The Role of Inquiry Data in Monitoring Economically Important Diseases – Results from the PDIO Plant Disease Inquiry Database

Yonghao Li and Lindsay Patrick
The Connecticut Agricultural Experiment Station
New Haven, CT 06504

CAES
The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

NPDN
National Plant Diagnostic Network

Introduction

The Connecticut Agricultural Experiment Station (CAES) is the oldest agricultural experiment station in the United States. The Plant Disease Information Office (PDIO) at the Station has assisted homeowners, growers and professionals with plant disease identification and inquiries about plants and plant health since the Station was established in 1875. The PDIO has maintained inquiries about plant disease and plant health in an electronic database since 1998. This inquiry data is not only useful for tracking records, but also valuable for investigating changes in plant disease over time and space. The objectives of this study were to illustrate how plant disease databases may be used to monitor epidemics of plant diseases and to develop integrated pest management programs.

Materials and Methods

A total of 108,607 inquiries that were received during the years of 1998-2015 were used in the present study. After the inquiries were sorted by host, pathogen, and year, variations in the number of inquiries received annually were observed in important diseases including late blight and Septoria leaf spot of tomato, Rhizosphaera needlecast, Stigmina needlecast and needle rust of spruce, Canavirgella needlecast of white pine, Volutella canker and Macrophoma leaf spot of boxwood, and boxwood blight. To understand the relationship between the outbreak of tomato late blight in 2009 and weather conditions, daily maximum temperature, minimum temperature, and rainfall from June to September that were collected from the Lockwood Farm in Hamden, CT were analyzed.

Results and Discussion

Boxwood blight, Volutella canker, and Macrophoma leaf spot of boxwood: Before 2012, inquiries about boxwood had been kept under 100 per year and a major disease concern was Volutella canker disease (Fig. 1). However, boxwood-related inquiries and samples sharply increased in 2012 after boxwood blight was newly found in Connecticut in October 2011. Due to severe damage caused by newly introduced boxwood blight in established landscapes and the significant economic losses in nurseries, inquiries about boxwood health have remained at a high volume (average 450 inquiries/year) since 2012. Although boxwood blight inquiries decreased after the peak in 2012, inquiries about Volutella canker remained high and Macrophoma leaf spot increased (Fig. 1).
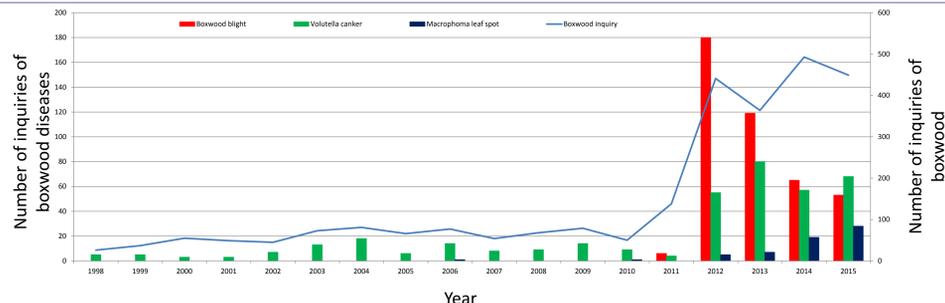
Figure 1. Changes in numbers of inquiries about boxwood and its diseases by year

Rhizosphaera needle cast, Stigmina needle cast, and needle rust of spruce: Among the three foliar diseases that were analyzed in the present study, Rhizosphaera needle cast and needle rust were problematic almost every year. While there were no significant changes in needle rust inquiries, inquiries about Rhizosphaera needle cast has increased dramatically since 2009 and reached a high peak in 2014. The results show an increase of Stigmina needle cast since it was first found in 2012.
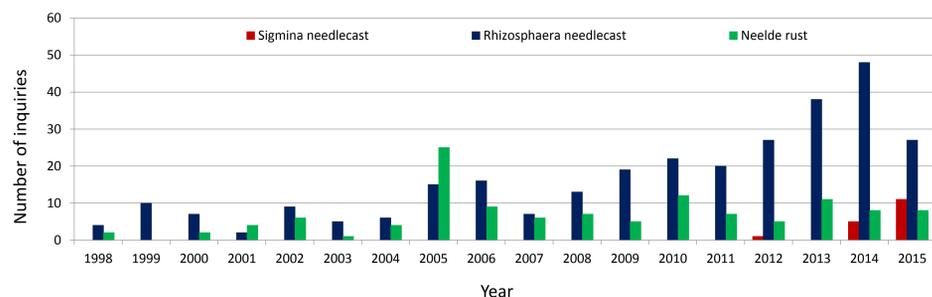
Figure 2. Changes in numbers of inquiries about Rhizosphaera needle cast, needle rust, and Stigmina needle cast by year

Summary

- A total of 108,607 plant disease and plant-related inquiries during the years of 1998-2015 compiled from the Plant Disease Information Office (PDIO) inquiry database were analyzed.
- Some important diseases were grouped into three categories: emerging (e.g. boxwood blight, Stigmina needlecast of spruce), recurrent (e.g. late blight of tomato, Canavirgella needlecast of white pine), and annual (Volutella canker of boxwood, Rhizosphaera needlecast, Septoria leaf spot).
- The results suggested that epidemics of emerging and recurrent diseases were associated with the introduction of new pathogens, the subsequent build-up of inoculum, and favorable weather conditions. The increased concern of Rhizosphaera needle cast, an annual disease, might be due to effects of climate changes on spruce trees that more vulnerable to the disease.
- It was demonstrated that plant disease databases can be a useful tool to monitor the onset of economically important diseases and may be helpful in developing predictive disease management programs that may reflect climate change models.

Canavirgella needle cast of white pine: The results in Fig. 3 show that most inquiries about Canavirgella needle cast were received during the periods of 1998-2002 and 2006-2011. Inquiry numbers for Canavirgella needle cast decreased from 21 to 2 during the years of 1998-2002. After three years without concern of the disease, the number of inquiries increased in 2006 and reached a peak (27 inquiries) in 2009. The number of the inquiries decreased again after 2011 and remained at a low volume. The results suggest that epidemics of Canavirgella needle cast of white pine are periodic.
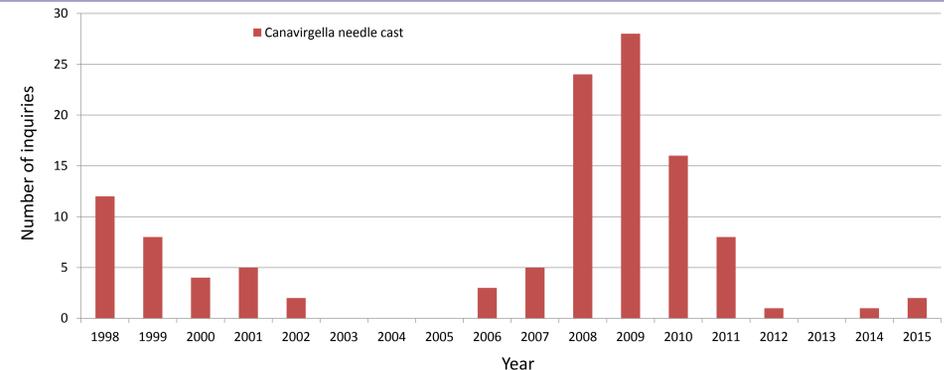
Figure 3. Changes in numbers of inquiries about Canavirgella needle cast by year

Late blight and Septoria leaf spot of tomato: The results (Fig. 4) show that the number of inquiries about Septoria leaf spot were 10 to 50 per year during the period of 1998-2015, which suggests that Septoria leaf spot is problematic every year. However, there were no inquires about late blight until 2004 when ten phone and email inquiries were received. All of these late blight inquiries were received a few days after the news article 'Fungus Threatens Tomato Crops in Northeast' was released on The Pittsburgh Post-Gazette website on August 10th, 2004. In 2009, a sharp increase in inquiries about late blight was due to an outbreak of the disease in Connecticut. In 2009 (Fig. 5A), the first inquiry about late blight was received via email on June 26th after a homeowner read a news article about late blight in The Pittsburgh Post Gazette in June 2009. The first positive late blight sample was confirmed on July 13th. All inquiries received between June 26th and June 17th were about late blight on potatoes. The first case of late blight on tomato was confirmed on July 17th 2009. Inquiries about tomato late blight increased dramatically and remained high during the growing season. The weather data from May through September 2009 (Fig. 5B) showed that there were two consecutive days with 2 inches of rain on average in late June and cool night temperatures (50 to 60°F) during June and July, which may have contributed to the epidemics of late blight of potato in late June and early July. The outbreak of late blight on tomato in 2009 was associated with early season epidemics of late blight on potato and five days with average rainfall of 1-2 inches between early July and early August. In 2004 (Fig. 5C), although daily temperatures had similar patterns to that of 2009, it was dry in the early summer and there was less rainfall during the summer, which might be the reason that no epidemics of late blight occurred in Connecticut while an outbreak was recorded in Pennsylvania in August 2004.
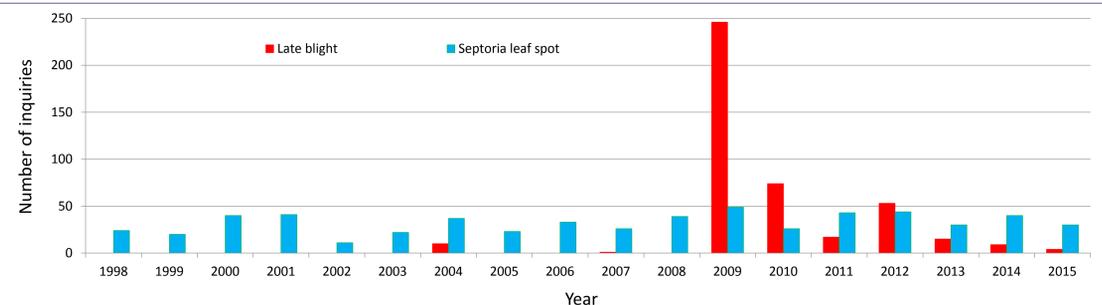
Figure 4. Changes in numbers of inquiries about Septoria leaf spot of tomato and late blight of tomato and potato
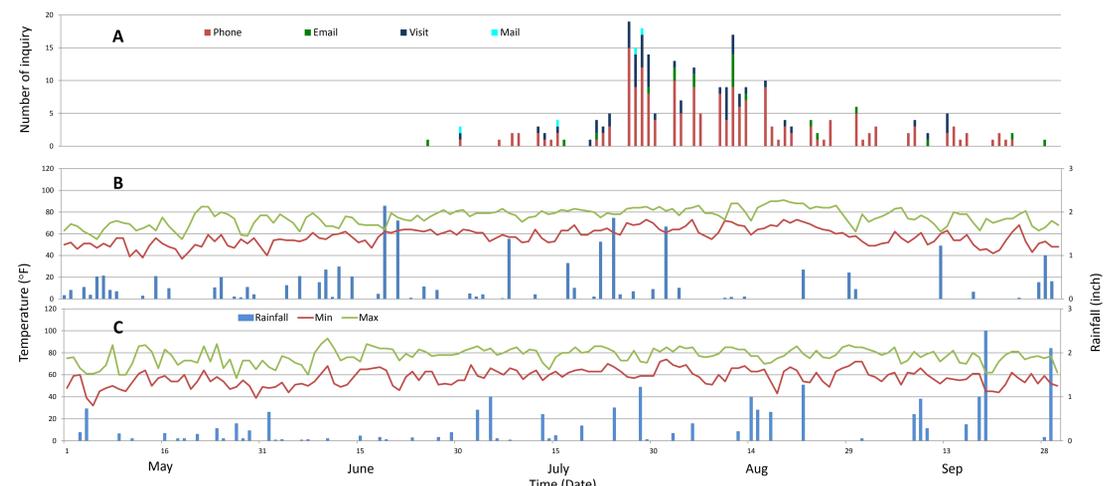
Figure 5. Changes in numbers of inquiries about late blight of tomato and potato in 2009 (A) and daily rainfall and temperature in 2004 (B) and 2009 (C)