

# Effect of temperature on the daylily rust pathogen, *Puccinia hemerocallidis*

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## INTRODUCTION

Daylilies (*Hemerocallis* spp.) are one of the most popular ornamental plant species in the United States. Daylily rust caused by *Puccinia hemerocallidis* Thim. was recently introduced into the United States in 2000 (Williams-Woodward et al., 2001, *Plant Dis.* 85:1121) and has become an increasing problem for growers. First found in Georgia, daylily rust has spread rapidly throughout the United States and has been reported as far north as Minnesota and west as Oregon and California. Bright yellow-orange to rust-brown pustules containing urediniospores are produced on the upper and lower leaf surfaces within 7 to 14 days after infecting plants.

At present little is known about the biology of *P. hemerocallidis*. The objectives of this study were to provide information on: i) the effect of light and temperature on spore germination, and ii) the optimal temperature for infection and disease development.

## MATERIALS AND METHODS

### UREDINIOSPORE GERMINATION

Urediniospores were collected from 10- to 12-day-old pustules and suspended in Tween 20 (0.05%). Fifty  $\mu$ l of the spore suspension ( $1-2 \times 10^5$  spores  $\text{ml}^{-1}$ ) were placed on potato dextrose agar.

**Light study** – Four dishes (replications) were placed under varying levels of photo-synthetically active radiation (PAR) [0, 21, 43, 64, 86, and  $112 \mu\text{mol s}^{-1}\text{m}^{-2}$ ].

**Temperature study** – Each dish was wrapped with aluminum foil and four replications were incubated at 4, 7, 10, 16, 18, 22, 26, 28, 30, 32, 34, or  $36^\circ\text{C}$ .

**Incubation study** – Each dish was wrapped with aluminum foil and incubated at 4 or  $36^\circ\text{C}$  for different lengths of time then transferred to  $22^\circ\text{C}$  for eight hours.

### INFECTION AND DISEASE DEVELOPMENT

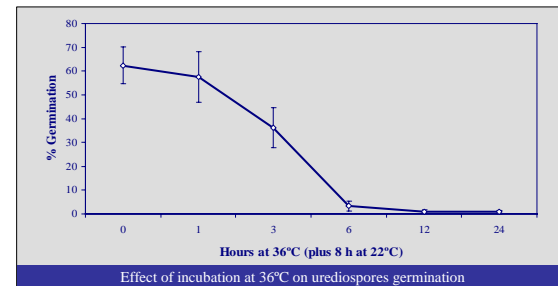
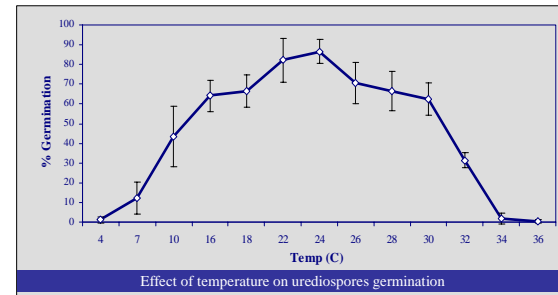
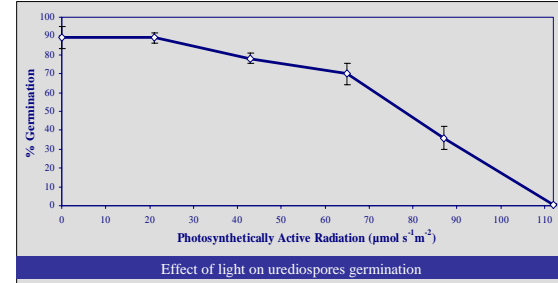
**Infection** – Pardon Me daylilies were watered to saturation, sprayed with a urediniospore solution adjusted to  $2 \times 10^5$  spores  $\text{ml}^{-1}$ , sealed in clear plastic bags to maintain high relative humidity, and stored at either 4, 10, 22, 30, or  $36^\circ\text{C}$  with no light. After 24 hours, bags were removed and plants were transferred to a research greenhouse with an average daily temperature of  $23^\circ\text{C}$ .

**Disease development** – Pardon Me daylilies were watered to saturation, sprayed with a urediniospore solution adjusted to  $2 \times 10^5$  spores  $\text{ml}^{-1}$ , sealed in clear plastic bags, and stored at  $22^\circ\text{C}$  with no light. After 24 hours, bags were removed and plants were transferred to growth chambers set at 10, 22, 30, and  $36^\circ\text{C}$ .

Fifteen and 21 days after inoculation, rust lesions were enumerated on 6 leaves on each plant. The number of lesions  $\text{cm}^{-1}$  of leaf was calculated. The experiments were repeated.



Daylily rust lesions on leaves and scape

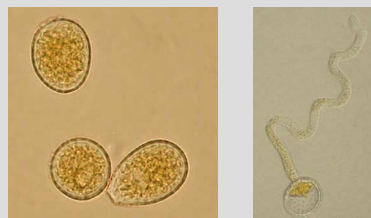


## SUMMARY

**LIGHT** – Photosynthetically active radiation (PAR) at  $21 \mu\text{mol s}^{-1}\text{m}^{-2}$  did not affect rust urediniospore germination, however, almost no urediniospores germinated at  $112 \mu\text{mol s}^{-1}\text{m}^{-2}$ . Regression analysis showed a significant linear relationship between PAR and urediniospores germination ( $P < 0.0001$ ). The  $R^2$  value was 0.88 and the model was  $Y = 96 - 0.6x$ .

**TEMPERATURE** – Urediniospore germination was observed from 7 to  $34^\circ\text{C}$  and peaked at  $24^\circ\text{C}$ . From 16 to  $30^\circ\text{C}$ , over 60% of the urediniospores germinated. Incubation at  $36^\circ\text{C}$  for 6 h followed by 8 h at  $22^\circ\text{C}$  lowered germination 95%, while over half of the urediniospores germinated after one week of incubation at  $4^\circ\text{C}$ . At 4, 10, 30, and  $36^\circ\text{C}$ , there was an 89-99% reduction in infection, compared to  $22^\circ\text{C}$ . Once infection occurred, there was no difference in lesion development between 22 and  $30^\circ\text{C}$ , but lesion development was reduced at 10 and  $36^\circ\text{C}$ .

These data suggest that daylily infection probably will not occur during bright, hot weather conditions associated with the summer days in the SE United States. More work is needed looking at the interactions between these variables to better understand the disease.



*Puccinia hemerocallidis* urediniospores

Temp ( $^\circ\text{C}$ )	Disease development	
	Infection	Disease development
	---- # Pustules / cm leaf ----	
4	0.1	--
10	1.5	0.1
22	13.0	5.3
30	0.2	3.8
36	0.2	0.0
LSD (0.05)	1.8	1.9

Effect of temperature on infection and disease development