

USING INFECTION DECLINE CURVES IN ALTERNATE HOST ERADICATION RUST CONTROL

It had been determined that ribes eradication was an effective means of white pine blister rust control before any large scale control programs were initiated (2,8,12). It had also been noted that removing the ribes within 600 feet of the pine would control the rust (2). Since this early work was published locally and in government agency reports, many workers today are no longer aware that this testing was done.

During the evolution of the control program, tests were continued that demonstrated the effectiveness of alternate host eradication (3,5,7), and showed that complete eradication was not essential(3). Detailed plot study reports maintained in the Milwaukee Regional White Pine Blister Rust Control Office (1930–43) provide the original data from many valuable epidemiological studies. In 1967–68 I undertook a review of this work to present in a symposium on The Effects of Decreased Inoculum on Infection (10).

I reviewed the data gathered on permanent plots maintained 1929–67 in the Lake States where ribes were eradicated to control blister rust. Since white pine grows one whorl of branches each year, infection times can be determined by the age of the infected wood. Reexamination of permanent plots was necessary because climatic variation between plots affected the spread of rust to a great extent and invalidated comparisons between plots in different areas. Therefore, comparisons of the same plot before and after eradication were necessary to show the effectiveness of eradication. A onetime survey after eradication was also invalid because of the loss of cankers through decay. In a survey made in any given year, the greatest number of cankers were found 4–5 years before the time of inspection, regardless of the eradication history: e.g., on a plot that was inspected in 1935 and 1939, the year of the maximum number of cankers initiated changed with the inspection time. The 1935 inspection showed the greatest of cankers started in 1931, and the 1939 inspection showed the greatest number in 1934. Therefore, only permanent plot data were evaluated to determine the effectiveness of ribes eradication in reducing rust infection (10).

The data used were from 35 permanent plots containing 9,353 trees, maintained 1929–42 by Dr. E. E. Honey, et al. Of Honey's plots, 29 were eradicated. During the 4 years prior to eradication (the eradication years varied), 5,174 cankers were initiated; during the 4 yrs after eradication 103 cankers were initiated. This was 72.4 cankers per 100 trees before eradication, compared to 1.4 cankers per 100 trees after eradication. Of the 29 plots 23 showed fewer cankers after eradication, 3 showed no change (rust free before eradication), and three showed more rust. The increased incidence was found in areas to which the rust had not yet spread prior to eradication (1 case) or where continued infection indicated long-distance spread (2 cases). These 3 plots did show benefit from eradication as part of the paired sample plots described next (10).

In 6 pairs of Honey's plots where one of each pair was eradicated, those plots which showed an increase in rust incidence after eradication, increased to a much lesser degree than their non-eradicated partners did. The non-eradicated plots had 2,575 cankers during the 4 yrs before their partners were eradicated and 1,663 cankers afterwards. The eradicated plots had 3,852 cankers before eradication and 12 cankers afterwards. Expressed as cankers per 100 trees the ratios were 117:75 (not eradicated) :: 142:0.4 (eradicated). All paired plots showed benefits from eradication (10).

The distance that the alternate host had to be eradicated from the protected host was determined by developing infection decline curves. These were made by recording the amount of rust per unit area of target (e.g., the number of cankers per tree) and plotting it against the distance from the source of inoculum (e.g. a specific group of susceptible ribes bushes). Blister rust infection decline curves have been published (1, 6, 9), and I have constructed some from published infection incidence data (4,8,11). Mathematically the number of spores at the source was not as important as the gradient of the number of infections along the line as indicated by the square root distance. In the case of blister rust the empirically

determined distance for control was twice the square root distance along the infection decline curve. The square root distance was determined by environmental factors affecting the spread. In California and interior British Columbia the square root distance was about 25 ft. (1.6), which was similar to that in the southern Lake States. In the northern Lake States the square root distance was 300 ft. At distances more than twice the square root distance, the number of cankers was asymptotic to zero and did not show further decreases in the level of infection. Therefore., in the northern Lake States the width of the eradication control zone is 600 ft., in the southern Lake States it is 50 ft.

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