0 ab
24	18	8.0 c	1.6 a	1.8 b
24	24	10.4 d	6.0 b	6.6 c
32	18	0.0 a	0.0 a	0.0 a
32	24	0.0 a	0.0 a	0.0 a
32	32	0.0 a	0.0 a	0.0 a

[y] Twelve lesions were possible per plant at wound sites.
[z] Means were separated in each column using Duncan's new multiple range test ($P = 0.05$).

Table 4. Effect of varying exposures to 32 C on development of Myrothecium leaf spot of *Dieffenbachia maculata* 'Perfection'

Temperature (C)		Hours at 32 C	No. lesions/plant[a]		
Night	Day		Test 1	Test 2	Test 3
24	24	0	2.5	7.2	3.3
24	32	2	2.2	5.8	0.0
24	32	4	0.0	2.0	0.0
24	32	6	0.5	3.6	0.3
24	32	8	0.0	0.4	0.0
24	32	10	0.0	0.0	0.0
Significance[b]			%TrSS	%TrSS	%TrSS
Linear			75.9*	86.2*	37.2*
Quadratic			16.6**	1.5 ns	32.5*
Cubic			2.4 ns	0.1 ns	24.9*
Residual			5.1 ns	12.2 ns	5.4 ns

[a] Twelve lesions were possible per plant at wound sites.
[b] Regression analyses were performed for tests in which a significant difference between treatment was indicated by the 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: * = 0.01, ** = 0.05, and ns = not significant.

DISCUSSION

Myrothecium leaf spot of dieffenbachias is influenced by temperature. Although humidity is clearly involved in the infection process in many diseases, the experimental methods employed maintained an RH of 95–100% during the infection period (48 hr). Temperature changes as little as two degrees that occur from one end of a greenhouse to the other are sufficient to alter development of disease; the highest number of lesions forms on plants closest to the pads (relatively cooler than the fan end of the bench). Growth chamber trials indicated that the most favorable temperature range for lesion development is between 21 and 27 C. Temperatures of 32 C result in a severe reduction of lesions if plants are exposed to this temperature for 4 hr or more per day. In contrast, the fungus grows well and sporulates at 32 C on an artificial medium.

Disease development on dieffenbachias reaches a maximum at somewhat lower temperatures (21–27 C) compared with 28–30 C as reported previously (3,5). Myrothecium leaf spot of this foliage plant is greatly reduced at temperatures near 30 C, although this is within the range of optimum temperatures reported in the literature. The in vitro response of the pathogen was the same as that reported in the literature, and therefore, the possibility that isolates of this pathogen from Florida have a different temperature growth optimum seems unlikely.

Control of Myrothecium leaf spot of foliage plants through chemical means should be stressed during the fall and spring months, when temperatures are optimal for disease development. Temperatures in Florida greenhouses frequently reach and exceed 32 C during the summer months. Dieffenbachias grow well up to 38 C with adequate irrigation (9). Temperature controls set at 38 C could greatly reduce the need for chemical applications during the summer months.

ACKNOWLEDGMENTS

Appreciation is extended to M. Salt, W. McLees, and R. Caldwell for technical assistance during these tests.

LITERATURE CITED

1. Chase, A. R. 1983. Influence of host plant and isolate source on severity of Myrothecium leaf spot of foliage plants. Plant Dis. 67:668-671.
2. Chase, A. R., Zettler, F. W., and Knauss, J. F. 1981. Perfection 137B, a pathogen-free selection of *Dieffenbachia maculata* derived through tissue culture. Fla. Agric. Exp. Stn. Circ. S-280. 7 pp.
3. Cunfer, B. M., Graham, H. H., and Lukezic, F. L. 1969. Studies on the biology of *Myrothecium roridum* and *M. verrucaria* pathogenic on red clover. Phytopathology 59:1306-1309.
4. Fergus, C. L. 1957. *Myrothecium roridum* on gardenia. Mycologia 49:124-127.
5. Lakshminarayana, C. S., and Joshi, L. K. 1978. Myrothecium disease of soybean in India. Plant Dis. Rep. 62:231-234.
6. Littrell, R. H. 1965. A myrothecium rot of gloxinias. Plant Dis. Rep. 49:78-80.
7. Munjal, R. L. 1960. A commonly occurring leaf spot disease caused by *Myrothecium roridum* Tode ex Fr. Indian Phytopathol. 13:150-155.
8. Ploetz, R. C., and Engelhard, A. W. 1980. Chemical control of myrothecium disease of gloxinia. Proc. Fla. State Hortic. Soc. 93:181-183.
9. Poole, R. T., and Conover, C. A. 1981. Influence of maximum air temperatures and irrigation frequencies during high temperature periods on growth of four foliage plants. HortScience 16:556-557.