Abstract

Growers were able to save on fungicide applications for late blight control during 2001. The 2001 season was not conducive to the development of late blight. Late blight was not predicted in 2001 at Klamath Falls, 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

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. 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 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. Blitecast and other predictive models are being compared to the actual onset and development of late blight.

Blitecast has worked as a predictive model with the criteria of 90 percent relative humidity in the crop canopy. It is essential that instruments are monitoring field conditions from the beginning of potato emergence.

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.

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 2001 season in the Treasure Valley, Klamath Basin, and Central Oregon.

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 Blitecast 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 2000 and 2001 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), 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 Blitecast, and those estimates were distributed via the station web site, e-mail, and fax. Various models were tested in 1999 and 2000, with special emphasis on Blitecast and late blight predictions using leaf wetness.

**Results, Discussion, And Conclusions**

**Disease Development and Predictions**
The 2001 season was not conducive to the development of late blight. Late blight was not predicted in 2001 at Klamath Falls, Tulelake, Culver, Madras, Ontario, Nyssa, or Adrian, and did not occur. 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.

**Treasure Valley**
Infield data were collected from four stations in 1996 and 1997, and three stations in 1998, 1999, 2000, and 2001. Starting in 1996, access to late blight predictions and low cost fungicide recommendations has helped growers in the Treasure Valley to reduce fungicide costs and control late blight.

Environmental conditions at Ontario, Nyssa, and Adrian were particularly dry in 2000 and 2001. The estimated accumulated severity values did not pass 2 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 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. In 1998, 1999, 2000, and 2001 late blight was not predicted by Blitecast 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 collected data near Madras during 1998, 1999, 2000, and 2001. Conventional Blitecast did not predict late blight in 1997, 1998, 1999, 2000, or 2001 and the occurrence of late blight was not recorded. The air in potato canopies has been 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. Blitecast rapidly accumulated severity values at Woodburn in 1998 as it had in 1997.

In 1999, Blitecast 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. Blitecast predicted late blight 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, 1999, 2000, and 2001. Severity values accumulated slowly in 2001 due to dry atmospheric conditions (Fig. 5). The severity index remained very low at Tulelake during the 1999, 2000, and 2001 seasons (Fig. 6). The duration of high humidity in 2001 caused the severity index to reach 14 at Henley during 2001, perhaps 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).

The severity index at Klamath Falls remained at zero during 2001 as it had in 1999, and 2000. In 1997, conventional Blitecast 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 by Blitecast on July 26. The Klamath Falls late blight epidemic in 1998 occurred later in August (Fig. 8).

**Leaf wetness**

Leaf wetness estimates were made at all sites starting in 1998 using Campbell Scientific Leaf Wetness Sensors 237LW (Campbell Scientific, Logan UT). The late blight severity values based on leaf wetness accumulated much more rapidly than the severity values based on relative humidity in the plant canopy because the duration of the wet periods proved to be longer than the periods of high relative humidity. Marked differences were recorded for accumulated severity values based on 90 percent relative humidity and the conventional Blitecast program as compared with the use of leaf-wetness data. Severity indices based on leaf wetness have had little association with the onset of late blight.

In conclusion, conventional Blitecast 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.

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Figure 1. Comparison of three Treasure Valley locations (Ontario, Nyssa, and Owyhee Jct.) in the accumulation of estimated late blight risk during the 2001 season. Low relative humidity was associated with low accumulation of severity values; Malheur Experiment Station, Oregon State University, 2001.

Figure 2. Comparison of late blight risk estimates over the last 7 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 detected the last 4 years; Malheur Experiment Station, Oregon State University, 2001.
Figure 3. Accumulated severity values have remained low at Culver, Central Oregon during the last three seasons; Malheur Experiment Station, Oregon State University, 2001.

Figure 4. Accumulated severity values have also remained low the last five seasons at
Madras in Central Oregon; Malheur Experiment Station, Oregon State University, 2001.
Figure 5. Comparison of three Klamath Basin locations in the accumulation of estimated late blight severity values during the 2001 season; Malheur Experiment Station, Oregon State University, 2001.

Figure 6. Comparison of late blight risk estimates over the last 5 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, 2000, or 2001; Malheur Experiment Station, Oregon State University, 2001.
Figure 7. Comparison of the accumulation of estimated late blight severity values near Malin over the last 4 years. The severity index reached 18 at Malin only near the end of the 2000 growing cycle due to irrigation practices; Malheur Experiment Station, Oregon State University, 2001.

Figure 8. Comparison of late blight risk estimates over the last 5 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, 2001.