Dispersal of Aeciospores of Peridermium harknessii in Central Nebraska

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ABSTRACT

Western gall rust, caused by *Peridermium harknessii*, is prevalent in pine plantations on the Nebraska National Forest near Halsey, Nebr. As high as 4% of pine seedlings and transplants in the adjacent Bessey Nursery have been infected by this rust. Automatic volumetric spore traps and weather recording equipment were installed in and adjacent to the nursery to determine when and under what conditions aeciospores are dispersed. On rainless days, there was diurnal periodicity in the number of spores trapped. The number of spores increased sharply in the morning (0700 hr) as air temperature increased and relative humidity decreased. Numbers of spores reached a maximum about 1100 hr, and decreased sharply about 1300 hr. This periodicity was interrupted on days with rain. Aeciospores were dispersed as early as 8 May; dispersal was essentially completed by the end of June. During the 2 years of trapping, dispersal was over 80% completed by the end of May.

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Western gall rust caused by the fungus *Peridermium harknessii* Moore has damaged ponderosa pine (*Pinus ponderosa* Laws.) on the Nebraska National Forest, Bessey Division, for over 50 years. Infected trees in the forest are a source of inoculum for pine seedlings and transplants in the adjacent Bessey Nursery. Rust galls were found on as high as 4% of ponderosa pine transplants in this nursery prior to 1964. The number of infected trees near the nursery was reduced by wildfire in 1965, by sanitation for gall rust begun in 1966, and by insect control operations in 1967. Less than 0.5% of the nursery stock became infected during the years 1965-1970.

Because *P. harknessii* can spread from pine to pine, the outplanting of one infected tree could cause serious damage in an outplanting area. Therefore, even low levels of disease in the nursery are a cause for concern. Levels of disease have been so low, however, that fungicides for control of this rust could not be tested. If disease increases and chemical control does become necessary, it will be essential to know when and under what conditions aeciospores of this fungus are dispersed.

MATERIALS AND METHODS.—Automatic, volumetric (Hirst, Burkard) spore traps were used with a suction rate of 10 liters/min. Average number of spores/m^3 of air was calculated for 2-hr intervals. Traps were installed within Bessey Nursery and in a ponderosa pine stand adjacent to the nursery. The trap orifice was 1 m above the soil surface. Traps were operated from 5 May to 18 July 1969, and 11 May to 23 June 1970. A hygrothermograph, a recording rain gauge, and wind direction and wind velocity instruments were operated at the site for the same periods.

RESULTS.—Aeciospores of *Peridermium harknessii* were seldom collected in the two traps placed in the nursery 90 and 900 m from stands with infected ponderosa pines. Even on days when high numbers of aeciospores were collected in the trap within the pine stand, so few were collected by traps within the nursery that they could not be correlated with weather data. Thus, the following results pertain to spores trapped in air within stands with infected ponderosa pines.

Aeciospores were first trapped on 8 May in 1969 and on 14 May in 1970 (Fig. 1). Most aeciospores were dispersed in May: 88% in 1969; 91% in 1970. Dispersal was essentially completed in June. The highest daily concentration was similar both years, but occurred earlier in 1969 (15 May) than in 1970 (23 May).

There was a diurnal periodicity in the number of spores trapped. On rainless days, few spores were trapped during dark periods (Fig. 2-A). The number of spores trapped increased sharply after 0500 hr. The number trapped remained high and peaked about 1100 hr, and decreased rapidly between 1200 and 1300 hr.

This periodicity was interrupted on days with rain. On such days, the number of spores trapped was often high in the afternoon as well as in the morning (Fig. 2-B). The number trapped in early morning (0100, 0300 hr) was often higher than on rainless days.

The rapid increase in the number of spores trapped at 0700 on rainless days was consistently correlated with a rapid drop in relative humidity associated with the rapid rise in temperature. The number of spores trapped declined sharply at 1300 hr when relative humidity was near its minimum and temperature was near its peak.

Wind velocity and turbulence often increased about 0700 hr, when there was an increase in the number of spores trapped. However, wind velocity and turbulence were often still high beyond the time (1300 hr) when there was a rapid decrease in the number of spores trapped.

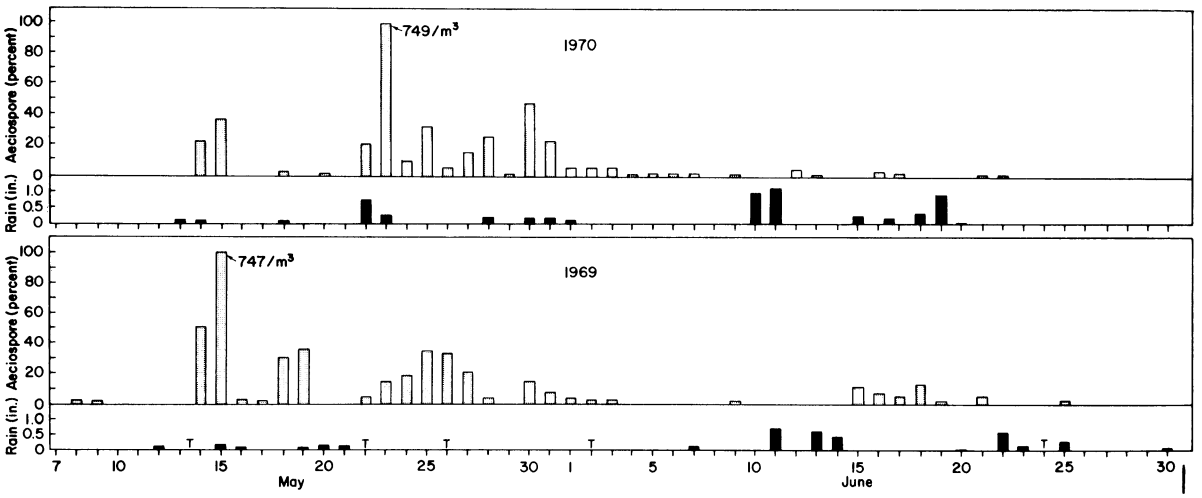

Fig. 1. Daily concentration of *Peridermium harknessii* aeciospores in air within a stand of infected ponderosa pines in central Nebraska. The sum of bihourly concentrations for each day are expressed as a percentage of the maximum concentration.

The number of spores trapped within the stand was not influenced by wind direction, since the trap was surrounded by infected trees. However, wind direction probably had much to do with low numbers of spores trapped within the nursery. The stands with infected pines were south-southwest-west of the nursery beds. Although wind direction was toward the nursery beds 34% of the time, it was from the west twice as frequently as from the south or southwest. This decreased chances of spores reaching nursery beds, since the beds were about 250 m from the east edge of the stand and only 90 m from the north edge.

Rainfall interrupted the diurnal periodicity. The amount of rain did not appear to be critical for initiation of dispersal. Seasonal dispersal started earlier and peaked earlier in 1969, when rainfall in April and May was 1.17 inches, than it did in 1970 when rainfall in the same period was 4.64 inches. Total number of spores trapped apparently was not influenced by total rainfall. Rainfall in May 1970 totaled 1.42 inches, and in May 1969 totaled 0.77 inches; yet the total number of spores trapped in May of these 2 years was about the same. Though considerable rain fell in June of both years (2.9 inches, 3.36 inches), few spores were trapped in June of either year.

Maximum spore concentrations in both years occurred on days with rain. However, spores were seldom trapped during rains. On some days with rain, no spores were trapped. Spores were also trapped on several successive rain-free days (Fig. 1).

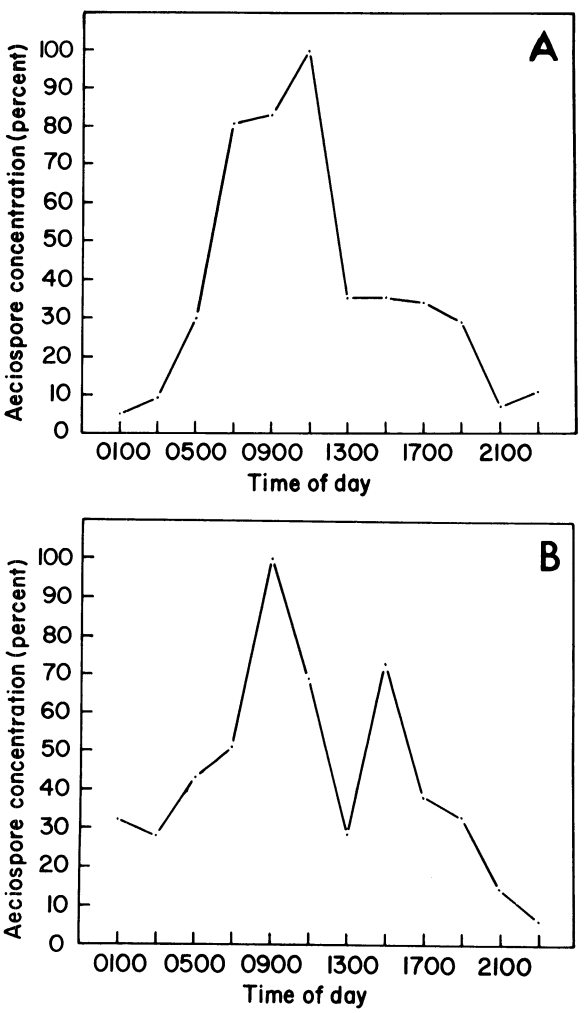

Fig. 2. *Peridermium harknessii* aeciospore concentration in air within a stand of infected ponderosa pines in May and June in 1969 and 1970 on (A) rainless days and on (B) days with rain. The sums of bihourly spore concentrations are expressed as a percentage of the maximum concentration.

DISCUSSION.—Since essentially all aeciospores were dispersed during May and June, fungicide applications could be limited to these months. The low number of aeciospores trapped in the last 2 weeks in June and the smaller size of 1st-year pine seedlings at that time indicate that there would be a low risk in leaving 1st-year seedlings unsprayed.

The highest level of infection (4%) noted in Bessey Nursery is near the level (3%) that Carlson (1) observed in nursery beds of 3-year-old jack pine seedlings located near a heavily infected natural stand of jack pines in Manitoba. He found few infected seedlings more than 275 m from the natural stand.

LITERATURE CITED

1. CARLSON, L. W. 1969. Western gall rust on jack pine nursery stock in Manitoba. Plant Dis. Reptr. 53:100.