FORECASTING WEATHER FAVORABLE FOR FUSIFORM RUST INFECTION

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In southern pine nurseries, infection of seedlings with fusiform rust takes place chiefly during April, May, and June, at which times telia of the causal fungus (*Cronartium fusiforme* Hedgc. & Hunt ex Cumm.) are present on leaves of oaks, the alternate host. Nearly all infection occurs during periods of warm, humid weather, when the telia produce airborne basidiospores that establish themselves on succulent tissues of pines. Fungicidal sprays, regularly scheduled, are essential as long as viable telia remain on the oaks. Research has established, however, that reinforcement spraying just before periods of high humidity will increase control by protecting tissue formed since the last scheduled spraying (*2*).

The question remains whether localized high-hazard conditions can be reliably predicted. We recently suggested that they can be (*1*), and this paper reports an initial test of the proposition. The test was made in 1969, when the forestry meteorologist for Mississippi prepared forecasts for three cooperating forest nurseries in the south-central part of the State.

The nurseries were given advisories daily, Monday through Friday, from April 22 to June 2. The information was prepared in Jackson and was in the hands of the nurserymen by 10 a.m. each morning. It included: (a) maximum air temperatures for the current day and the next day, (b) minimum temperatures for the night, (c) the day and approximate hour when the relative humidity would reach or exceed 90 percent, (d) the number of hours the relative humidity would remain 90 percent or above, (e) the probability of rain during the day, night, or next day, and (f) a general statement on the severity of the weather for the next 3 days as it related to rust infection.

These factors were selected on the basis of criteria previously defined to describe weather favoring infection (*3*). The probability of infection increases rapidly when relative humidity remains above 97 percent for more than 9 hours, and air temperatures are concurrently above 60° F. The hazard is very severe when these conditions prevail for 14 hours or more, and when rains occur—especially rains during the late afternoon or early evening (*3*).

Most weather data are collected from stations at airports. We have observed that humidities at nurseries are normally about 10 percent higher than at airports; irrigation, a large area of transpiring surfaces, and less air circulation probably cause the difference. To prevent underestimating the humidity at nurseries, airport humidities of 90 percent, rather than 97, were taken as threshold values in making forecasts.

The cooperating nurseries lacked equipment for taking weather observations to critically evaluate the forecasts. Detailed psychrometric and rainfall data were therefore collected on the Harrison Experimental Forest, which is 25 miles sout of the W. W. Ashe Nursery at Brooklyn, Miss. The observation point was at the edge of a large forest opening, and the microclimate approximated that at the cooperating nursery.

There were two periods (May 7 to 9 and May 16 to 18) when weather conditions were optimum for rust infection (RH $\geq$ 97 percent for 14 or more hours, and rain fell in the afternoon). Warnings were issued 3 days prior to both of these periods. Moderately favorable conditions for infection (RH $\geq$ 97 percent for 9 to 13 hours) occurred on 11 days. Nine of these periods were forecast at least 12 hours before they occurred. On one of the days not forecast, RH $\geq$ 97 percent was recorded for exactly 9 hours, and on the other, this humidity level continued for 10 hours.

Regular spray schedules were followed at all nurseries, and additional sprays were applied 1 to 2 days before the two periods of severe weather. Incidence of rust was less than 3 percent at two of the nurseries. At the Ashe, it was 3 percent on slash pine but above 20 percent on loblolly pine. A possible explanation is that the loblolly seedlings germinated during the week of May 7th and were in phase of accelerated

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growth when the hazardous weather occurred. The slash pine seed had germinated earlier.

The initial trial indicated that severe rust weather can be forecast with high accuracy, and that most periods of moderate hazard can also be predicted. This approach to rust control seems promising, and it is hoped that additional nurseries will cooperate in extended trials.

It is not anticipated, at present, that forecast spraying will make scheduled spraying unnecessary. Rather, nurserymen should continue regular applications, with reinforcement spraying when the forestry meteorologists forecast weather that favors infection.

Literature Cited

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THE EFFECT OF LATE SUMMER IRRIGATION ON RED PINE BUDS AND SHOOT LENGTHS

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Red pine (*Pinus resinosa* Ait.) completes its height growth by early summer and begins to set buds in midsummer. This paper shows that irrigation, as opposed to drought, during the period of bud growth results in larger shoots that emerge from the buds the following year.

The Experiment

The experimental procedure was described in detail earlier.[1] In brief, there were 60, 5-year-old red pines averaging 33 cm. in height growing in clay pots. In 1963, the following three treatments were employed: frequent watering—about 35 mm. equivalent rainfall once a week; infrequent watering—about 35 mm. equivalent rainfall every 2.5 to 3 weeks; and drought—no water added after start of the experiment. These treatments began July 23, and for convenience were termed: wet, intermediate, and dry.

In 1964, half of the trees from each 1963 treatment received frequent watering, while the other half were not watered. Before the treatments in 1964, all plants were well watered. These treatments began May 8 and ended June 30 when leader extension stopped.

Lengths of terminal buds on leading shoots were measured in November 1963. Final shoot lengths were measured in 1964. Hereafter, in this paper, shoot refers to the 1964 leading shoot.

Differences in mean bud sizes and mean shoot lengths between treatments were tested by *t*-test. The level of significance of statistical tests was 5 percent.

Results

Mean bud sizes and shoot sizes are shown in table 1. Buds on the wet trees were 14 percent longer than those on intermediate trees and 38 percent longer than those on dry trees. All differences in mean bud length were significant.

In the 1964 dry treatment, mean shoot length of wet trees was greater than that of intermediate trees, which, in turn, was greater than that of dry trees. The difference between wet trees and dry trees was significant.

In the 1964 wet treatment, wet and intermediate trees grew about the same amounts, which, in turn, exceeded significantly the shoot growth of dry trees.

Differences between mean shoot lengths under the two 1964 treatments were not significant for any of the 1963 treatments.

[1] Clements, J. R. Shoot responses of young red pine to watering applied over two seasons. Can. J. Bot. 48 (1): 75-80. 1970.