INCIDENCE AND IMPACT OF LATE BLIGHT IN POTATO AND TOMATO IN WISCONSIN

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Introduction

Late blight is a potentially destructive disease of potatoes and tomatoes caused by the fungal-like organism, *Phytophthora infestans*. This pathogen is referred to as a 'water mold' since it thrives under wet conditions. Symptoms include leaf lesions beginning as pale green or olive green areas that quickly enlarge to become brown-black, water-soaked, and oily in appearance. Lesions on leaves can also produce pathogen sporulation which looks like white-gray fuzzy growth. Stems can also exhibit dark brown to black lesions with sporulation. Tuber infections are dark brown to purple in color and internal tissues are often reddish brown in color and firm to corky in texture. The time from first infection to lesion development and sporulation can be as fast as 7 days, depending upon the weather.

Two mating types are needed to produce sexual, persistent soil-borne oospores. The population is largely clonal outside its center of origin in the Toluca Valley of Mexico, relying on production of asexual sporangia for persistence. In the U.S., clonal lineage (also referred to as genotype or strain) US-1 (A1 mating type) was the predominant clonal lineage until the late 1980s-early 1990s, when US-8 appeared. US-8 was the opposite mating type (A2) and was insensitive to mefenoxam, a fungicide with exceptional activity against oomycetes, but with a specific mode of action that effectively selects for insensitivity. New clonal lineages have predominated epidemics in recent years with varying levels of mefenoxam resistance. Late blight pathogen populations in the U.S. have and continue to experience major genetic changes or evolution. The end result is the production of pathogen isolates with unique genotypes and epidemiological characteristics. As such, continued investigation of this pathogen is necessary to maintain best management strategies in susceptible crops.

Our objective was to monitor for late blight on a state-wide basis and characterize *P. infestans* in a timely manner to inform appropriate management recommendations and enhance understanding of the pathogens introduction and persistence in Wisconsin.

RESULTS & DISCUSSION

The generally hot, dry weather of Wisconsin in the 2012 production season made for a year of good foliar disease control in potato and vegetable crops. In potato, but for minor incidences of early rhizoctonia and blackleg, and some later early blight, the season seemed destined to make its way through to harvest without account of late blight.

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However, mid-July brought isolated, and in some parts of the state, intense rain storms, adding the critical third angle to the disease triangle (recall the other two: disease-susceptible plants and pathogen). The manner in which the pathogen was introduced in 2012 is not well understood, but we know that sources can include infected potato seed or tomato transplants, infected potato volunteers, or aerial movement of inoculum from sites of disease. By 18 July, potatoes in Antigo and Plover areas had reached or exceeded late blight disease thresholds (DSVs of ≥18) and preventative fungicides for control were initiated. By 31 July, the first case of late blight was confirmed in state, with several counties to follow in the months of August and September (Table 1).

Table 1. Characterization of *Phytophthora infestans* isolates causing late blight in Wisconsin tomato and potato crops in 2012.

County	Crop	Date of Detection	Clonal Lineage of the Late Blight Pathogen
Barron	Potato/Tomato	31 July 2012	US-23
Adams	Potato/Tomato	31 July 2012	US-23
Portage	Potato/Tomato	2 August 2012	US-23
Oneida	Potato	4 August 2012	US-23
Waushara	Potato/Tomato	20 August 2012	US-23
Marathon	Potato/Tomato	22 August 2012	US-23
Rusk	Tomato	23 August 2012	US-23
Sheboygan	Tomato	24 August 2012	US-23
Sauk	Tomato	10 September 2012	US-23
Eau Claire	Tomato	14 September 2012	US-23

In 2012 across the U.S., late blight challenged both tomato and potato crops in over a dozen states along the eastern seaboard, the Midwestern states, and in isolated cases along the west coast. Predominating the epidemics was late blight clonal lineage US-23, a lineage only recently identified and characterized by the allozyme banding pattern at the glucose phosphate isomerase (Gpi) locus of 100/100 (2), is of the A1 mating type, and has some sensitivity to mefenoxam. In our UW-Plant Pathology Laboratory, US-23 isolates have shown to be prolific producers of sporangia (airborne spores), and have a cooler optimum growth temperature than other recent strains, US-22 or US-24.

Over the past 4 years, late blight isolates were collected from potato and tomato from across the state. A lab technique known as allozymes genotyping revealed 3 banding patterns which profiled US-22, US-23, and US-24. In our phenotype testing, all isolates of US-22 were sensitive to mefenoxam, while isolates of US-23 and US-24 showed partial insensitivity. US-22 isolates were of the A2 mating type, and US-23 and US-24 isolates were of the A1 mating type. Isolates of opposite mating types were geographically separated in the state in 2010. We have only identified single mating types (A1) in WI in the past 2 years, reducing the potential risk for recombination and production of soil persistent oospores (Figure 1).

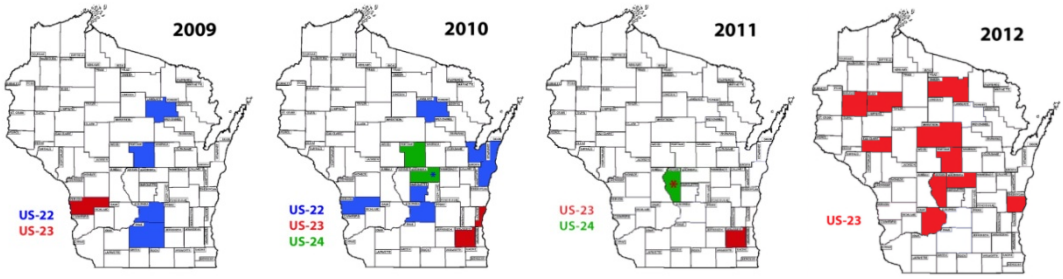

Figure 1. Occurrence of late blight in potato and/or tomato crops in Wisconsin during 2009 to 2012. Blue-colored counties indicate *P. infestans* clonal lineage US-22. Red counties indicate US-23. Green counties indicate US-24.

In each of the recent 4 years of late blight epidemic in Wisconsin, inoculum sources have likely been variable resulting in inconsistent clonal lineage and geographic patterns in each year. The late blight in WI in 2009 was associated with the nationwide epidemic likely initiated by infected tomato transplants, thus one clonal lineage, US-22, predominated. In 2010, the sources of late blight are unknown, but US-22 may have overwintered on plant material protected under the early heavy snowfall; US-24 was found only on potato in central WI, and US-23 was found only on tomato, primarily in areas of WI with concentrated suburban tomato gardens. In 2011, WI had an early (7 July) and isolated detection of late blight on tomato in Waukesha Co. caused by US-23. Late blight did not again reappear until confirmed on 26 and 27 August in Waushara and Adams Cos. (both US-23 and US-24). The US-23 clonal lineage was the only lineage identified in the state in 2012. Due to the late blight field signature in potato fields in late-July 2012, in addition to early season detects of US-23 in potato fields in other U.S. production regions, it is likely that US-23 was disseminated in the seed potatoes. Table 2 provides further detail on characteristics of common clonal lineages identified in Wisconsin during 2009-2012.

Table 2. Characterization of *P. infestans* clonal lineages US-22, US-23, and US-24 identified in Wisconsin during 2009 to 2012.

Clonal lineage	**Mating type**	**Optimum growth temp**	**Host comments**	**Years found in WI**	**Resistance to mefenoxam**
US-22	A2	24ºC	Tomato and potato, poor pathogen on pepper, eggplant, tomatillo	2009, 2010	Sensitive
US-23	**A1**	**18ºC**	**Tomato and potato**	**2010, 2011, 2012**	**Intermediately resistant**
US-24	A1	20ºC	potato	2010, 2011	Intermediately resistant (great variability among isolates)

With the recent presence of the late blight pathogen in the state and likelihood of disease-favorable weather conditions in upcoming years, it is critical that producers regularly scout their plants for disease. If late blight is suspected, contact your county extension agent, a crop consultant, the plant disease diagnostic clinic at UW-Madison, or myself. Additionally, protectant fungicides can manage late blight when applied in advance of infection and when re-applied as the crop grows. Wisconsin fungicide recommendations for late blight can be found in the University of Wisconsin Extension Publication entitled "Commercial Vegetable Production in Wisconsin," publication number A3422 (http://learningstore.uwex.edu/assets/pdfs/A3422.PDF) and additional information is provided in weekly newsletters during the growing season (provided at the vegetable pathology website: http://www.plantpath.wisc.edu/wivegdis/).

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