PREDICTING THE SPREAD AND SEVERITY OF POTATO LATE BLIGHT (*PHYTOPHTHORA INFESTANS*) IN OREGON, 2002

Clint Shock, Cedric Shock, Lamont Saunders, and Katie Kimberling
Malheur Experiment Station
Lynn Jensen
Malheur County Extension Service
Oregon State University
Ontario, OR

Abstract

The 2002 season was not conducive to the development of late blight, therefore, growers were able to save on fungicide applications for potato late blight control during 2002. Late blight was not predicted in 2002 at Klamath Falls, Malin, Tulelake, Culver, Madras, Ontario, Nyssa, or Adrian, and did not occur.

Eight potato fields in the Treasure Valley, Central Oregon, and the Klamath Basin were monitored for temperature, relative humidity, and leaf wetness in the plant canopy. These data and rainfall data were recorded every 10 minutes and the data were forwarded via cellular phone daily to the Malheur Experiment Station. Data were used to estimate real-time late blight risk, using a model to predict potato late blight. Those estimates were distributed four to five times a week via the station web site at http://www.cropinfo.net/Potatoblight/blightcast.htm and e-mail.

Introduction

Economic Importance

Before the 1995 growing season, potato late blight (*Phytophthora infestans*) was not a management concern in the Treasure Valley, Central Oregon, or the Klamath Basin. During the 1995 season, late blight spread rapidly throughout the Treasure Valley from initial outbreaks in low-lying, humid areas. Treasure Valley growers made three to six fungicide applications in 1995 at great expense. Lack of adequate late blight control in 1995 in the Treasure Valley resulted in yield losses and some losses during storage. Late blight outbreaks in 1997 and 1998 in the Klamath Basin also have caused considerable economic loss.

The ability to predict when late blight is most likely to cause economic loss and when conditions are conducive to its rapid spread would aid in grower decisions as to the necessity and timing of fungicide applications. The refinement of late blight predictions could save growers money by improving the efficiency of control measures. Accurate late blight predictions are needed now for areas both where the disease normally occurs and areas, such as the Treasure Valley and the Klamath Basin, where it has not been a problem in the past.

The Wallin Model

The Wallin model uses hours of duration of relative humidity above 90 percent along with the corresponding temperature range to calculate the extent to which the daily environment has been favorable for potato late blight disease development. The Wallin model program used at the Malheur Experiment Station accumulates environmental conditions favorable for the development of late blight, which are called "severity values." When the severity value total reaches 18, late blight is predicted and additional fungicide control measures are indicated. The Wallin and other predictive models are being compared to the actual onset and development of late blight. It is essential that instruments are monitoring field conditions from the beginning of potato emergence.

The Blitecast Model

Blitecast is a program module for late blight prediction that is part of the "Wisdom" software for potato crop and pest management from the University of Wisconsin, Madison. Like the Wallin Model, the Blitecast model uses hours of duration of relative humidity above 90 percent along with the corresponding temperature range to calculate the extent to which the daily environment has been favorable for disease development. The Blitecast model also includes rainfall duration and intensity in the risk for late blight, yet rainfall factors are usually not pertinent in arid eastern Oregon. The Blitecast program accumulates environmental conditions favorable for the development of late blight, which are called "severity values." When the severity value total reaches 18, late blight is predicted and additional fungicide control measures are indicated.

According to Dr. Walter Stevenson of the University of Wisconsin, Wisconsin potato growers are using Blitecast to control blight while simultaneously saving considerably on fungicides. These economies are possible through the adequate prediction of late and early blight. Both university personnel and private consultants make predictions using Blitecast in Wisconsin. University of Wisconsin extension information is distributed through newsletters, e-mail, and the university web site, and this extension information depends on the forecasts. Economies of production realized in Wisconsin are now being made available to interested Oregon growers.

Objectives

1. Provide daily predictions of the risk of the expansion of potato late blight during the 2002 season in the Treasure Valley, Klamath Basin, and Central Oregon using the Wallin model.

2. Help protect growers from economic loss to late blight. Help growers reduce their cost of production by avoiding unnecessary applications of fungicides.

3. Automate the collection of data from weather stations in growers' fields and AgriMet stations. Predictive models for potato late blight need to be adapted to the relatively arid areas of Oregon where potato growers are now suffering economic losses from late blight. Arid summer weather was not originally envisioned in the development of the Wallin model and other models to predict late blight.

Methods

During 2000, a visual basic program was refined at Ontario to allow the direct application of raw field weather data to a wide range of disease prediction models. Model variations used included the substitution of leaf wetness for the duration of 90 percent relative humidity and the use of different relative humidity and leaf wetness criteria. The use of alternative criteria is not reported here.

During the 2000, 2001, and 2002 seasons, data were collected from stations in eight potato fields and several AgriMet weather stations. Each of the eight stations in growers' fields consisted of a relative humidity sensor, a temperature sensor, a tipping bucket rain gauge, two Campbell Scientific Leaf Wetness Sensors (237LW)(Campbell Scientific, Logan, UT), a portable stand, a data logger with battery and solar panel, a modem, and a cellular phone. Temperature, leaf wetness, and relative humidity in the plant canopy and the rainfall were recorded every 10 minutes. Data were forwarded daily via cellular phone or notebook computer to the Malheur Experiment Station. Weather data from outside of the crop canopy were collected every 15 minutes from seven AgriMet stations closest to the monitored commercial potato fields and forwarded electronically to the Malheur Experiment Station.

Data were used to estimate real-time late blight risk using the same relative humidity and temperature criteria used in the Wallin model, and those estimates were distributed via the station web site and e-mail.

Results, Discussion, and Conclusions

Disease Development and Predictions

The 2002 season was not conducive to the development of late blight. Late blight was not predicted in 2002 at Klamath Falls, Malin, Tulelake, Culver, Madras, Ontario, Nyssa, or Adrian, and did not occur. During the 2001 season, environmental conditions were favorable for the rapid spread of late blight at Malin in the Klamath Basin very late in the season, but late blight was not present. The evaluation of the results of the last couple of years indicates only part of the value of predicting potato late blight. Access to late blight predictions since the program began has helped growers reduce fungicide costs by not making unneeded applications. The prediction of late blight before it has occurred has allowed timely fungicide applications and control of late blight.

Treasure Valley

Infield data were collected from four stations in 1996 and 1997, and three stations in 1998-2002. Starting in 1996, growers had access to late blight predictions.

Environmental conditions at Ontario, Nyssa, and Adrian were particularly dry in 2000, 2001, and 2002. The estimated accumulated severity values did not pass 7 at any location; the threshold value is 18 (Fig. 1). The late blight outbreak was severe in 1995 prior to the beginning of this program (Fig. 2). Late blight was predicted before it occurred in both 1996 and 1997. Late blight was first detected close to Parma, Idaho near the Idaho-Oregon border on August 21, 1996, and on July 17, 1997. Between 1998 and 2002 late blight was not predicted and was not detected in these areas.

Central Oregon
Starting in 1997, the data collection in the potato canopy and late blight predictions were extended to Madras. Two stations have collected data near Madras since 1998. The Wallin model did not predict late blight in 1997-2002 and the occurrence of late blight was not recorded. The air in potato canopies was very dry at Culver (Fig. 3) and Madras (Fig. 4), resulting in low accumulation of severity values in recent years.

Willamette Valley
One station in 1997 and two stations in 1998 and 1999 monitored potato canopy conditions. Late blight occurred on potatoes and sprouted potatoes on a cull pile and in a commercial tomato planting before potatoes emerged in 1998. Consequently, late blight spores were being spread even before they could be produced on potato plants, causing early onset of late blight in the Willamette Valley in 1998. The Wallin model rapidly accumulated severity values at Woodburn in 1998 as it had in 1997.

In 1999, the Wallin model predicted late blight in the Willamette Valley very late in the season, in contrast to previous years, due to shorter duration of high relative humidity throughout the season. Late blight was predicted on August 8 at Woodburn and August 11 at Sherwood, before late blight was found in commercial fields in late August. Due to little interest by Willamette Valley growers and a reduced budget in 2000 and 2001, Willamette Valley sites have not been monitored since 1999.

Klamath Basin
A single station was set up south of Klamath Falls in 1997, and three stations were used in 1998-2002. Severity values accumulated slowly in 2001 due to dry atmospheric conditions (Fig. 5). The severity index remained very low at Tulelake during the 1999-2002 seasons (Fig. 6). The duration of high humidity in 2001 caused the severity index to reach 14 at Henley during 2001, in part due to irrigation patterns during the day that resulted in the potato canopy remaining wet from one night through to the next night on several occasions (Fig. 7). During the 2002 season, high humidity and a high severity index were caused by irrigation patterns. After the irrigation criteria was altered, no more severity values accumulated during the season. The severity index at Klamath Falls remained at zero in 1999-2002.

In 1997, Wallin model severity values reached 17 at Klamath Falls before late blight was found in Tulelake, California (considerably to the south of the single in-field weather station). In 1998, late blight was found on a few isolated plants on July 10 before it was predicted on July 26. The Klamath Falls late blight epidemic in 1998 occurred later in August after it had been predicted (Fig. 8).

Summary
In conclusion, the Wallin model worked well with the 90 percent relative humidity criteria to predict late blight in recent years, and the automated handling of data facilitated rapid evaluation and transmission of results.

Cooperators and Acknowledgments

We acknowledge the indispensable support of the Oregon Potato Commission for the last 6 years, as well as contributions by the regional growers' associations. This work would not have been possible without the cooperation of Steve James, Kerry Locke, Ken Rykbost, Harry Carlson, Brian Charlton, Don Kirby, Rob Hibbs, Al Mosley, Steve Iverson, Tom Kirsch, Wes Hagman, Jerry and Dave Mizuta, Bob and Alan Peterson, Bruce Corn, Doug Tracy, Kirk Kirkpatrick, Larry Cheyne, Jr., Steve Cheyne, Roy Hasebe, Rod Blackman, Mike McVay, Dan Chin, and Jay Hoffman. Constructive suggestions by Mary Powelson, Ken Rykbost, Bob Witters, and Al Mosley have been appreciated greatly.

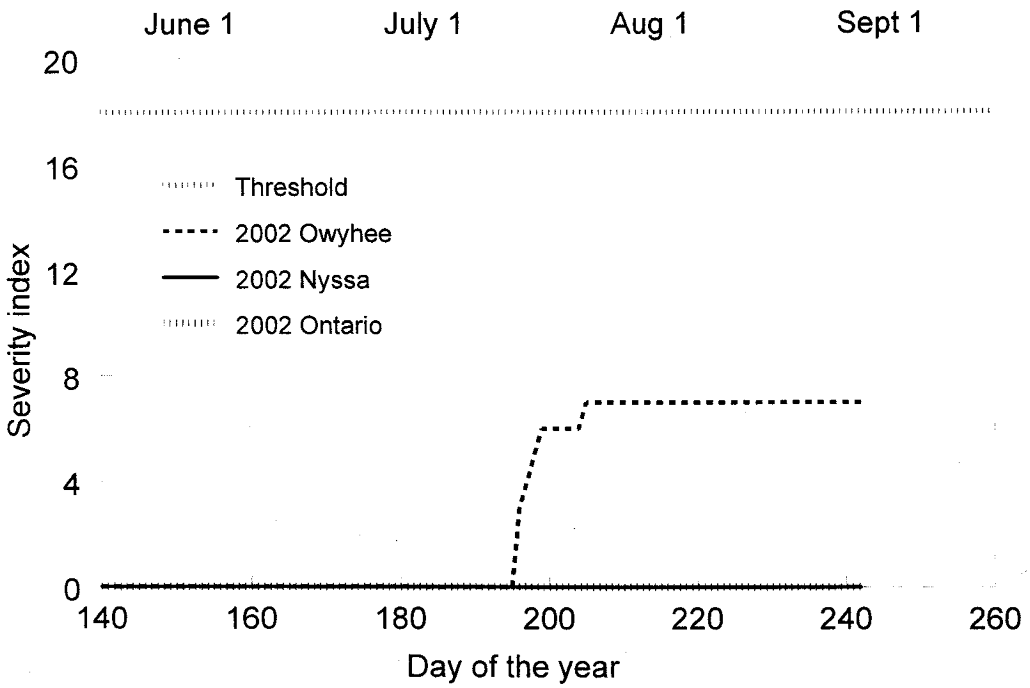

Figure 1. Comparison of three Treasure Valley locations (Ontario, Nyssa, and Owyhee Jct.) in the accumulation of estimated late blight risk during the 2002 season. Low relative humidity was associated with low accumulation of severity values in 2002; Malheur Experiment Station, Oregon State University, OR.

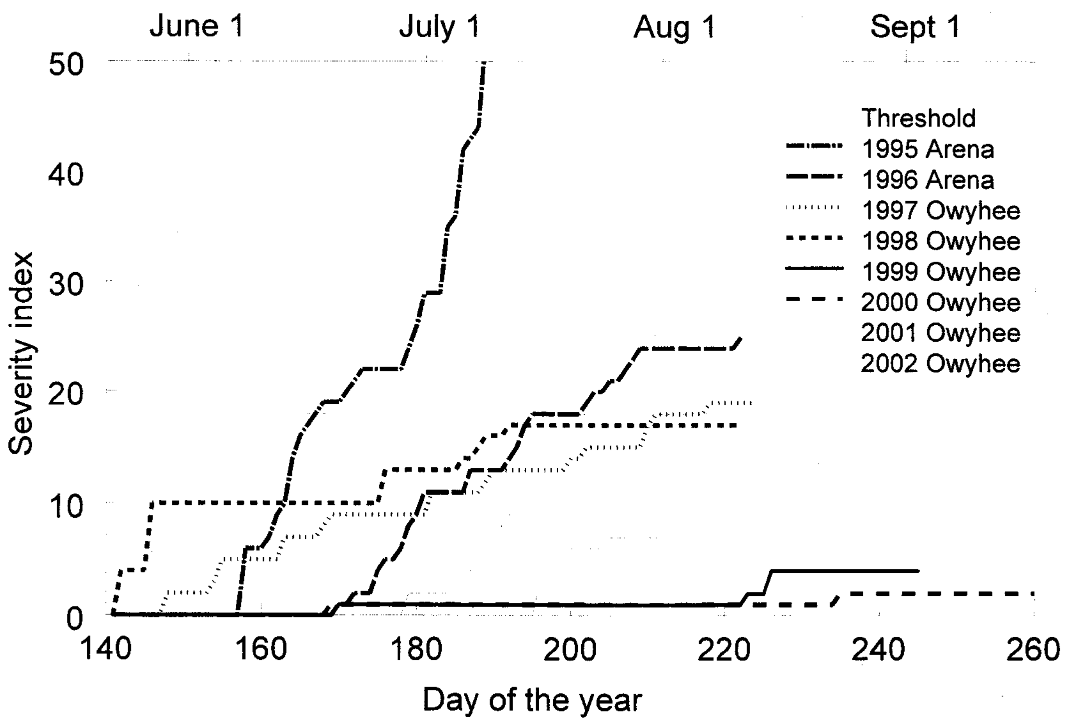

Figure 2. Comparison of late blight risk estimates over the last 8 years in the Treasure Valley. A severe late blight outbreak in 1995 was followed by a few late blight detections in 1996 and 1997. Late blight has not been predicted or detected the last 5 years; Malheur Experiment Station, Oregon State University, OR, 2002.

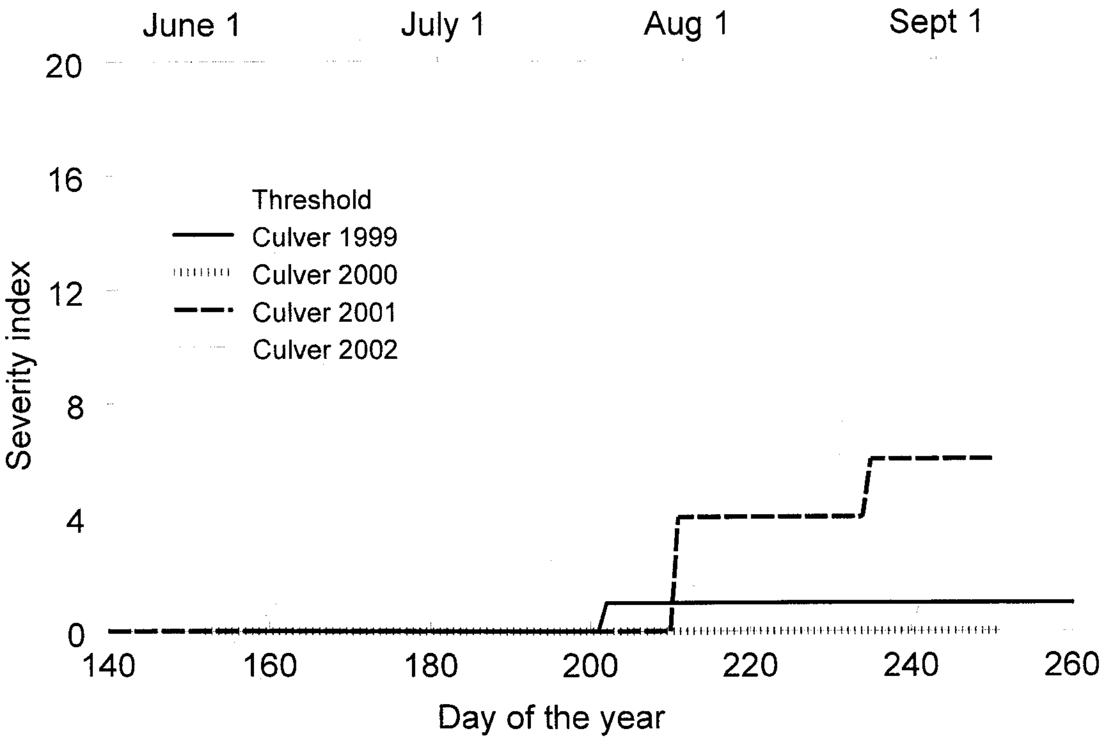

Figure 3. Accumulated severity values have remained low at Culver, Central Oregon during the last four seasons; Malheur Experiment Station, Oregon State University, OR, 2002.

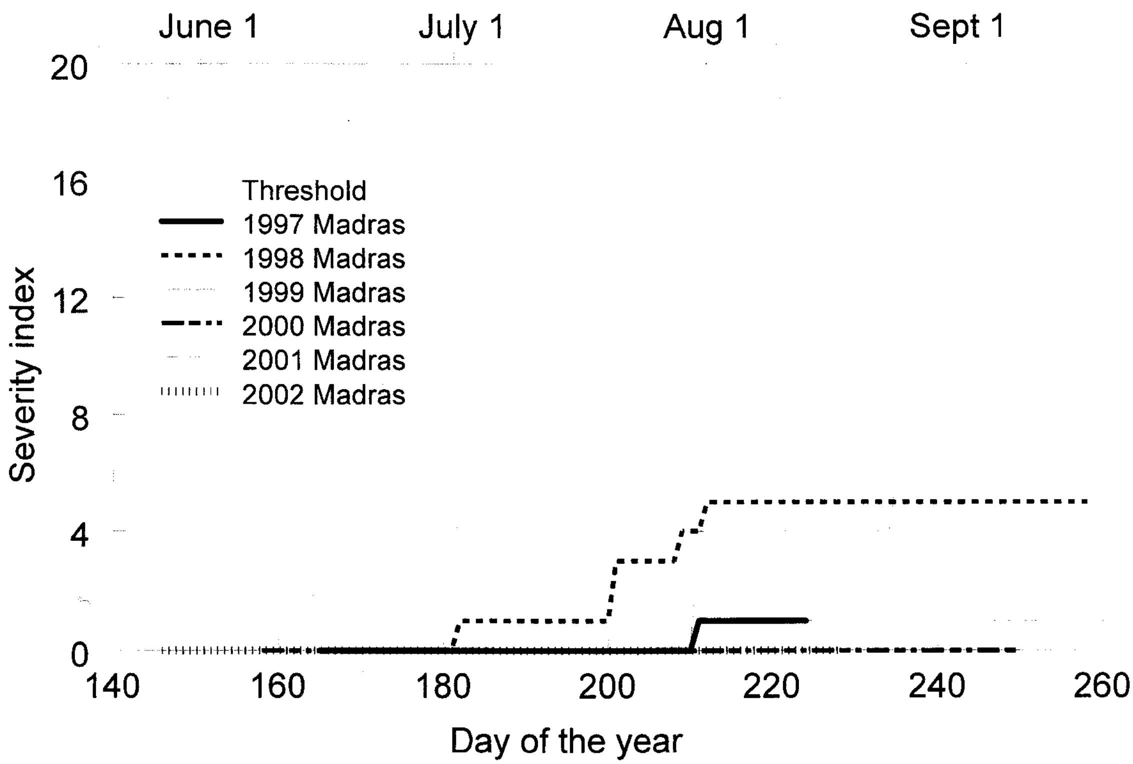

Figure 4. Accumulated severity values have remained low the last six seasons at Madras in Central Oregon; Malheur Experiment Station, Oregon State University, OR, 2002.

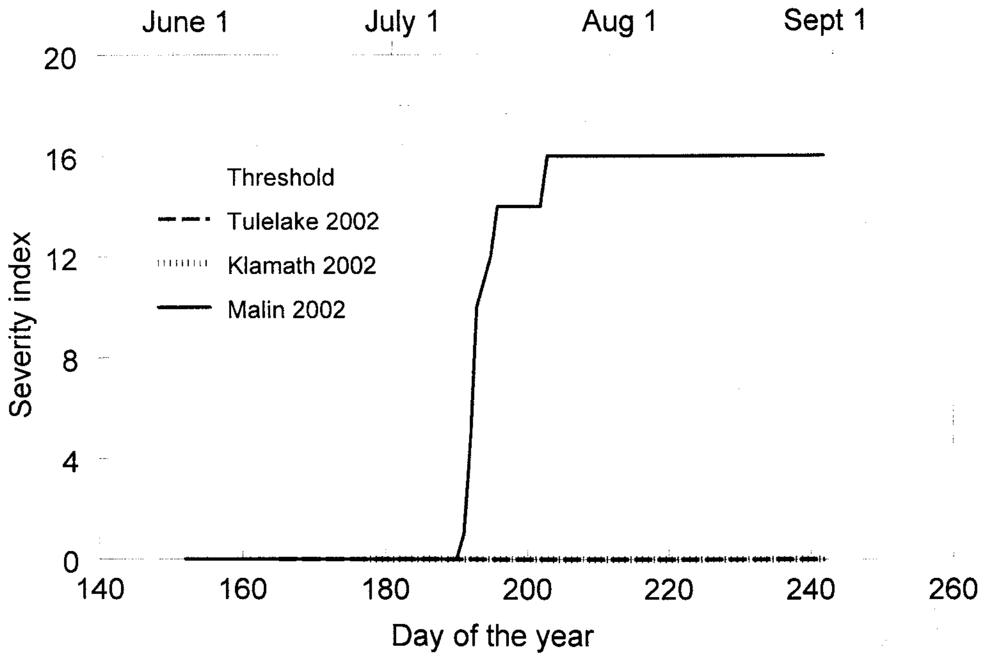

Figure 5. Comparison of three Klamath Basin locations in the accumulation of estimated late blight severity values during the 2002 season; Malheur Experiment Station, Oregon State University, OR, 2002.

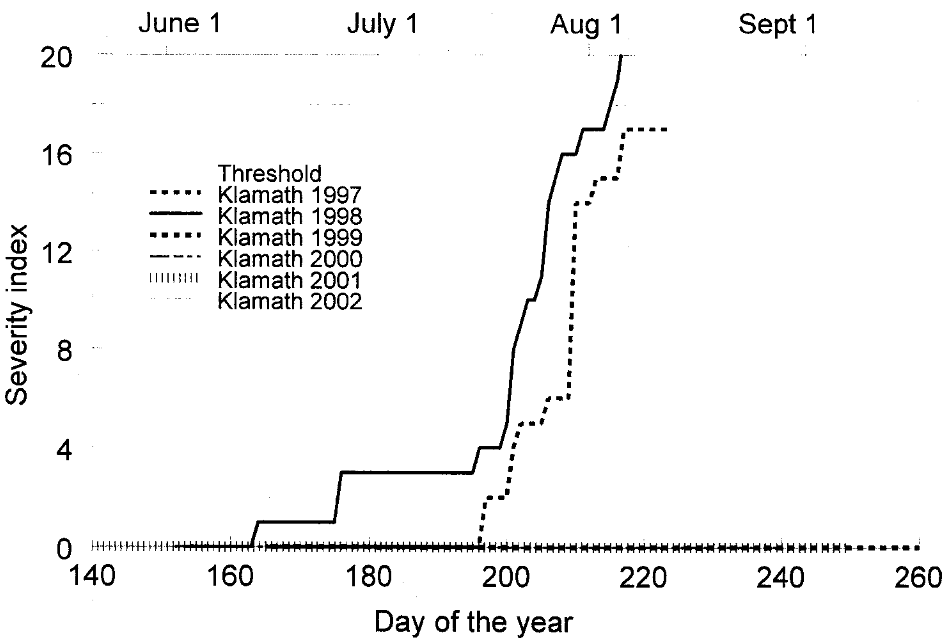

Figure 6. Comparison of late blight risk estimates over the last 6 years in the vicinity of Klamath Falls. Rapid accumulation of severity values in 1997 and 1998 was followed by losses to late blight. Risk estimates have not accumulated in 1999-2002; Malheur Experiment Station, Oregon State University, OR, 2002.

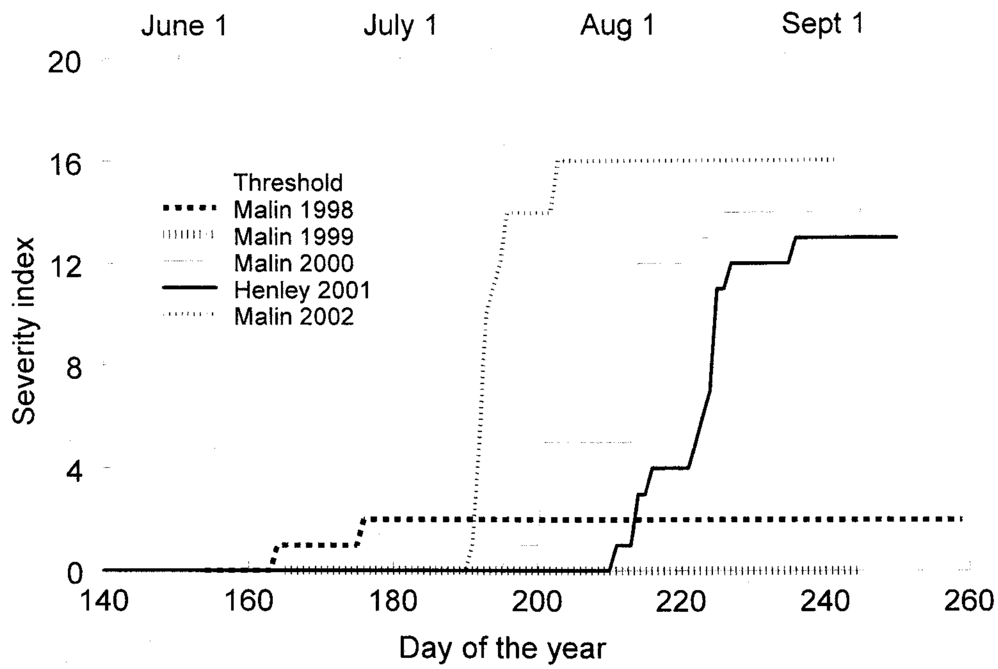

Figure 7. Comparison of the accumulation of estimated late blight severity values near Malin over the last 5 years. The severity index reached 18 at Malin only near the end of the 2000 growing cycle, apparently due to irrigation practices; Malheur Experiment Station, Oregon State University, OR, 2002.

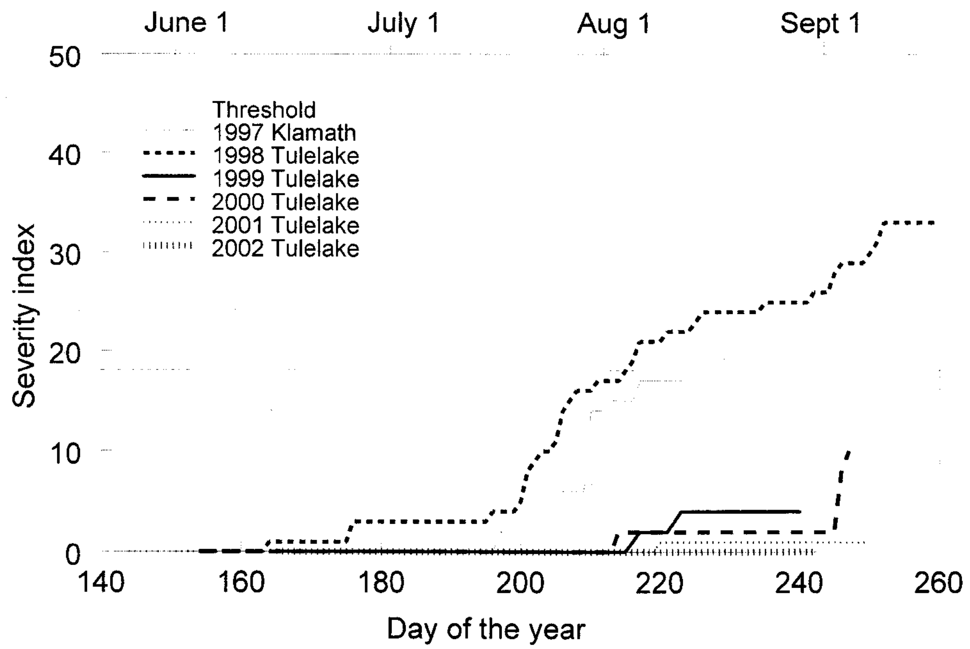

Figure 8. Comparison of late blight risk estimates over the last 6 years in the vicinity of Tulelake. Rapid accumulation of severity values in 1997 and 1998 was followed by losses to late blight; Malheur Experiment Station, Oregon State University, OR, 2002.