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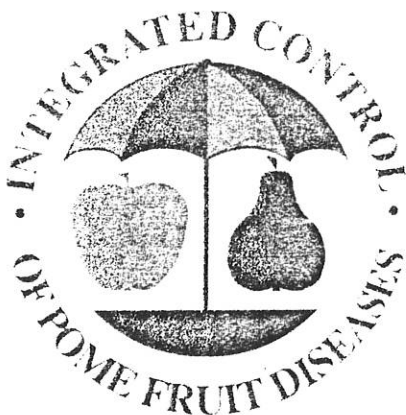
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Conidial infection of apple plants by *Venturia inaequalis* in controlled environmental conditions

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Abstract

The influence of environmental conditions during the conidial infection process on subsequent disease severity was evaluated. All the experiments were conducted in controlled environmental conditions. Three different disease severity curves were obtained, representing the relationships between constant temperature, duration of leaf wetness and infection. The C₃ curve, which corresponds to a high severity in optimal conditions, is proposed as a low risk curve in orchard conditions. The results obtained with different patterns of temperature variation during the wetting period, at a mean temperature of 18°C, showed that the mean temperature can be used to evaluate the expected disease severity.

Introduction

MacHardy and Gadoury (1989) proposed a revision of Mill's criteria for the prediction of apple scab infection periods. They suggested the use of two different infection curves, one for the ascospores and the other for the conidia, on the basis of the longer wetness duration required for the infection by the conidia. The infection curve obtained by Schwabe (1980) in South Africa was proposed to predict the conidial infection.

The objective of this study was to evaluate the influence of controlled environmental conditions during the conidial infection process on subsequent disease severity. The scope was to determine accurate infection curves for our experimental conditions, and to predict the expected disease severity. A study of discontinuous wetting and fluctuating temperature regimes, and inoculum dose will then be possible under similar experimental conditions.

We report here the results obtained at constant temperature with different length of leaf wetness durations, and one example of the effect of fluctuating temperatures during the wetting period.

Materials and methods

All the experiments were conducted in a computer driven growth chamber where temperature, relative humidity, illumination and fog can all be controlled. Apple plants of two months old from the cross Golden Delicious x Idared were inoculated with conidial suspension (2.5×10^5 conidia/ml). In the temperature range 4 - 25 °C,

various leaf wetness durations were applied. At 18°C, the influence of different patterns of temperature variation were tested. Disease severity (number of scab lesions per plant) was assessed about 14 days after the inoculation. The disease severity obtained with each different temperature pattern was compared by the Mann-Whitney test ($P=0.05$).

Results

Three different disease severity curves (C_1 , C_2 , C_3) were obtained, representing the relationships between temperature and leaf wetness (Fig. 1). Fig. 2 illustrates the different patterns of temperature variation tested, for the mean temperature of 18°C. There were no significant differences in the disease severity obtained with the different regimes.

Discussion

The C_3 curve (severity ≥ 50 scab lesions per plant) is similar to the low risk curve obtained by Schwabe (1980), under different experimental conditions. We used optimal conditions for scab development, with a high inoculum level and under controlled experimental conditions. This may explain the similarity between the C_3 curve, which leads to a high disease severity, and the Schwabe low risk curve. Compared to our experimental conditions, orchard climatic conditions are not always so favourable for scab development, and the level of orchard inoculum is probably lower. For these reasons, and because our data correlate well with those of Schwabe, we propose the C_3 curve as a low risk curve in orchard conditions. However, the orchard validation of this infection curve remains to be done.

The C_1 curve (severity ≤ 5 scab lesions per plant) indicates the minimum leaf wetness duration needed to obtain a low scab severity in our experimental conditions; this curve has little value for orchard application.

The results obtained with different patterns of temperature variation showed that the mean temperature during the wetting period can be used to evaluate the expected disease severity. These results confirm the value of experiments made at constant temperature, but must be confirmed at several mean temperatures, including low temperatures.

Further work will concern the relationships between inoculum concentration, continuous and discontinuous leaf wetness, and disease severity.

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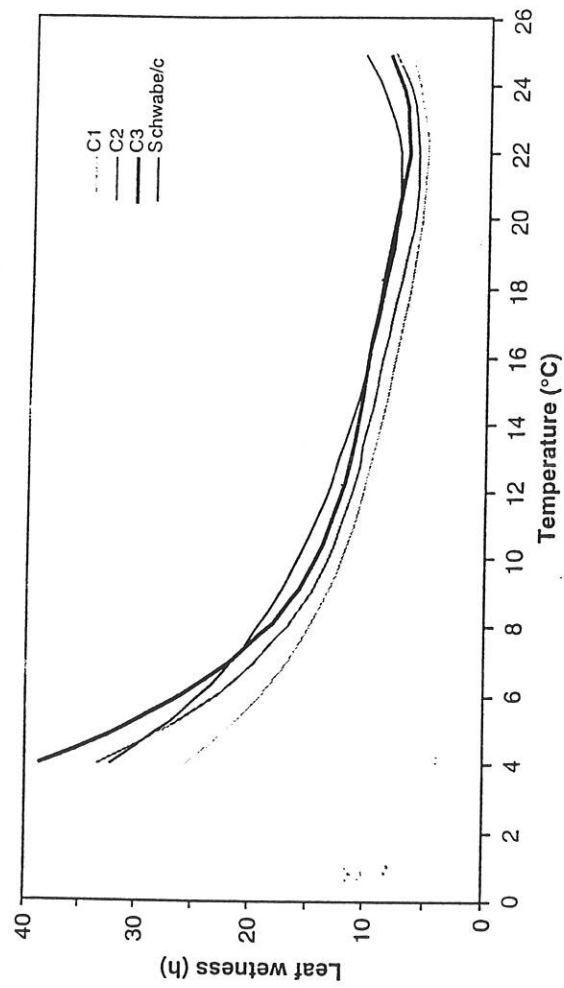


Figure 1. Relationship between leaf wetness duration, temperature and severity of infection by conidia of *Venturia inaequalis*.

C1 : severity ≤ 5 scab lesions/plant

C2 : 10 scab lesions/plant $\leq$ severity ≤ 30 scab lesions/plant

C3 : severity ≥ 50 scab lesions/plant

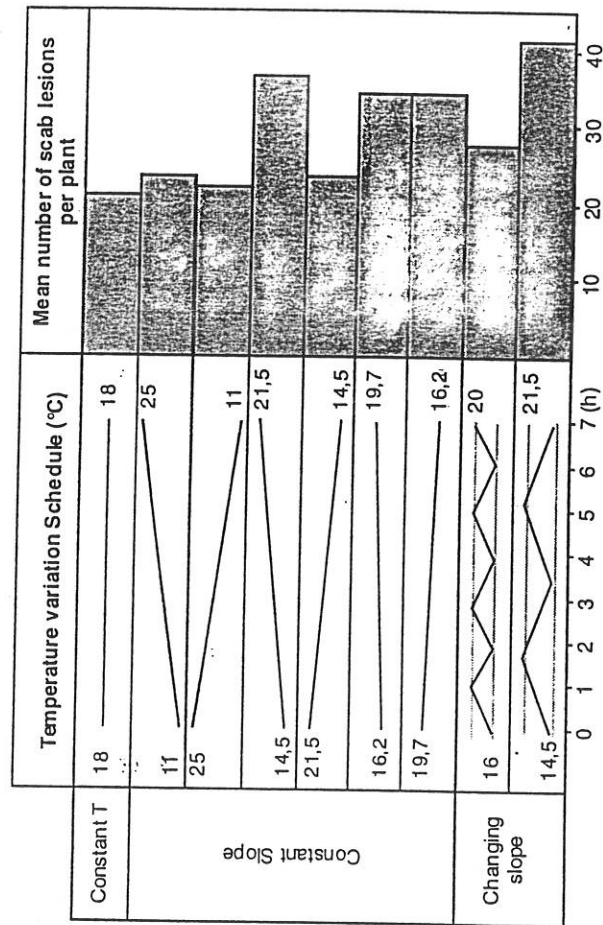


Figure 2. Disease severity obtained with different patterns of temperature variation (mean temperature = 18 °C).