Progress Report: Pierce's Disease Risk Zones in the Southeast

Principal investigator: Turner B. Sutton
Department of Plant Pathology
Box 7616
North Carolina State University
Raleigh, NC 27695
Phone (919) 515-6823; e-mail turner_sutton@ncsu.edu

Objectives:

1. To create a risk map for Pierce's disease for the vinifera/French-American hybrid winegrape growing region in the Southeast based on minimum winter temperatures.

Justification:

Wine production, based primarily on cultivation of the native muscadine grape, *Vitis rotundifolia*, has occurred for almost 400 years in the Southeast. Recently the industry has experienced rapid growth in the Piedmont and Mountain regions of the Southeast as a result of the establishment of *V. vinifera* and French-American hybrid grapes. Further expansion of the winegrape industry in the Piedmont and Mountain regions of the Southeast may be inhibited by Pierce's disease (PD), caused by the bacterium *Xylella fastidiosa* (*Xf*), which is geographically limited to areas with mild winters. The bacterium, transmitted by insect vectors, can kill infected vines in 1 to 2 years. In the past, PD was considered rare in the Piedmont and Mountain regions (Fig 1. www.cnr.berkeley.edu/xylella/PD-USAmap.jpg).

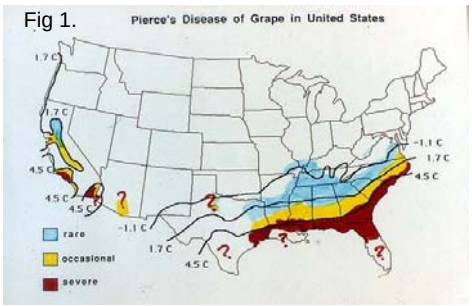


Fig 1.

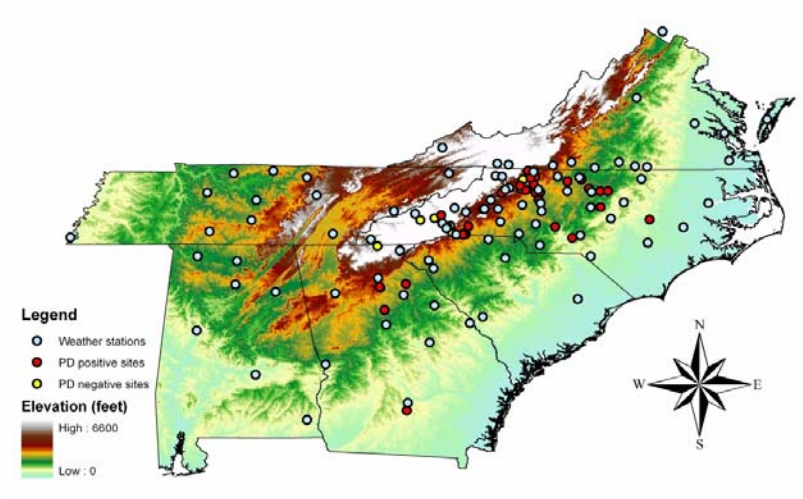
A survey of NC vineyards of *V. vinifera* and French-American hybrid grapes was conducted during the 2001 and 2002 growing seasons (Harrison, Anas, and Sutton, 2002 and *unpublished data*) to determine the presence of *Xf* in vineyards in which vines expressed symptoms characteristic of PD. The bacterium was detected in grapevines from 14 of 19 vineyards in the NC Piedmont and Mountain regions surveyed in 2001 and 18 of 22 in 2002. Disease incidence ranged from a few scattered vines to nearly 100%. Much of the planned expansion of the winegrape industry is in the Piedmont at mid-elevations ranging from 300-600 m where PD has been most prevalent in our surveys. The vineyards within this region are exposed to a continuum of low to moderate average minimum temperatures during the winter season. In the 2001 and 2002 surveys, vineyards with negative ELISA results were largely limited to areas of the state that have lower average winter temperatures, specifically the mountains of western NC. Populations of *Xf* within grape xylem have been shown to decline under cool conditions. Additionally vines have been shown to recover following freezing temperatures. Preliminary analyses of 30 years of weather data (1972-2001) from 41 locations in the Piedmont and Mountains of NC and adjacent areas in VA and SC had shown that regions in NC with either low or no PD incidence most closely align with regions that have 5-6 days of temperatures $\leq$-12.2C for November to March. Based on this analysis we identified three risk zones in NC. The maps indicated that the risk for PD in the Piedmont region of NC is much greater than previously published maps. The objective of this project is to create an extended risk maps for PD for the winegrape growing region of the Southeast.

Materials and Methods:

Pierce's disease survey data: Data on the incidence of PD were taken from surveys conducted in 2001 and 2002 in NC (Harrison, Anas and Sutton, *unpublished*) and from surveys conducted in Georgia in (Brannen and Chang, *unpublished*) (Fig 2). PD is rare in Tennessee (Dave Lockwood, *personal communications*).

Temperature mapping: Daily minimum temperature data from 1972-2005 from a total of 84 weather stations from AL, GA, NC, SC, TN and VA were obtained from National Climatic Data Center http://www.ncdc.noaa.gov/oa/ncdc.html (Fig 2).

Fig 2. Relief Map of Southeastern US indicating Weather Stations and Positive and Negative PD sites



Days with minimum temperatures ≤-12.2C and ≤-9.4C were determined for the months November through March for each year and location. Isolines for each of the temperature thresholds were determined for the years 1972-1997 (25 years average) (Fig 3) and 1997-2005 (8 years average) (Fig 4) using ArcGIS 9.1. The vineyard survey was then superimposed on each map and maps were visually examined to determine those measures of temperature that most closely aligned with vineyards that scored negative or positive for PD.

Fig 3. Pierce's Disease Risk Zones based o Number of Days of Minimum Temperature 1972-1997 (25-Years Average)

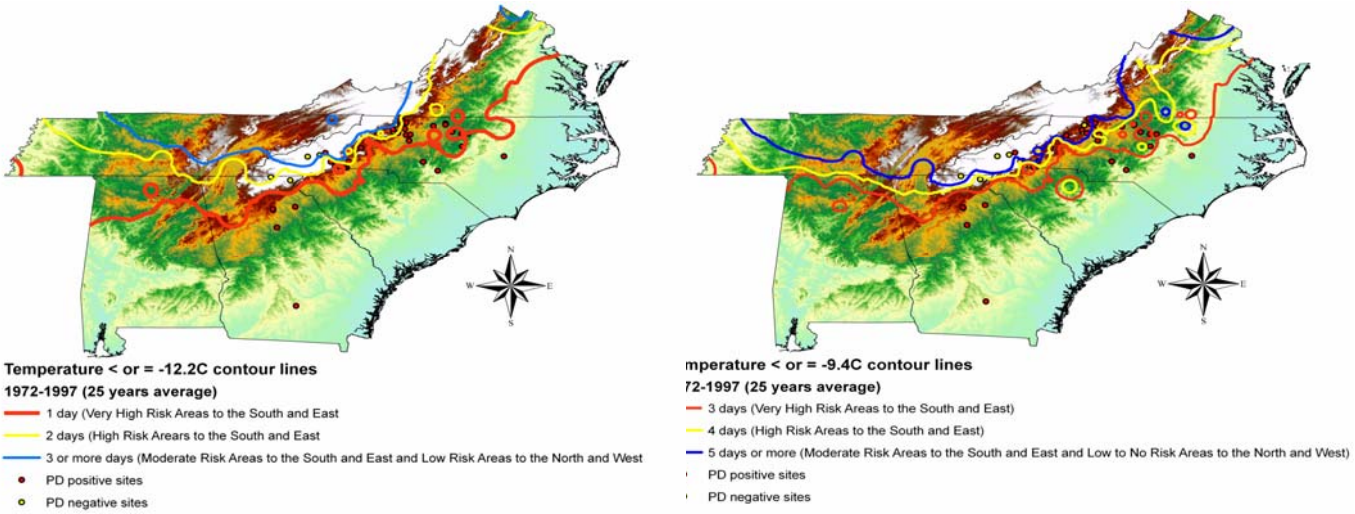
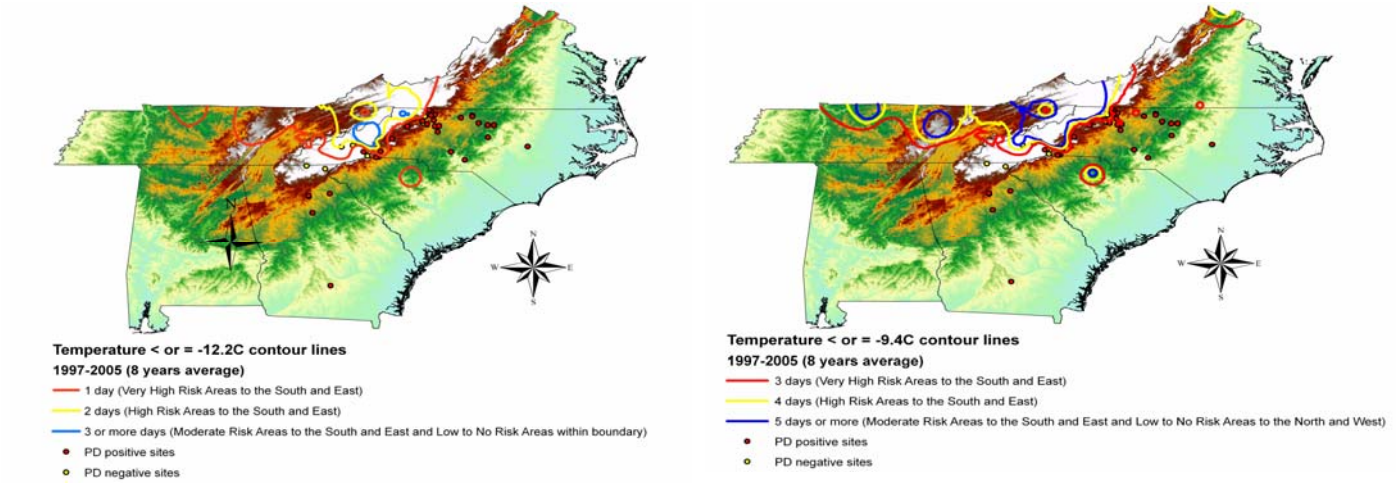


Fig 4. Pierce's Disease Risk Zones based on Number of Days of Minimum Temperature 1997-2005 (8-Years Average)



Results:

1. Negative ELISA test results for PD were largely limited to areas in the Southeast characterized by higher elevations and lower average winter temperatures, specifically the western Piedmont and Mountain regions of NC and GA (Fig 2).

2. The regions of NC and GA with vineyards in which no PD was observed or the PD incidence was very low most closely aligned with regions that had more than 2 days of temperatures $\leq$-12.2C or more than 4 days of temperatures $\leq$-9.4C for the period 1972-97 (25-years average) (Fig 3).

3. Compared to the period 1972-97 (25-years average), temperatures have been warmer for the past 8-year period from 1997-2005 and the isolines have shifted north and west (Fig 4).

Discussion & Conclusion:

Preliminary analyses of weather data indicate that the number of days with temperatures $\leq$-12.2C or $\leq$-9.4C are important in defining the region where PD is likely not to be a problem. Recently warm winters, extend the area where Pierce's disease is likely to be a problem to much of the North Carolina, South Carolina and Georgia where the disease was previously believed not a great threat. Additionally much of Tennessee and Virginia now falls in moderate to high risk areas. Warmer weather over the past 8-years has increased the likelihood that PD will become a problem in vineyards in the Southeastern wine growing region.

Impact Statement:

The maps generated define the high risk areas for PD in the Southeast and provide a guide for individuals considering establishing a vineyard. The increase in temperatures over the past 8-years increases the likelihood that PD will become a greater problem in the Southeast.

Citations of publications:

When data analyses are complete the risk maps will be published on the Southern Region Small Fruit Consortium web site (http://www.smallfruits.org).