# LATE BLIGHT UPDATE FOR 2014

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## REVIEW OF THE BASICS

Late blight of potato and tomato is caused by *Phytophthora infestans,* a filamentous microbe that was first noticed by farmers and scientists in the mid-1840s. The disease was detected first in the USA and subsequently in Europe. It is known for its capacity to cause dramatic, devastating and rapid epidemics. The pathogen can infect all parts of the potato (and tomato) plant. The annual worldwide costs caused by this disease are estimated to be in the range of $6-8 billion. These costs include reduced yield, destruction of tubers, and fungicide and application expenses. The ancestral home of this pathogen is most likely in the highlands of central Mexico, where it has co-existed with wild *Solanum* spp for millennia. This region contains the most diverse population of *P. infestans* in the world.

**Disease Cycle:** The disease cycle in the United States is very simple. While the pathogen is capable of both sexual and asexual reproduction, epidemics in the USA have been caused almost exclusively by asexual reproduction of the pathogen. (As an asexual organism, *P. infestans* is essentially an obligate pathogen – it cannot exist for more than a few weeks in the absence of a host. The product of sexual reproduction is an oospore which can survive for years in soils.) Asexual reproduction is favored by mild temperatures (typical of night time temperatures in the northeast) and moist conditions (i.e. associated with dew). The pathogen propagule that is dispersed from one plant to another is a sporangium. This propagule germinates in a film of water to produce a motile zoospore which can swim in water for minutes before it settles down and penetrates into suitable host tissue. Infection can be established in less than two hours after a sporangium arrives on a host surface. Once the pathogen establishes infection in host tissue it is protected from most "contact" fungicides.

**Epidemics:** Epidemics can occur astonishingly fast or surprisingly slow. A fast epidemic is difficult to suppress, but a slow epidemic is much easier to suppress. A fast epidemic can occur if there is a large source of the pathogen on susceptible plants close to your field, and if weather conditions are very favorable to pathogen growth (i.e. night time temperatures of 55-70 °F, and night time leaf wetness for 8- 12 hours). These conditions will stimulate pathogen growth (sporulation) and the resulting sporangia can be wind dispersed to your field (especially if your field is close (within 1-2 miles). Dispersal typically occurs during the daytime, and infection typically occurs during the cool wet conditions at night. Cycles of reproduction can occur in as few as four days. If there is a very large number of sporangia deposited on an unprotected crop, severe symptoms are likely detectable within 5-8 days after inoculation. A slow epidemic would occur if there is a very small source of the pathogen (only a few lesions at the source, a source at some distance away, weather conditions that do not favor the pathogen (dry), or a protected crop (fungicide or a high level of host resistance). If there are very few infections in your crop, these are very difficult to see – even upon careful scouting. A slow epidemic might barely persist for several weeks – until it dies out or until conditions change so that the epidemic can gain momentum and become visible.

**Source of the pathogen.** The most common source of the pathogen in a potato agro-ecosystem is infected seed tubers or infected tubers that survive the winter as volunteers or in a cull pile. While infected seed tubers are very important in terms of long distance dispersal, most infected seed tubers do not initiate an epidemic, but rather either rot in the ground or produce a healthy plant. In a tomato agro-ecosystem, we've seen that infected transplants (i.e. 2009 epidemic) can be remarkably effective in distributing this pathogen. However, infected transplants have probably reverted to being a rare event.

**Pathogen dispersal.** In addition to long distance transport in infected seed tubers, *P. infestans* sporangia can also be wind dispersed. Wind dispersal happens mainly during the daytime. We know that solar radiation is lethal to sporangia, so very long distance transport of sporangia is highly unlikely. However, local aerial transport is certainly possible.

## PATHOGEN DIVERSITY

In the United States, there is often dramatic similarity of the pathogen over broad regions. Essentially the same strain of the pathogen can be distributed very widely. This was dramatically evident in 2009 when the US22 lineage of *P. infestans* was distributed throughout the eastern USA. We can identify different strains of *P. infestans* using diverse molecular markers, and recently, only four strains (lineages) have been common. In 2009, US22 was very common. More recently US23 has become dominant in the east, and US24 has been detected primarily in the Midwest and West. US11 has been found mainly in the West and in Florida. In the absence of sexual reproduction, these lineages remain somewhat dominant – unless a new lineage is introduced from some other source.

The current lineages have somewhat diverse characteristics as identified in the table below:

Table 1. Recent lineages of *P. infestans* prevalent in the USA

| Lineage | Sensitivity to Mefenoxam | Mating type | Host Preference |
|---|---|---|---|
| US11 | R | A1 | Potato and Tomato |
| US22 | S | A2 | potato and tomato |
| US23 | S | A1 | Potato and Tomato |
| US24 | S | A1 | Potato |

US11 is very pathogenic on both potatoes and tomatoes; US22 is somewhat less aggressive than US11 on potatoes and tomatoes; US23 has become prevalent and is quite pathogenic on both potatoes and tomatoes; US24 is mainly a pathogen of potatoes. While both A1 and A2 mating types have been in the USA, there is not yet evidence of sexual reproduction contributing significantly to the pathogen diversity or ecology. In 2013, US23 accounted for >95% of all samples typed in our lab.

## USE OF THE CORNELL DECISION SUPPORT SYSTEM (DSS) TO MANAGE LATE BLIGHT

We have been working for some years to develop an integrated approach to managing late blight. The DSS is available at www.usablight.org/DSS, or at http://blight.eas.cornell.edu/blight/. The system enables the user to obtain very site-specific weather and very site-specific weather forecasts. These weather data are combined with data concerning the host resistance and a record of fungicide application to identify the most effective and efficient management of late blight. In field tests on the Freeville research farm, we've suppressed late blight as effectively as the standard grower practice while allocating fungicide more efficiently (less fungicide). Cultivar resistance, fungicide efficacy and weather are all variables that are considered in determining the need for the next fungicide application. Features of the DSS will be discussed.