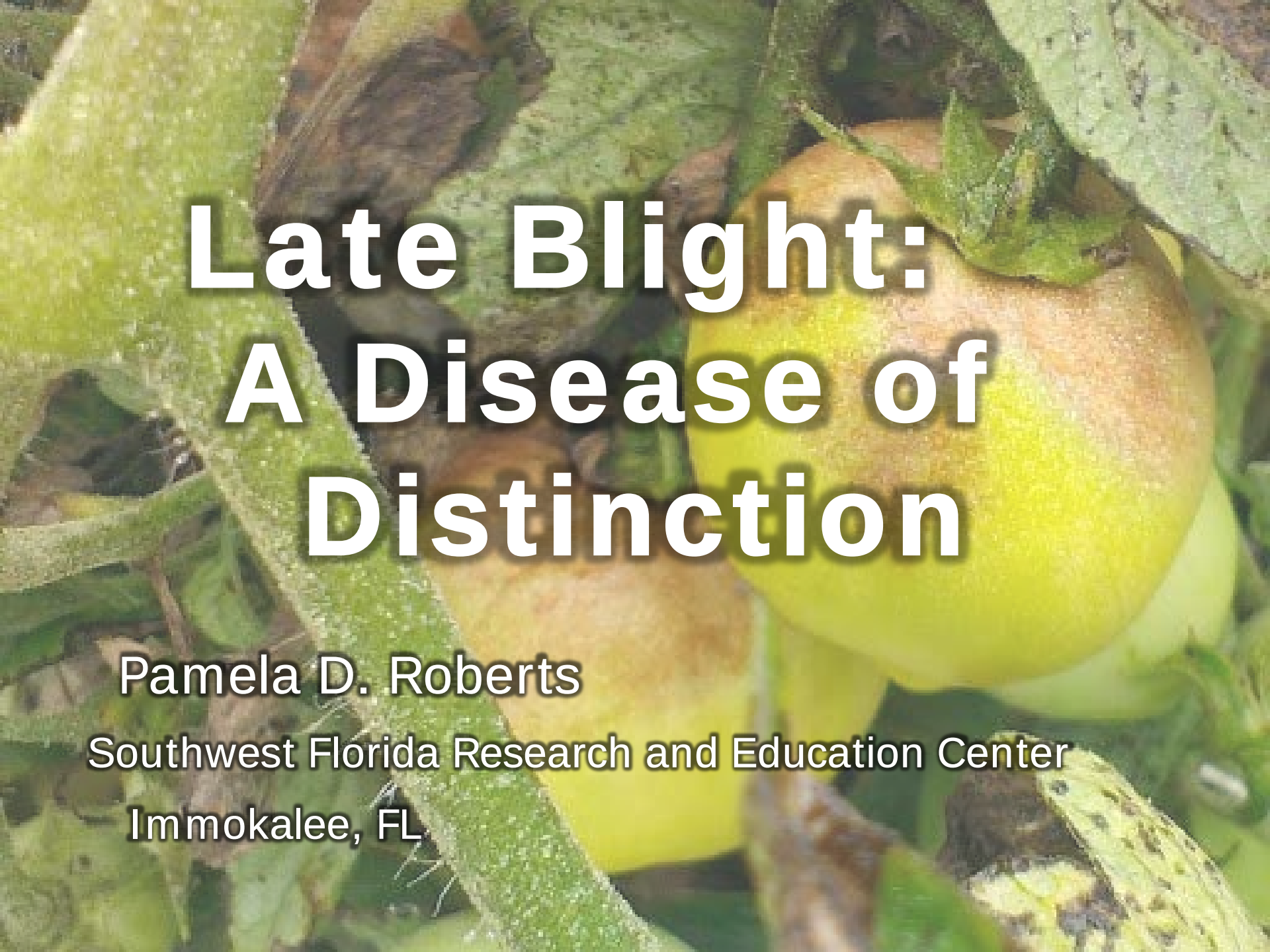


Late Blight: A Disease of Distinction

Pamela D. Roberts

Southwest Florida Research and Education Center

Immokalee, FL

What is late blight?

- Occurs on potato and tomato and is historically one of the most important diseases on worldwide
- Caused by fungal-like oomycete, *Phytophthora infestans*
- *Phytophthora* = 'Plant destroyer'
- Irish potato famine- contributed to mass starvation and emigration in Ireland along with other factors
- Pandemic in 2009 caused nearly 100% loss of organic and backyard tomatoes on east coast of US
- Estimated $3 billion annually to control and manage this disease worldwide

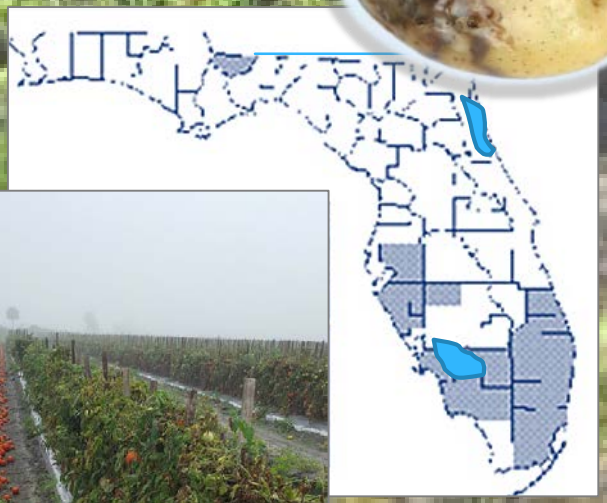
Why is it a disease of distinction?

- Historical and economic impact
- “Continues to appear in new locations and new intensity”
- “Worldwide populations of the pathogen are in flux”
- “Genomics revolution has enabled researchers to make tremendous progress in understanding host-pathogen interactions”
- “Many compelling unanswered questions remain”

*Fry et al. 2015. Phytopathology 105:966-981

Late Blight in Florida

- Occurs on both potato and tomato
- Reported on petunia and solanaceous hosts but not documented to occur naturally in Florida
- Significant losses (up to 100%) can occur if not controlled



- The additional fungicides needed for late blight control can increase pest management costs up to $100-300/acre (34,000 A tomato harvested in 2012)
- In 2005, widespread outbreaks led to huge losses due to a change in the ‘genotype’ of the pathogen
- Currently, late blight is not as big of a concern.

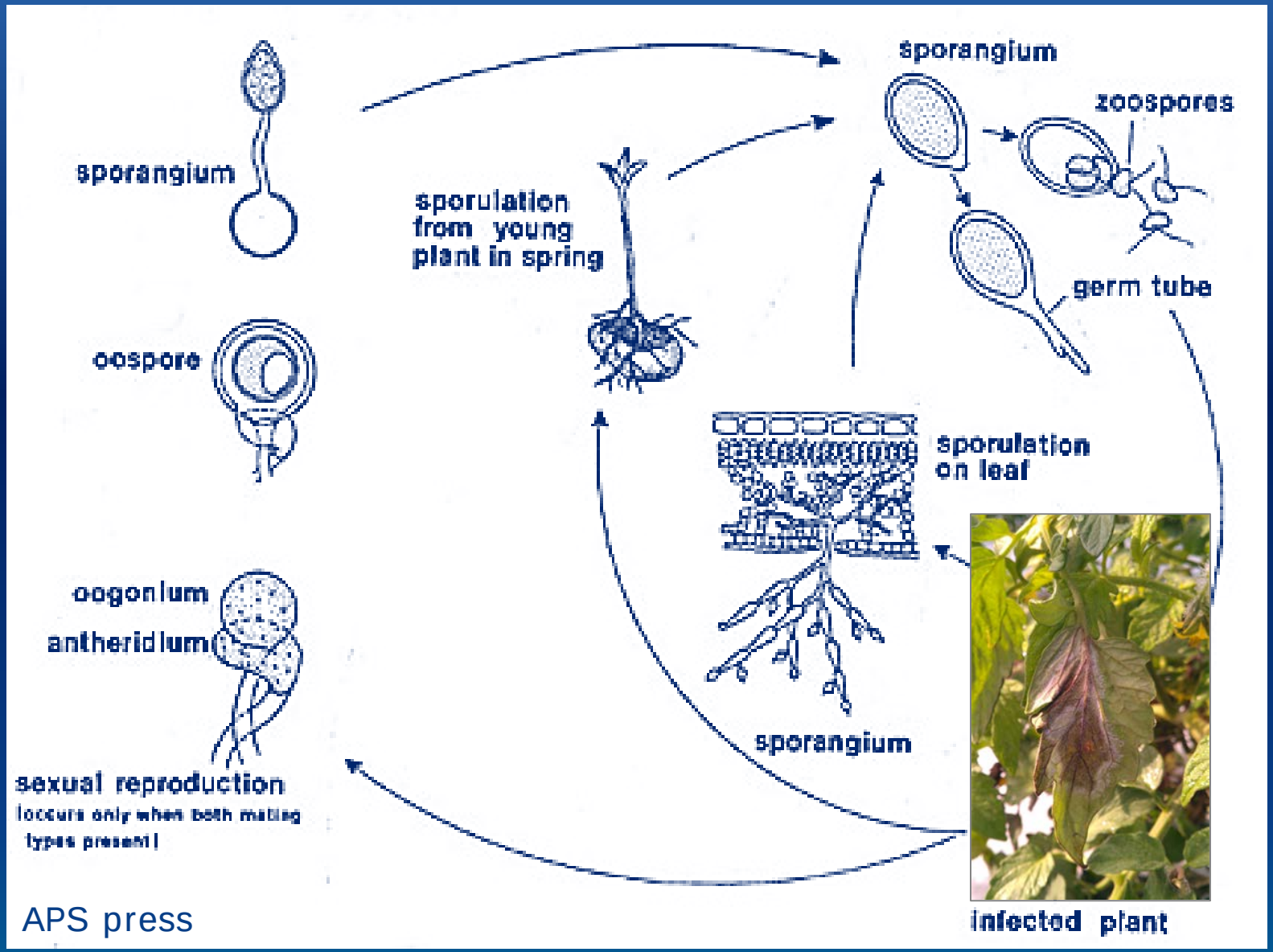
Late Blight caused by *Phytophthora infestans* on tomato

Late blight on potato

About the pathogen

- *Phytophthora infestans* is a very efficient and effective pathogen ‘very good at being bad’
- Sexual reproduction and mutations allow for new genotypes so new populations can emerge
- Effective short and long distance dispersal
- Rapid reproduction within 4 days of initial infection
- Entire fields can be blighted within 14 days of first detection

Disease Cycle of *Phytophthora infestans*



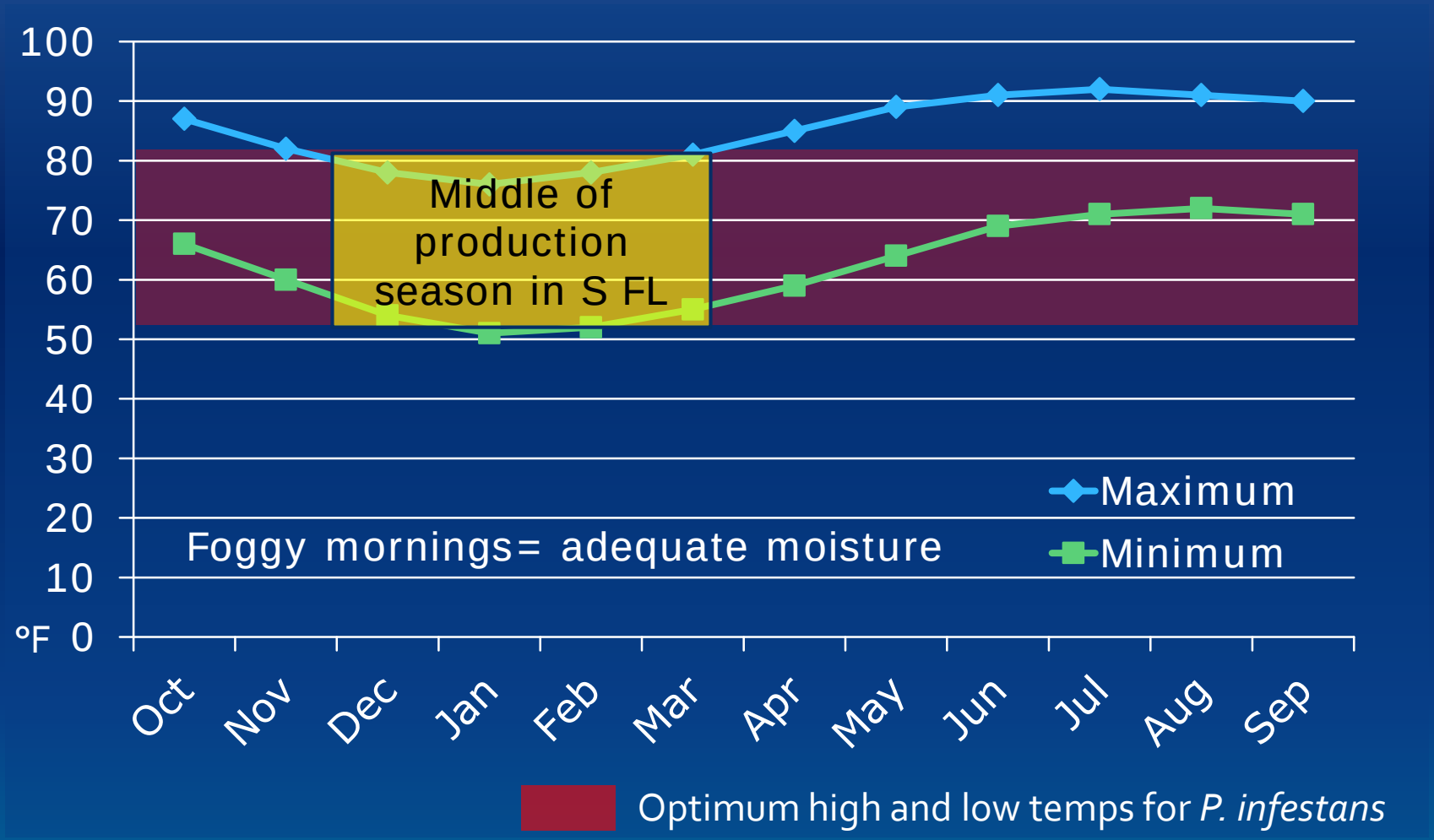
APS press

For infection to occur

Must have:

- Susceptible host
- Pathogen
- Conducive environmental conditions
  - Must have water film for zoospores to swim. It needs moisture
  - Foggy mornings are sufficient for leaf wetness

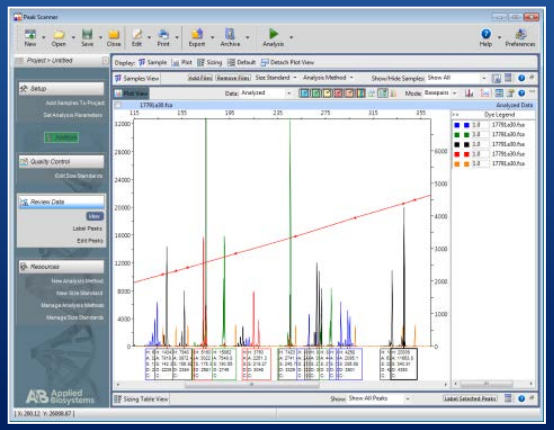
30-Year Average High and Low Temperatures for Immokalee



How does the pathogen get to Florida and move around?

- We know that it moves on infected potato tubers shipped into Florida
- No evidence for over-summering in Florida
- No evidence for sexual reproduction in Florida or most production regions in the US- we know this by genotyping and additional analyses

Importance of genotyping *P. infestans*



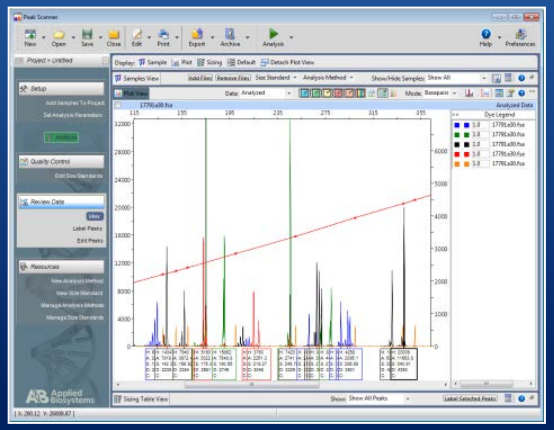
Genotype

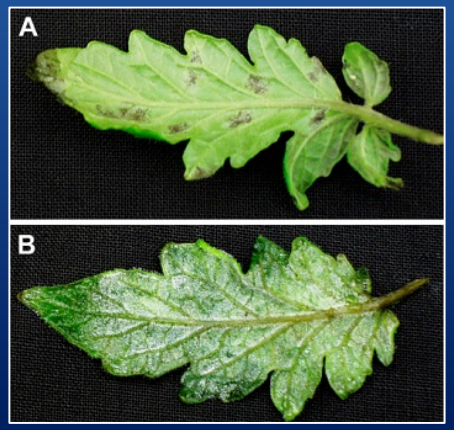
‘Genotype’ is defined as the genetic makeup of an organism

Not race because no associated resistance genes in hosts

- Currently DNA ‘Fingerprinting’
  - SSR =Microsatellite markers on more than 10 loci (Lee et al, 2006)
- Send samples to Dr. Bill Fry at Cornell for quick SSR typing
- Samples processed very quickly

Importance of genotyping *P. infestans*





Genotype → Phenotype →

Host preference

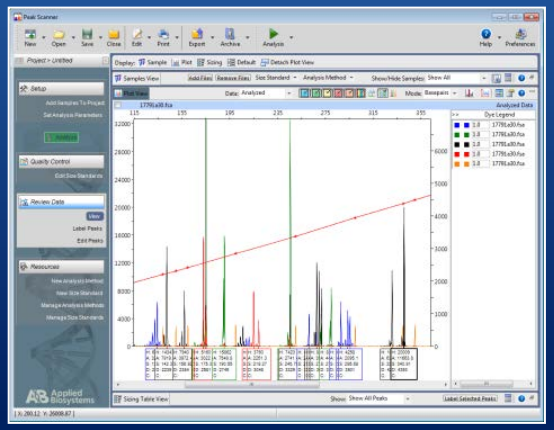
Fungicide sensitivity

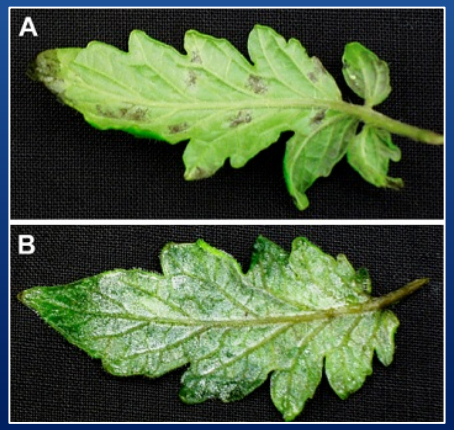
Mating type

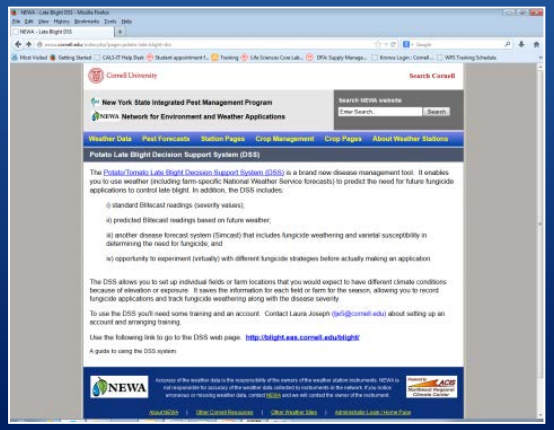
‘Historical’ epidemiological performance

Usablight.org

Importance of genotyping *P. infestans*







Genotype → Phenotype → Control Strategies

‘Genotype’ is defined as the genetic makeup of an organism

Host preference

Fungicide sensitivity

Mating type

Late blight Cornell Decision Support System (DSS)

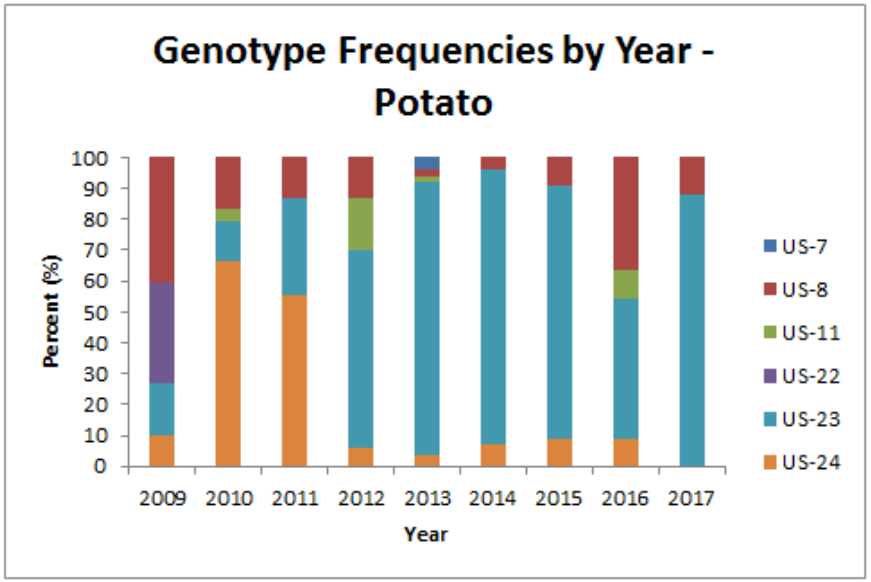
Fungicide selection

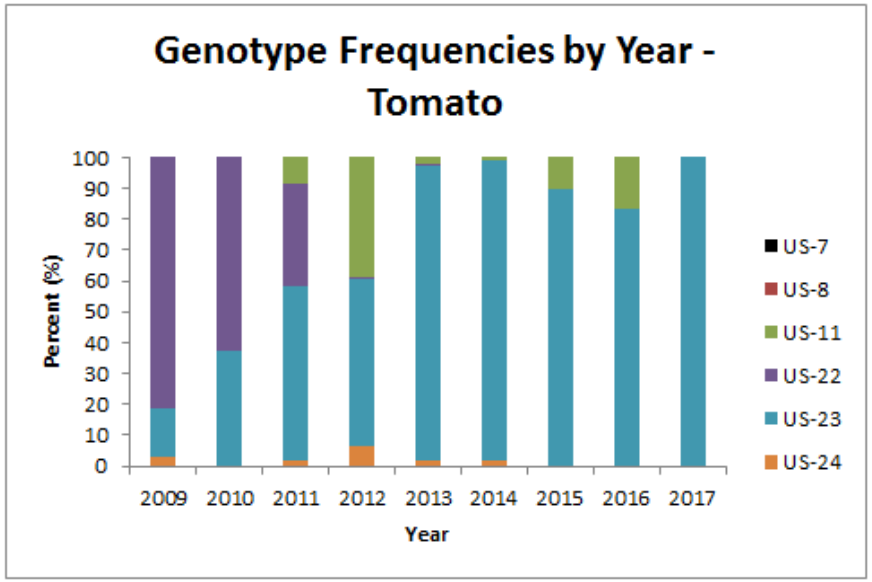
Usablight.org

Summary of some key characteristics of recent US genotypes of *Phytophthora infestans* on tomato and potato*

Genotype	Host	Mating type	Sensitivity to mefenoxam*
US-8	Potato	A2	Intermediate to Resistant
US-11	Potato/Tomato	A1	Resistant
US-20	Tomato	A2	Intermediate to Resistant
US-21	Tomato	A2	Sensitive to Intermediate
US-22	Potato/Tomato	A2	Sensitive to Intermediate
US-23	Potato/Tomato	A1	Sensitive to Intermediate
US-24	Potato	A1	Intermediate

*Mefenoxam (active ingredient in Ridomil) was one of the first effective fungicides and is also used to characterize populations as related to resistance genetics





Genotype which occurred in 2005 on tomato was particularly ‘aggressive’ and was not controlled by intensive spray program

In contrast, 2006 and recent genotypes were more ‘typical’ and not as difficult to manage

http://usablight.org/node/52

Recent Advances in Management of Late Blight

- Genotyping the USA population
- Improved early detection
- Resistance in tomato and potato
- Wider array of highly effective fungicides
- Decision support system (DSS) for timing of fungicides

Recent advances in Management of Late Blight

- Improved early detection – make management decisions before leaving field
  - Hyperspectral reflectance system in development
  - Rapid Diagnostic Assays- results in minutes

Recent advances in Management of Late Blight

- Resistance in tomato and potato
  - Several potato varieties have rate reducing resistance
  - Resistance in tomato: some non-Florida commercial and backyard gardener varieties have resistance—but UF/IFAS is working on it

Resistance to Late Blight in Tomato, Spring 2014

Resistant

Susceptible

Management of Late Blight in fungicide programs, Spring 2014

Untreated

BravoWeatherStik

BravoWeatherStik/Revus

BravoWeatherStik/Zampro/Ranman

Additional effective Fungicides have been Labeled recently

http://usablight.org/map | mp3support.sandisk.com | Late Blight Map | USAblight

Search | Share | More »

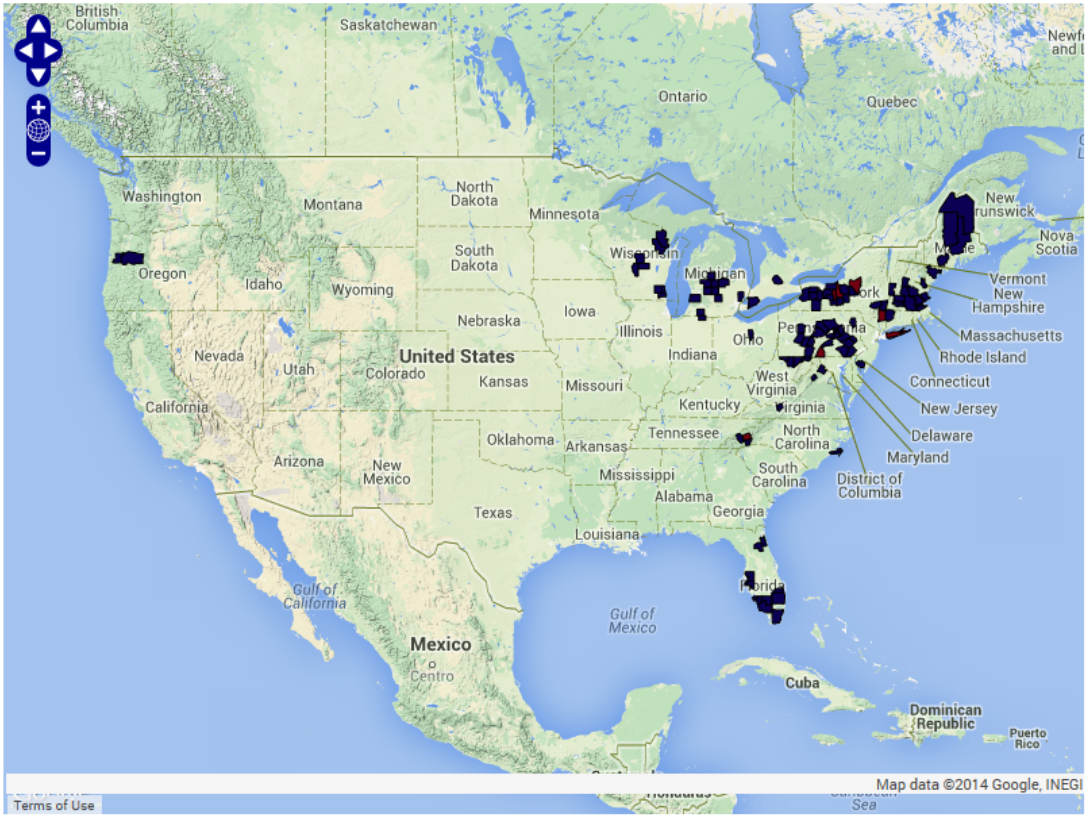
Occurrence Map ▼

Late Blight Map

http://usablight.org/map

Note: Not all states/regions currently report late blight to our web site. We encourage you to ask your local extension agent to report the disease.

Click on a county below for more report information.



Group by state

- 2 Buncombe County, NC
- 1 Cayuga County, NY
- 1 Dutchess County, NY
- 1 Oneida County, NY
- 1 Seneca County, NY
- 8 Suffolk County, NY
- 1 Franklin County, PA
- 1 Litchfield County, CT
- 1 Collier, FL
- 2 Collier County, FL
- 2 Hendry County, FL
- 2 Hillsborough County, FL
- 1 Lee County, FL
- 1 Manatee County, FL
- 1 Martin County, FL
- 1 Miami-Dade County, FL
- 1 Palm Beach County, FL
- 1 Putnam County, FL
- 3 St Johns County, FL
- 1 Lagrange County, IN

Legend: Observed in the last 7 days | Observed over 7 days ago

Late Blight Decision Support System (DSS)

*Small et al. 2015

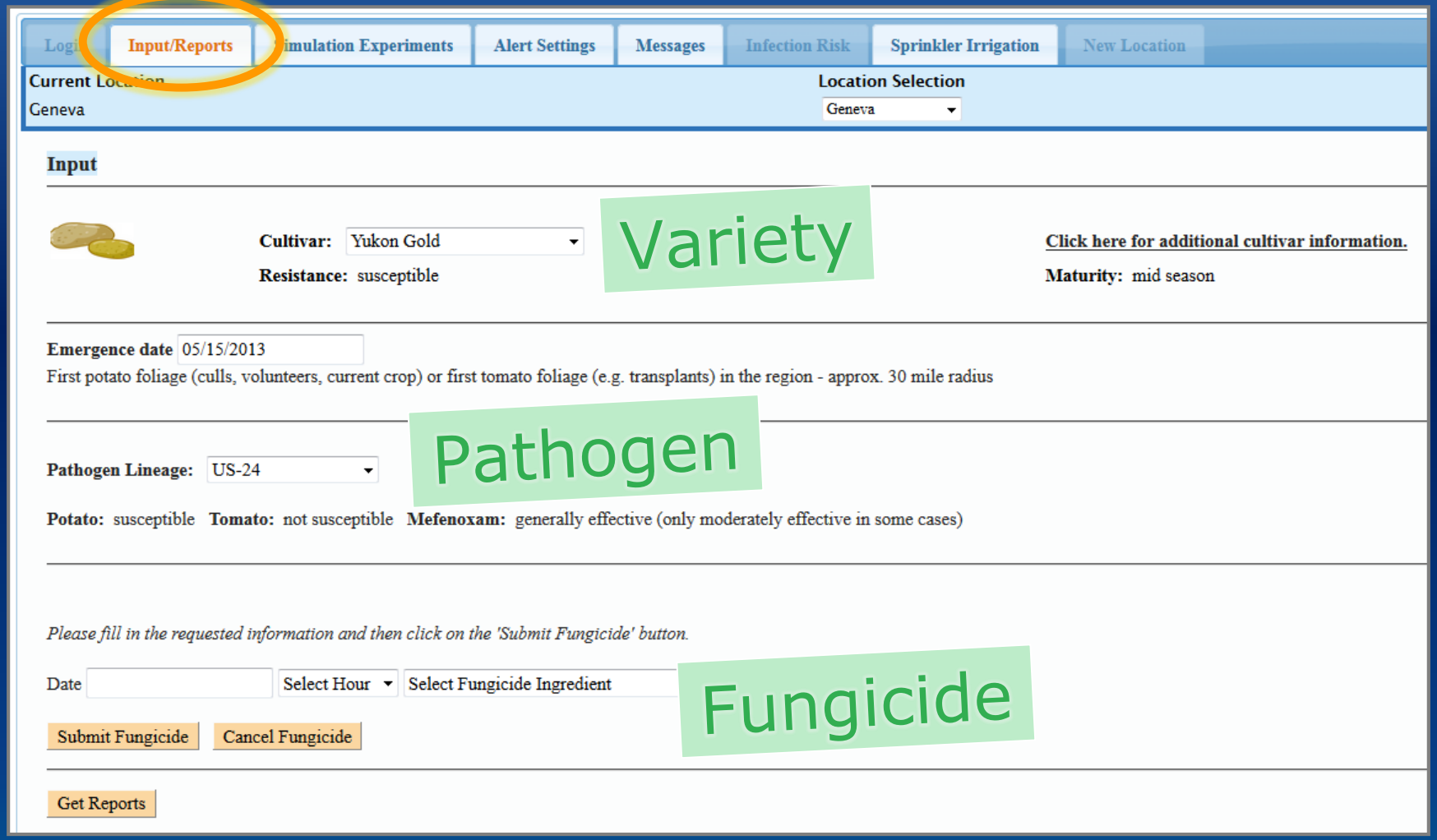
Decision Support System (DSS) is the term used for programs (mostly computer based) developed to assist growers in making disease management decisions, in this case fungicide applications.

1. Location-specific weather data (NWS, local FAWN)
2. Disease forecasting tools based on:

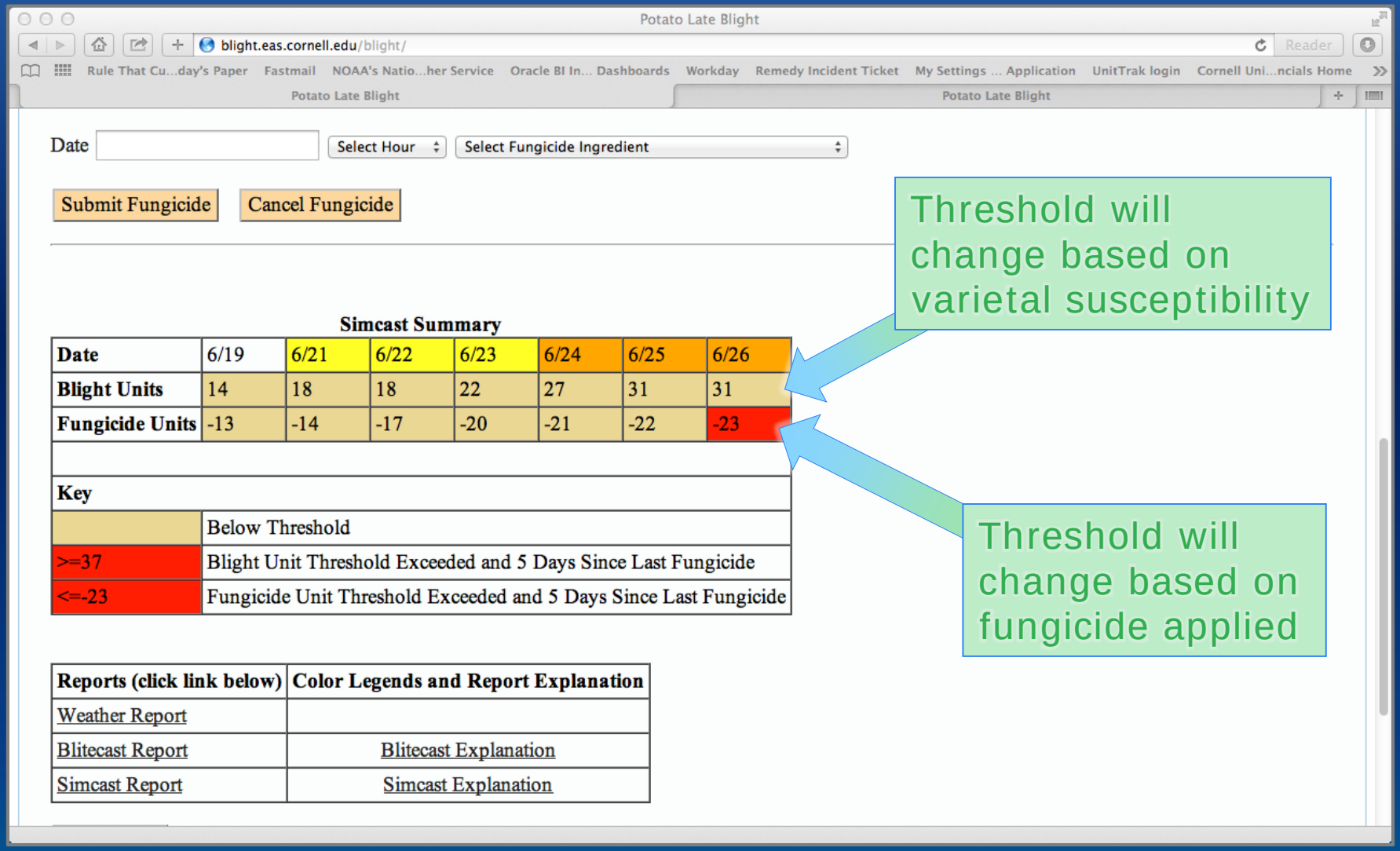
   Blitecast (estimates favorability of weather)

   Simcast (blight units, fungicide units and accounts for host resistance)
3. Can input varieties and US genotype
4. Alerts (email or text)

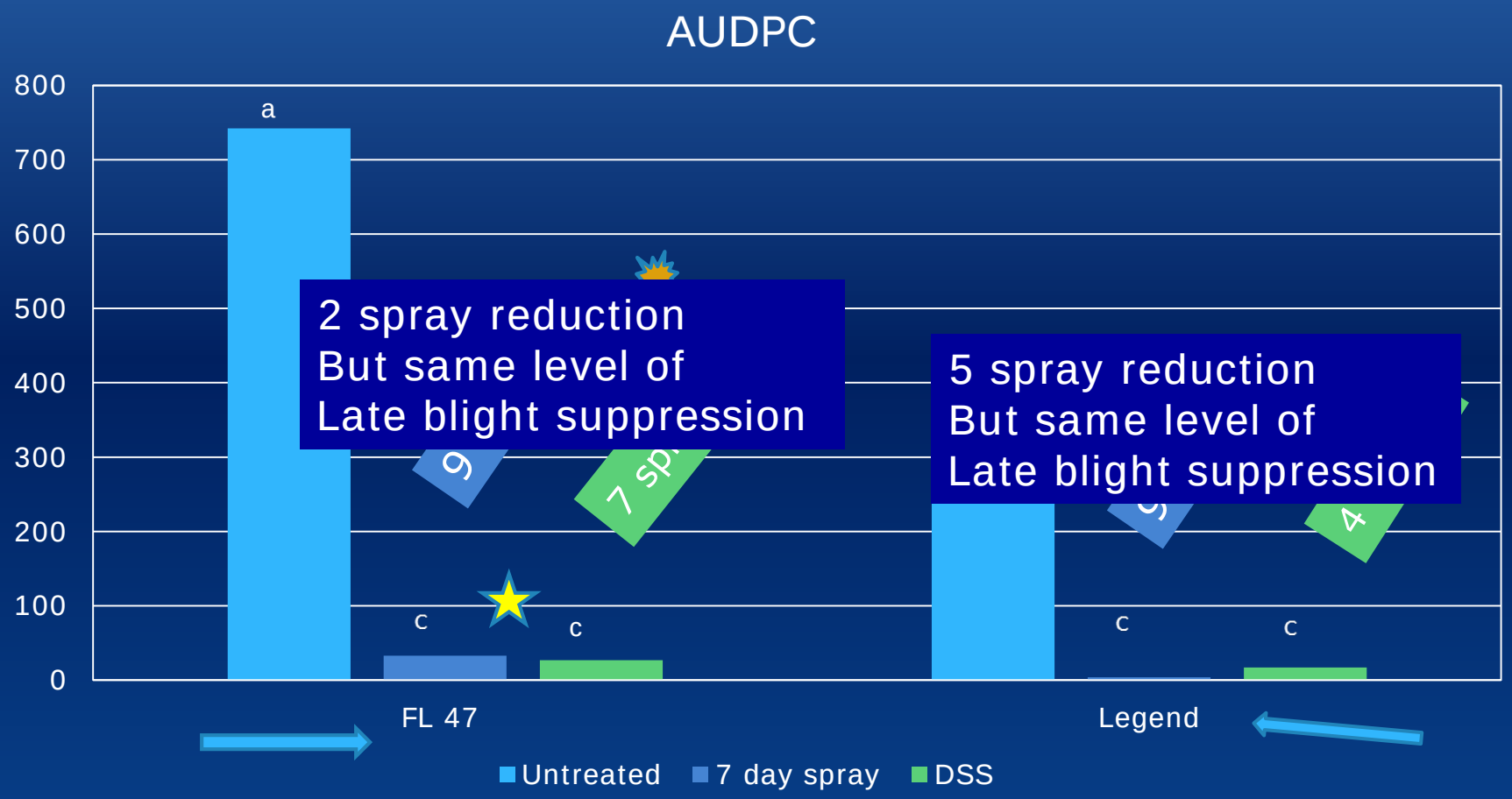
Late Blight Decision Support System



blight.eas.cornell.edu/blight/



Evaluation of a DSS for fungicide applications on very susceptible ‘FL47’ and moderately susceptible ‘Legend’ tomato, 2014

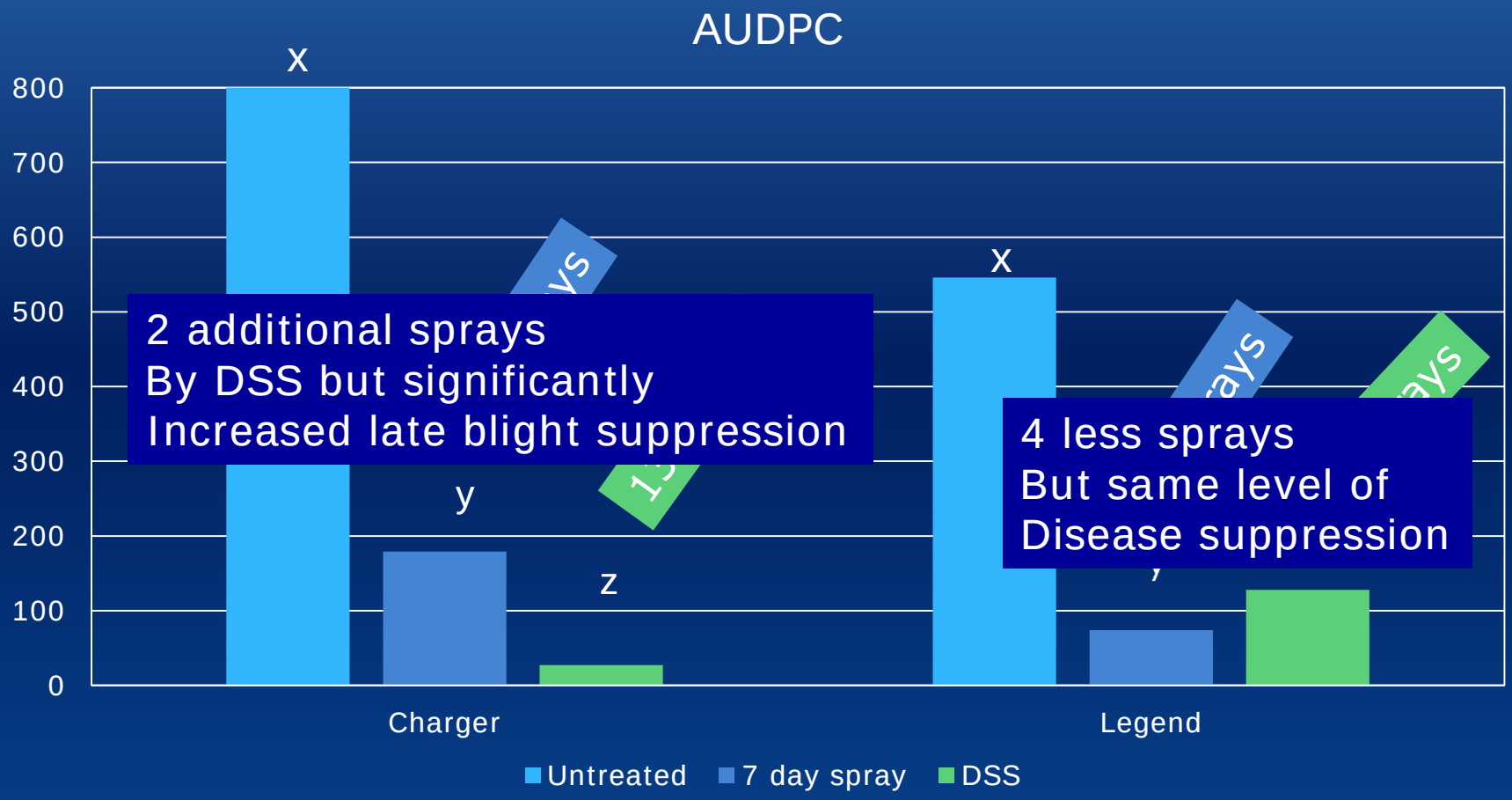


Untreated= no sprays

7 day full season= 9 sprays all chlorothalonil

DSS= Cornell Decision support system= 7 sprays for ‘FL 47’ and 4 for ‘Legend’

Evaluation of a DSS for fungicide applications on very susceptible ‘Charger’ and moderately susceptible ‘Legend’ tomato, 2015



Untreated= no sprays
7 day full season= 11 sprays: all late blight fungicides
DSS= Cornell Decision support system= 13 sprays for ‘Charger’ and 7 for ‘Legend’

Potential use of DSS in grower's fields

- Can this be used by growers?
- In 2017, we monitored a commercial tomato and potato field using the DSS
- The producer managed late blight in these crops according to their standard program
- At the end of the season, use of the DSS would have called for nearly 50% less applications of fungicide compared to grower's standard program
- We do not know if late blight would have been adequately controlled but, in the Netherlands, 40% of potato growers use a DSS system

In conclusion, DSS appears promising to aid in timing of fungicide applications in trials

Please refer to: Usablight.org

What about organic and backyard production?

- Select resistant varieties
- Use certified potato seed
- Destroy cull potato
- Destroy volunteers and weeds
- Early detection
- Protected culture
- Organic copper
- DSS to apply organic copper

*http://articles.extension.org/pages/18361/organic-management-of-late-blight-of-potato-and-tomato-phytophthora-infestans

“Currently, late blight is not as big of a concern”

- We have more information and tools than even 10 years ago
- What if new genotypes or old types appear?
- What if resistance to ‘new’ fungicides occur?
- Continued monitoring of pathogen is needed
- Still need to develop additional tools for use in commercial and organic operations
- Additional resources at http://edis.ifas.ufl.edu/

Acknowledgements

- Dr. Charles Mellinger, Galen Frantz, Leon Lucas and other personnel at Glades Crop Care
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- USDA–AFRI: This project was supported by the Agriculture and Food Research Initiative Competitive Grants Program Grant 2011-68004-30154 from the USDA National Institute of Food and Agriculture

Recommendations

- Untreated plants and fruit were severely infected usually within a week of first detection of late blight lesions
- After 14 days, unprotected plants were more than 60% defoliated
- Fungicide applications should not be delayed
- Protectant fungicides used prior to late blight such as chlorothalonil (highly effective), mancozeb, and copper (less effective)
- Follow resistance management guidelines on label
- Other fungicides used protectively with wide spectrum of activity may also protect from late blight
- When weather is highly conducive (high relative humidity; fog; rain; leaf wetness period longer than 6 hours; cool temperatures) and late blight is established
  - Use fungicides specific to late blight
  - May need to shorten application intervals

Late Blight Management in Potato and Tomato

- Use only certified disease-free transplants and tubers
- Avoid adjacent plantings with older, infected crops
- Eliminate cull piles and volunteers
- Some potato varieties are rate-reducing resistant, tomato resistance in some commercial varieties for production regions other than Florida
- Scout fields particularly in wetter parts of fields or where spray applications might miss
- Use a late blight forecasting system, where available
- Maintain preventative fungicide schedule with good coverage
  - Particularly November through March or when late blight has been reported