USABlight: A tool to fight late blight: a re-emerging plant disease that threatens global food security

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Late blight re-emerging disease: A constraint to production worldwide - food security

Has increased in incidence, geographical and host range
Why is late blight a re-emerging plant disease?

- Varied dispersal mechanism (airborne inoculum and in plant material)
- Polycyclic nature of disease cycle
- Fungicide resistance
- Ability to shift hosts (potato, tomato, petunia, wild hosts) exploit new niches
- Genome plasticity – effector diversity overcomes host resistance
- Monoculture of susceptible hosts
Late blight epidemics in the US in 2009
Emergence of US-22 strain

- Climate change – rainy season
- Movement of infected tomato transplants
- Susceptible varieties
USDA NIFA grant: Goal to slow disease reemergence

- Grower Alert System – Link extension and research communities to implement novel disease control strategies
- Real time system to track genotypes and phenotypes USA blight developed
- Evaluate baseline fungicide sensitivity data
- Develop quick methods to detect pathogen and fungicide sensitivity
- Durable resistance on both tomato and potato
Management recommendations for fungicide use, including solutions for organic growers.

- **Public reports**
  - National reporting & alert website

- **Co-PD labs**
  - *P. infestans* genotypes (SSRs) & phenotypes

**Objective:** improve management tools

Slide courtesy of H Judelson
Objective: characterize *P. infestans* strains

**Past**
- Methods for identifying genotypes developed.
- Phenotypes assigned to lineages.
- Data not available in time to aid disease management.
- Missed opportunities!

(2009 epidemic US-22 was sensitive to mefenoxam)

**Five-year funding period**
- Rapid genotyping, SSR (lineage) data to website in 3 days.
- Decision Support System deployed, tailored to pathogen phenotypes.
- Rapid (DNA-based) trait-specific assays developed, deployed to extension.

**Future vision**
- Real-time diagnosis of pathogen traits.
- Disease management more efficient.
- Economic and environmental benefits due to better control, reduced fungicide use.

Slide courtesy of H Judelson
Developed a National Grower Alert System

Welcome to USAblight

Welcome to USA blight, a new national website that will act as an information portal on late blight. You can report disease occurrences, submit a sample online, observe disease occurrence maps, and sign up for text disease alerts. There are also useful links to a decision support system, and information about identification and management of the disease.

Potato late blight lesion. Image courtesy of Jean Ristaino, NC State University.
Reported Late blight Outbreaks on USAblight
Landscape level view of late blight
ArcMap Project - Late blight outbreaks 2011-15
5 Years of Data

Number of records: 1094
Number of states/provinces: 37
~ 64% tomato reports
~ 82% US-23 reports (within genotyped samples)
~ 59% reports from conventional production systems
Recent Genotypes of *Phytophthora infestans* in the Eastern United States
Reveal Clonal Populations and Reappearance of Mefenoxam Sensitivity

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Table 3. Summary of multilocus genotypes of *Phytophthora infestans* collected in the United States and Canada, 2002 to 2009

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Host</th>
<th>MT</th>
<th>Gpi</th>
<th>Pep</th>
<th>Mefenoxam Sensitivity</th>
<th>mtDNA</th>
<th>RG57 RFLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>US-8</td>
<td>Potato</td>
<td>A2</td>
<td>100/111/122</td>
<td>100/100</td>
<td>R/I</td>
<td>Ia</td>
<td>1,5,10,13,14,16,20,21,23,24,25</td>
</tr>
<tr>
<td>US-20</td>
<td>Tomato</td>
<td>A2</td>
<td>100/100</td>
<td>100/100</td>
<td>R/I</td>
<td>Ia</td>
<td>1,3,5,7,10,13,14,16,18,20,21,24,25</td>
</tr>
<tr>
<td>US-21</td>
<td>Tomato</td>
<td>A2</td>
<td>100/122</td>
<td>100/100</td>
<td>R/I/S</td>
<td>Ia</td>
<td>1,5,10,13,14,18,20,21,24,25</td>
</tr>
<tr>
<td>US-22</td>
<td>Potato and tomato</td>
<td>A2</td>
<td>100/122</td>
<td>100/100</td>
<td>S/I</td>
<td>Ia</td>
<td>1,5,13,14,16,20,21,24,25</td>
</tr>
<tr>
<td>US-23</td>
<td>Potato and tomato</td>
<td>A1</td>
<td>100/100</td>
<td>100/100</td>
<td>S/I</td>
<td>Ia</td>
<td>1,2,5,6,10,13,14,17,20,21,24,24a,25</td>
</tr>
<tr>
<td>US-24</td>
<td>Potato</td>
<td>A1</td>
<td>100/100/111</td>
<td>100/100</td>
<td>I</td>
<td>Ia</td>
<td>1,3,5,7,10,13,14,16,20,21,23,24,25</td>
</tr>
</tbody>
</table>


US genotype frequency
Fungicides used for control

Over 2500 tons active ingredient/year in USA: $200 million
How do the recent US lineages respond to Oomycete target fungicides?

• US-8 and US-11 highly resistant to mefenoxam
• All lineages sensitive to azoxystrobin, cyazofamid, cymoxanil, fluopicolide, mandipropamid,

Summary

- USAblight disease alert system developed
- Rapid genotyping with 12-plex SSRs – Fry lab and team
- Shift in genotypes with time
- US-8 and US-11 are mefenoxam resistant. Other lineages are sensitive to most Oomycete targeted compounds
- FL tomatoes source of novel lineages in western NC and US
Thank you Late blight team and USDA NIFA for funding us

Judelson  Smart  Fry  Grünwald  Ristaino  Gloy  Gay  McComas
Klessig  Xiao  Girke  Birch  Boyles  Hein  Scott  Johnson
Besley  Seebold  Lozoya  Gugino  Everts  Gevens  McGrath  Stone  Roberts
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