Wind Dispersal of Conidia of Cercospora beticola

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ABSTRACT

In spore-trapping studies in Nebraska, conidia of *Cercospora beticola* were freely airborne, and formed a regular component of the air-spora over infected red beets (*Beta vulgaris*). Airborne conidia of *C. beticola* displayed a well-defined diurnal periodicity with a peak concn at 1000 hr; few conidia were trapped between 1600 and 0600 hr. Daily increases in conidium concn coincided with the time when wind velocity and temp were increasing and relative humidity was decreasing. Conidia were detected in the atmosphere on all days, but concn fluctuated greatly from day to day. Greatest numbers of conidia were trapped on warm, dry days preceded by a period of rain or overnight dew. High concn were also recorded during periods of high atmospheric turbulence. Very few conidia were detected in the air during rainfall or while the beet leaves were still wet. Phytopathology 60:1076-1078.

Additional key words: Leaf spot, Hirst spore trap, spores, aerobiology, epidemiology.

Spore release and dispersal in *Cercospora beticola* Sacc. was first investigated by McKay & Pool (7), who detected viable conidia in the air near diseased sugarbeet fields and concluded that wind was one agency of dispersal. They also found that conidia were sometimes dispersed by irrigation water and insects. Canova (2) found that conidia were easily detached from infected sugarbeet leaves by gentle air currents and by water running over the surface. He suggested that conidia were usually released by rain or dew, but that dispersal was by wind. Carlson (3) considered that rain was the principal dispersal agent, and that wind was of secondary importance. Spore-trapping studies conducted in a controlled environment (8) showed that abundant conidium release and dispersal were brought about by wind speeds of less than 1 mph. Conidia were also released by water running over sporodochia and by hygroscopic movements of conidia and conidiophores in response to a rapid decrease in vapor pressure. The present paper describes field studies on dispersal of *C. beticola* conidia in an attempt to elucidate natural dispersal agents more fully.

MATERIALS AND METHODS.—Spore-trapping studies with *C. beticola* were conducted in a 12 × 5 m plot of red beets (*Beta vulgaris* L.) in the Agricultural Experiment Station gardens, Lincoln, Nebraska. *Cercospora beticola* leaf spot symptoms first appeared toward the end of July 1967; by early September the disease had reached epidemic proportions. A Hirst spore trap (4, 5) was set up in the center of the plot, with its orifice 48 cm above ground and about 15 cm above the foliage, and was operated continuously from 19 August-17 October 1967. A thermohygrograph and a rain gauge were used to measure temp, relative humidity, and rainfall. Records of wind velocity were obtained from the Lincoln Weather Bureau. Only conidia agreeing in all respects with reference to *C. beticola* were recorded.

RESULTS.—In dry weather in the summer, airborne conidia of *C. beticola* exhibited a well-defined diurnal periodicity with a peak at 1000 hr (Fig. 1). After this, there was a decrease in concn until 1600 hr, followed by a gradual decline to a low concn by 0600 hr. The rapid increase in concn between 0800 and 1000 hr coincided with the time when wind velocity and temp were increasing and relative humidity was decreasing. Periodicity depicted in Fig. 1 was not displayed during unusual weather conditions. For example, when the morning was rainy, the peak concn occurred later than usual (between noon and 2000 hr) and coincided with the time when rain ceased and the beet foliage was drying out. On a few occasions, the peak concn occurred at night (between midnight and 0400 hr) when a storm was developing or when atmospheric turbulence was high. On several days a secondary, minor peak was recorded in the afternoon between 1400 and 1800 hr.

Conidia of *C. beticola* were detected in the atmosphere every day from 19 August-15 October, but conidium concentrations fluctuated greatly from day to day (Fig. 2); highest daily counts were recorded in September. Daily concn decreased markedly during a cooler period, which included overnight ground frosts, at the end of September (Fig. 2). Concn increased slightly during the following week when temp increased, but thereafter, concn declined again until zero counts were recorded from 15-17 October.

Greatest numbers of airborne conidia were trapped on warm, dry days preceded by a period of rain or a heavy overnight dew. For example, the two highest daily peak concn occurred after evaporation of heavy dew formation (17 September) and following overnight rainfall (21 September). High concn were also often recorded during periods of high atmospheric turbulence (Fig. 2). Very few conidia were detected in the air during rainfall, or while beet leaves were still wet. Continuous light rain or mist and high relative humidity throughout the day were usually associated with low or zero counts on that day. Conidium concn decreased rapidly to zero at the onset of rain, even when wind velocities remained high.

DISCUSSION.—This study indicated that *C. beticola*

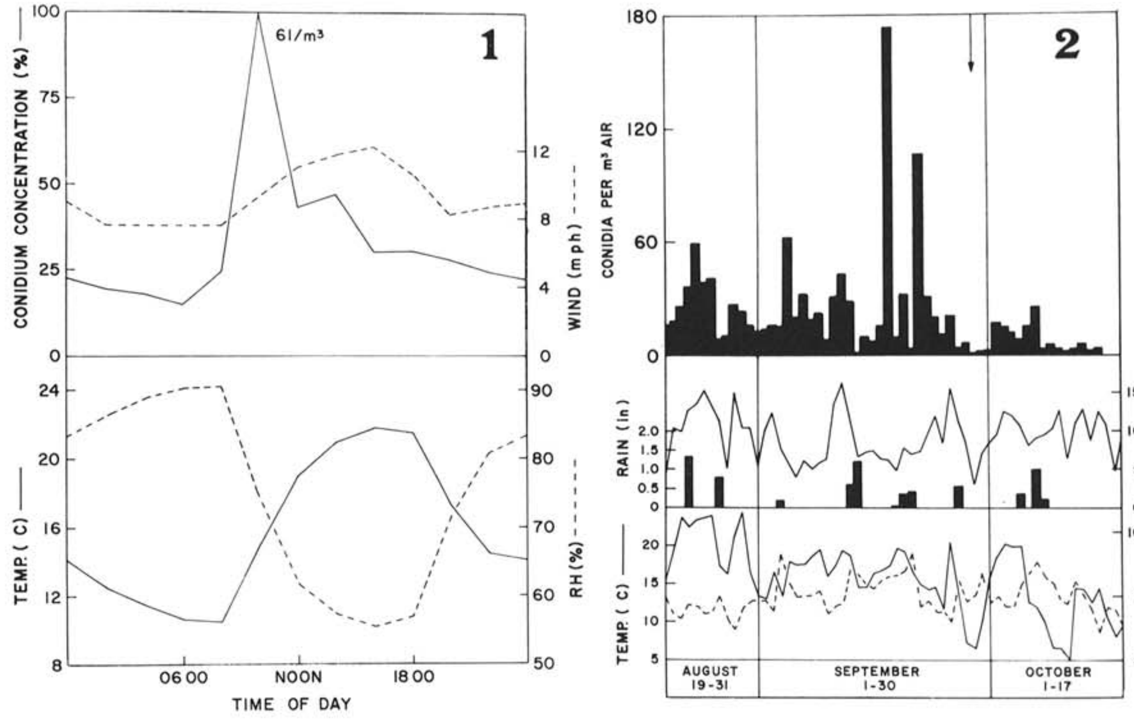

Fig. 1-2. 1) Mean diurnal periodicity curve for airborne conidia of *Cercospora beticola* for the period 19 August-17 October 1967, related to mean 2-hourly values for temp, relative humidity, and wind speed. Conidium concn are expressed as percentages of the peak arithmetic mean concn. **2)** Daily mean concn of airborne conidia of *Cercospora beticola* related to daily mean values for temp, relative humidity, rainfall, and wind speed for the period 19 August-17 October 1967. Arrow indicates time when first ground-frost was recorded.

conidia may form a regular and common component of the air-spora within and immediately above diseased beets. Diurnal periodicity of *C. beticola* in warm, dry weather is similar to that reported for some other *Cercospora* species (1, 6, 9, 10, 11).

Wind appeared to be a major factor influencing numbers of *C. beticola* conidia in the air, which tends to support the observations of Canova (2) and Meredith (8) that conidia are readily dislodged and dispersed by air currents. The daily increase in conidium concn in the morning may have been mostly due to increasing turbulence that released many conidia that had developed and matured on leaf lesions overnight. The subsequent decrease in conidium concn may have been due to the depletion of the sources of mature conidia. Occasionally, very few conidia were trapped on days following unusually high winds. It is possible that the lesions had been largely exhausted of conidia by the higher wind velocities, and a recovery period was required for the development and maturation of new conidia. On several days, a second, smaller peak concn was recorded in the late afternoon similar to that reported for an unidentified *Cercospora* by Pathak & Pady (9). This second peak may have been associated with the release of newly matured conidia formed later in the day.

Rain or heavy dew was often followed by large increases in concn of *C. beticola* conidia. This was probably a result of increased sporulation of the fungus after wetting of the sporodochia. Low atmospheric concn recorded during rain were probably a result of the effect of rain in removing spores from the air (5).

Carlson (3) stated that rain was the principal dispersal agent for *C. beticola* conidia, whereas wind was of only secondary importance. Methods employed by Carlson were relatively inefficient for detecting airborne conidia as compared with the Hirst trap, and were predisposed to collecting conidia in water droplets. While it is recognized that rain may be a major factor affecting release and dispersal in *C. beticola,* the present study indicates that wind is also important.

Numbers of airborne conidia were greatly reduced during a cool spell at the end of September. Concn increased during a following warmer period, indicating the ability of this fungus to recover from the effects of limiting temp for sporulation. At the end of the trapping period, field temp were apparently too low to allow sporulation.

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