Relationship of Temperature and Humidity to Development of Mycosphaerella Lesions on Chrysanthemum

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ABSTRACT

The development of stem lesions on florists' chrysanthemum inoculated with *Mycosphaerella ligulicola* was observed from 10 to 30 C at two relative humidities. In cultivar Fred Shoesmith, lesions are indeterminate and enlarge when conditions are favorable. The lesion-development: temperature curve closely parallels that for linear extension of the fungus on potato-dextrose agar (minimum > 3 C, optimum 26 C, maximum 30 C) except for a slightly narrower temperature range. The rate of lesion growth is greatest at humidities near saturation; relative humidities of 50% result in approximately half the values obtained at saturation.

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Additional key words: Ascochyta chrysanthemi, Chrysanthemum morifolium.

In constructing a computer simulator of the blight of *Chrysanthemum morifolium* (Ramat.) Hemsl. caused by *Mycosphaerella ligulicola* Baker, Dimock, & Davis, it was necessary to delineate the environmental relationships of each step of the disease cycle. Studies on the rate of growth of disease lesions are detailed in this report.

MATERIALS AND METHODS, RESULTS.–Two tests measuring growth of lesions caused by *M. ligulicola* on stems of susceptible cultivar Fred Shoesmith were performed. The rates of lesion growth obtained are compared to the rate of mycelial extension on potato-dextrose agar (PDA). Stems in both tests were inoculated by insertion of toothpicks on which the fungus had been grown for a period of 2 weeks, then allowed to air dry (4). The toothpicks were boiled in water to remove resins, then soaked in 0.1 strength Czapek-Dox broth prior to seeding with *M. ligulicola*. We performed inoculation by forcing a toothpick into a node, breaking off flush with the stem, and wrapping with a narrow strip of parafilm to prevent drying.

TABLE 1. Mean size and standard deviations of *Mycosphaerella ligulicola* lesions 6 days after inoculation of chrysanthemum stem sections held in vitro. Size measured from point of inoculation to furthest extension of lesion

	Temperature (C)								
	3	6	12	18	21	24	27	30	33
Lesion radius (mm)	0[a]	1.8	4.0	12	22	27	27	0[a]	0[b]
Standard deviation	0	± 1.0	± 1.0	± 7.4	± 9.6	± 8.9	± 4.0	0	0

[a]Tissue green, still living.
[b]Tissue dead; not *M. ligulicola* lesion.

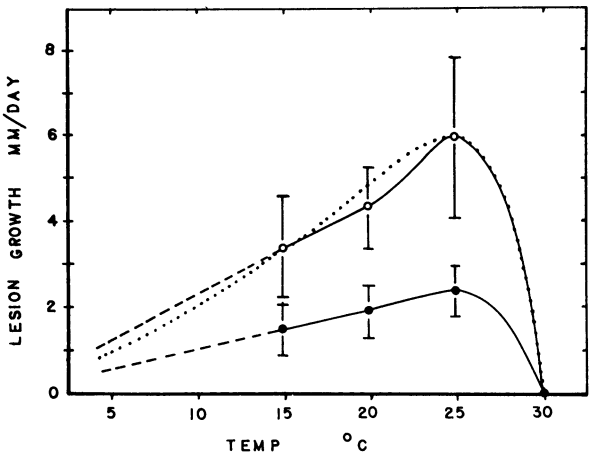

Fig. 1. Mean rates of development of *Mycosphaerella ligulicola* lesions on stems of chrysanthemum cultivar Fred Shoesmith at 95% (open circles) and 50% (solid circles) relative humidity on intact plants. Standard deviations of experimental points are indicated. Dotted line represents rate of linear extension of *M. ligulicola* on potato-dextrose agar in darkness as a function of temperature. Greatest standard deviation was ± 0.5 mm/day at 27 C.

Lesion growth in vitro.—In the first test, inoculated living stem sections ca. 7 cm long by 0.7 cm in diam were held in vitro in darkness at 3 to 33 C. The stems were placed vertically with their bases set in 1 cm of sterile moist vermiculite in sealed 10 cm diam jars. Four stem sections were placed in each jar, three jars being placed at each temperature. Measurements of lesion size were made every 2 days for a 6-day period. After 6 days, measurable lesion growth did not occur at 3, 30, or 33 C (Table 1).

Lesion growth on intact plants.—Lesion development on intact plants in lighted growth chambers at temperatures ranging from 15 to 30 C was studied at two relative humidity (RH) levels. The growth chamber at each temperature was maintained at 50% ± 3% RH. Half the plants in each chamber were covered with polyethylene bags, thereby giving them an RH of about 95% as measured by a Hygrodynamics narrow range electric hygrometer. The remaining uncovered plants were subject to the ambient chamber humidity of 50%. Fourteen inoculated stems were held at each temperature. Lesion size was recorded at 2 and 12 days after inoculation, and the growth rate in mm/day calculated. As in the first test, no measurable lesion growth occurred at 30 C, and 26 C was optimum (Fig. 1). The rate of lesion growth at 95% RH was approximately double that at 50% RH.

DISCUSSION.—Relative humidity is seen to exert a strong influence on the rate of lesion growth. The study of lesion growth on detached stems held in vitro in sealed jars is considered to have occurred at 100% RH. The values obtained compare favorably with those at 95% RH in the second test. At 50% RH, the values for lesion growth are approximately half as great as the values at saturation, thus pointing up the need for knowledge of RH conditions in evaluating studies of pathogenesis. The effect of continuous low RH as might be found in an arid climate could directly reduce the rate of development of Mycosphaerella blight in a host population, as determined by computer simulation studies (R. E. McCoy, *unpublished data*).

The curves describing the rates of growth of *M. ligulicola* stem lesions, of mycelium extension on PDA, and of pycnidium development (2) are similar. All have optimum temperatures of ca. 26 C, although the temperature range for detectable lesion growth is slightly narrower than that for mycelium extension on PDA. Unlike certain fungi whose optimum temperature for vegetative growth on artificial substrates differs significantly from that for lesion growth [e.g., *Alternaria solani* (1)], *M. ligulicola* has a single temperature curve for several phases of development. Note that an extremely susceptible cultivar was employed in this study to serve as a model demonstrating a high relative infection rate as defined by van der Plank (3). The rates of lesion growth on less susceptible cultivars, such as Iceberg or Delaware, are much lower, and the lesions may not be indeterminate. Both physical and biological factors influence lesion growth and together play an important role in determining the outcome of a Mycosphaerella blight epidemic.

LITERATURE CITED

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