

Late Blight of Tomato and Potato: Recent Occurrences and Management Experiences Webinar

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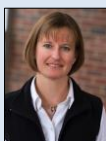
Chris Smart
Cornell University



Meg McGrath
Cornell University



Pam Roberts
University of Florida



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State University

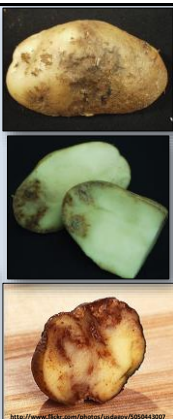


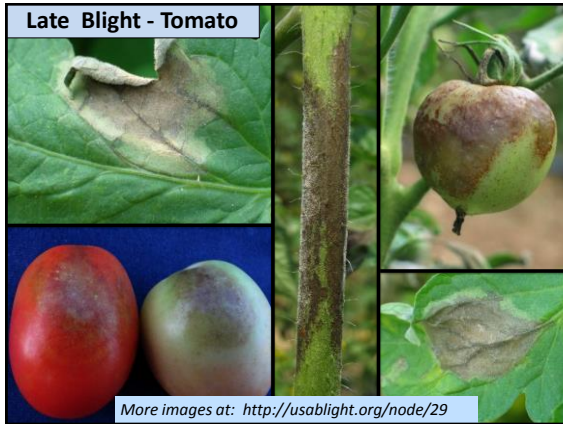
Amanda Gevens
University of Wisconsin

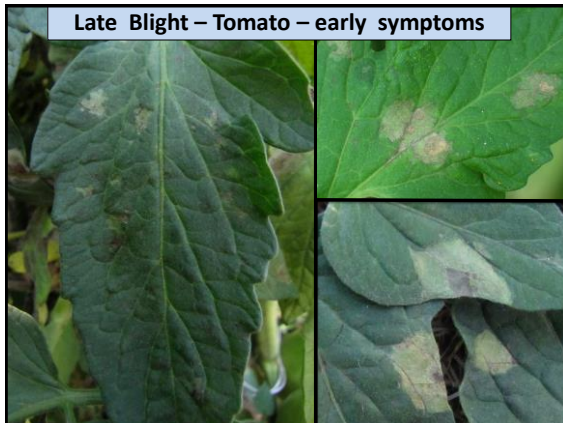
This project was supported by the Agriculture and Food Research Initiative Competitive Grants Program Grant 2011-68004-30154 from the USDA National Institute of Food and Agriculture.

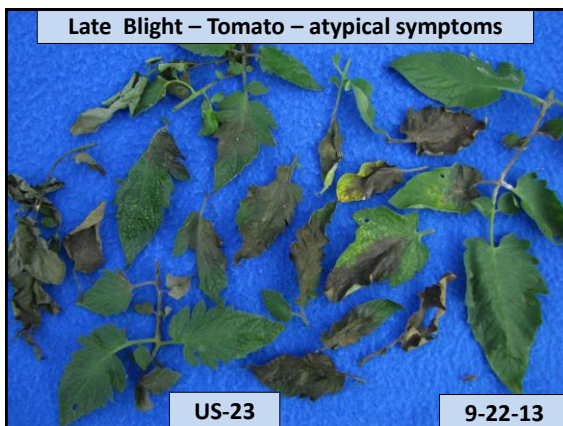


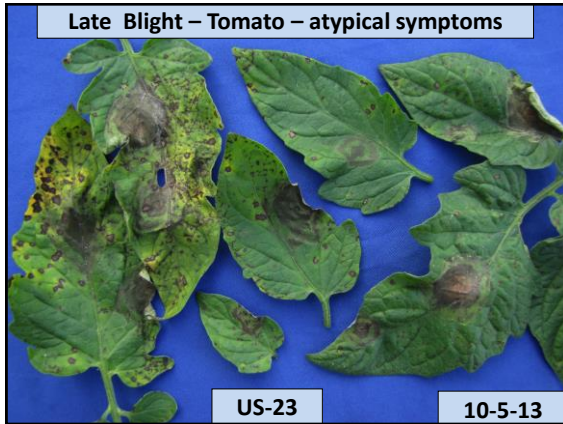
Late Blight
Potato











Poll Question #1

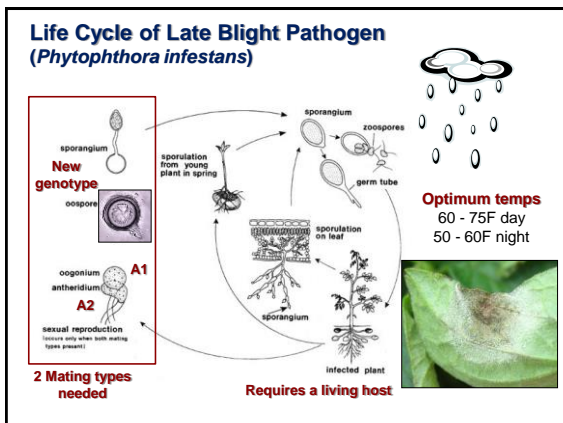
Growers: has late blight occurred on your plants?

Tomato

Potato

Both

Neither



Genotypes of *Phytophthora infestans*

- ➡ 'genotype' (or strain) is defined as the genetic makeup of an organism (DNA fingerprint).
- ➡ Knowing the genotype tells us LOTS about the pathogen (preferred host, ability to overcome resistance genes).
- ➡ Only 24 genotypes have ever been identified in the USA, with a small number (1-4) genotypes predominant each year.



Characteristics of recent strains

Genotype (strain)	Mating type	Host preference	# collected in 2013
US-8	A2	potato	2
US-22	A2	tomato	0
US-23	A1	potato/tomato	175
US-24	A1	potato	4

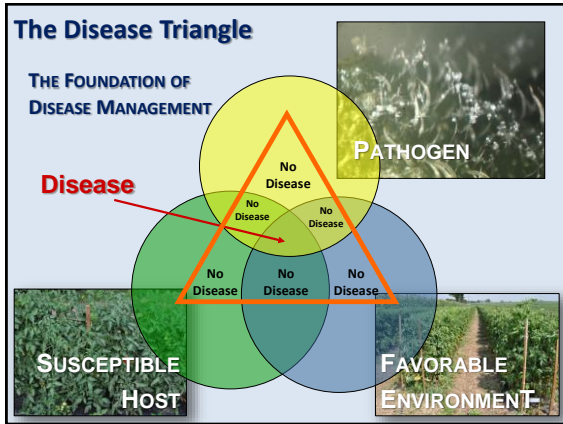
Poll Question #2

Growers: have you been able to effectively manage late blight?

Every season it has occurred

Some seasons

Never (nothing tried has worked adequately)





Major Genes for Late Blight Resistance in Tomato

Ph-1 Ph-2
Ph-3 Ph-5
 Plus unidentified genes

Many from a wild relative: *Solanum pimpinellifolium*

Heterozygous – one copy of the gene
Homozygous – two copies of the gene
 Gene-for-gene relationship with pathogen.

Late Blight Resistant Tomato Varieties

New Yorker (*Ph-1*)

Legend OP (*Ph-2*)

West Virginia (*Ph-2*)

Plum Regal (homozygous *Ph-3*)

Mountain Magic (campari) (heterozygous *Ph-2 + Ph-3*)

Defiant PHR (heterozygous *Ph-2 + Ph-3*)

Mountain Merit (heterozygous *Ph-2 + Ph-3*)

Iron Lady (homozygous *Ph-2 + Ph-3*)

Jasper (cherry)(undetermined resistance)

Matt's Wild Cherry (undetermined, *Ph-3?*)

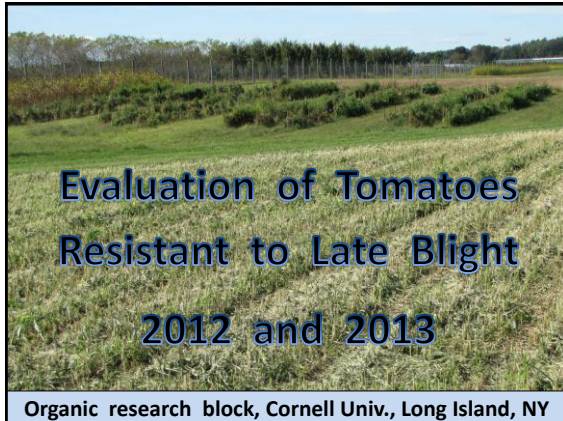
Juliet ??

Lemon Drop ??

Mr. Stripey (aka Tigerella) ??

Heinz 1439 ??

Wapsipinicon Peach ??



Resistant Variety Evaluation on Long Island

- ➡ Applied an organic fungicide program to all in 2012 (started late):

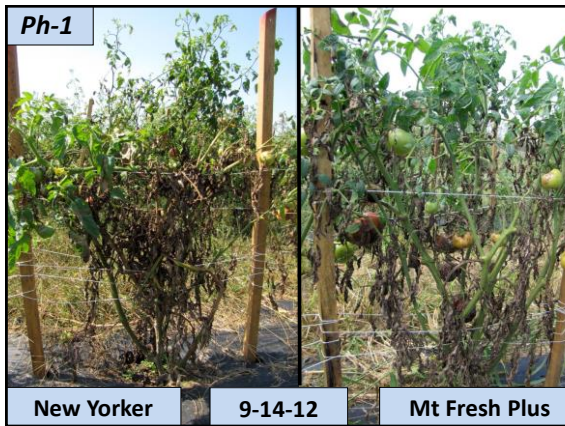
Symptoms found in experiment on 31 July.

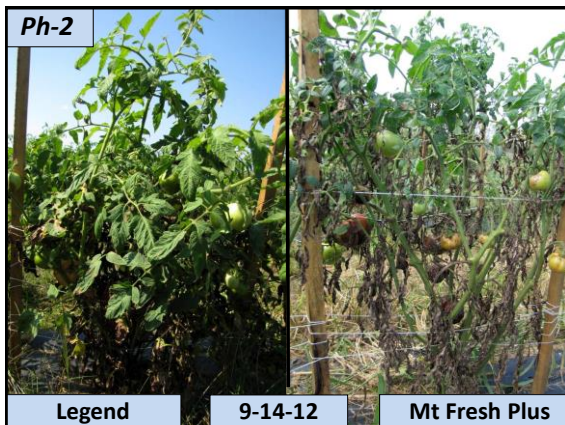
Actinovate (12 oz/A) + Badge X2 (1.75 lb). 14 Aug and 22 Aug.

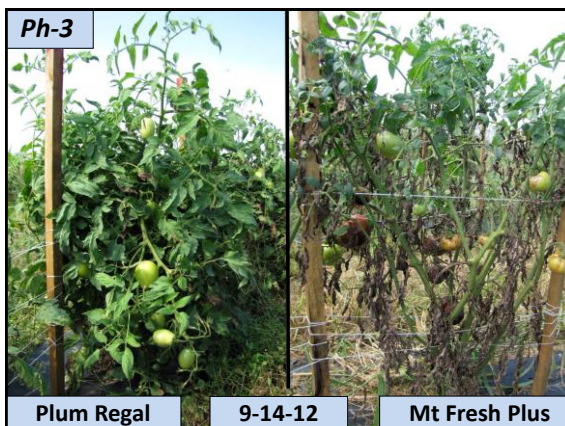
Regalia (2 qt/A) + Badge X2 (1.75 lb/A). 17 Aug, 31 Aug and 7 Sep.

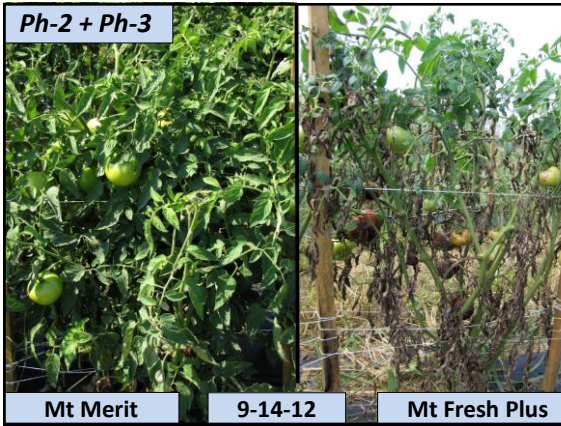
- ➡ Varieties with *Ph-2* and *Ph-3* were very effective. Especially in 2012. Some symptoms found.

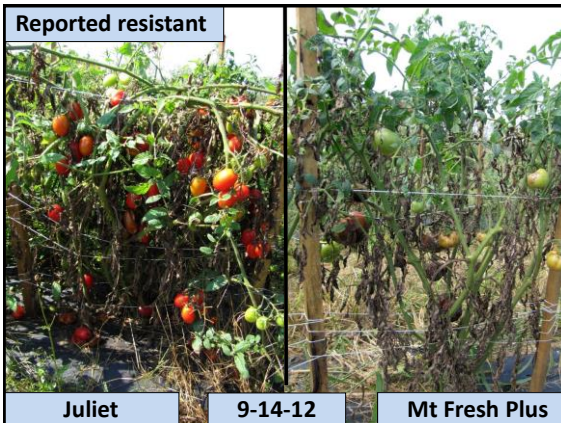
- ➡ Fungicides - more benefit applied to resistant varieties.

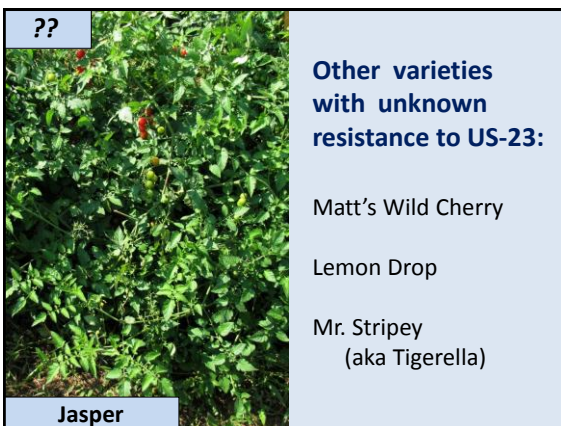


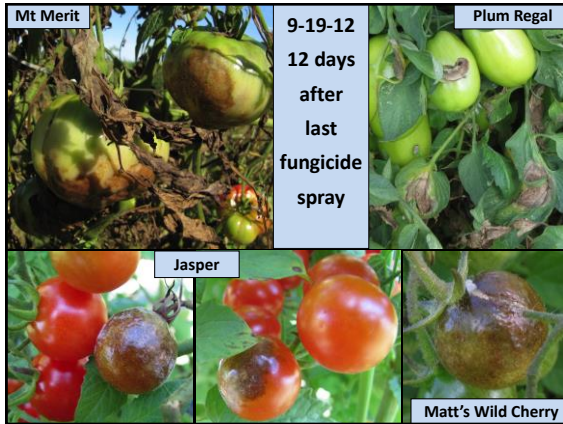












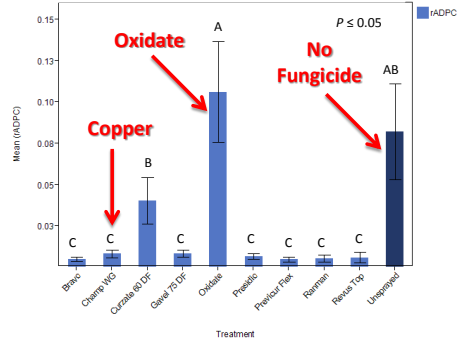
Late Blight Resistant Tomato Varieties

New Yorker (*Ph-1*)
 Legend OP (*Ph-2*)
 West Virginia (*Ph-2*)
 Plum Regal (homozygous *Ph-3*)
 Mountain Magic (campari) (heterozygous *Ph-2* + *Ph-3*)
 Defiant PHR (heterozygous *Ph-2* + *Ph-3*)
 Mountain Merit (heterozygous *Ph-2* + *Ph-3*)
 Iron Lady (homozygous *Ph-2* + *Ph-3*)
 Jasper (cherry)(undetermined resistance)
 Matt's Wild Cherry (undetermined, *Ph-3*?)
 Lemon Drop ?? Mr. Strikey (aka Tigerella) ??
 Heinz 1439 ?? Wapsipinicon Peach ??

Organic Fungicides for Late Blight

Copper (many different products)
 Actinovate (*Streptomyces lydicus*)
 Companion (*Bacillus subtilis*)
 DoubleNickle (*Bacillus amyloliquefaciens*)
 EF400 (blend of thyme, clove, garlic, and other herbal ingredients)
 Organocide (Sesame oil)
 Oxidate (hydrogen dioxide)
 Regalia (Extract of giant knotweed)
 Serenade (new - Optiva) (*Bacillus subtilis*)
 Sporatec (*Streptomyces lydicus*)
 Sonata (Rosemary, clove, and thyme oils)
 Trilogy (Neem oil)

Evaluation of fungicide treatments (applied weekly) for reduction of foliar late blight



Evaluation conducted by Bill Fry, New York, 2010

WI - Fungicide treatments

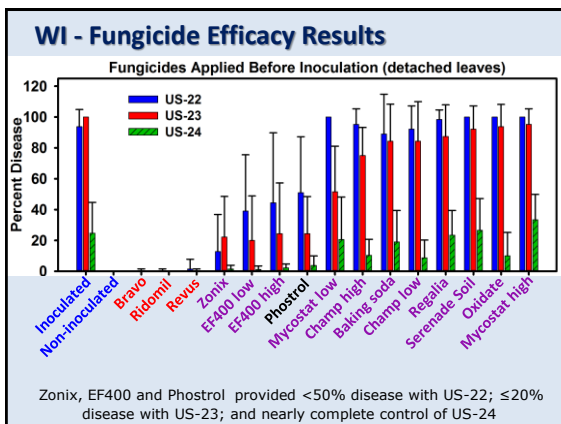
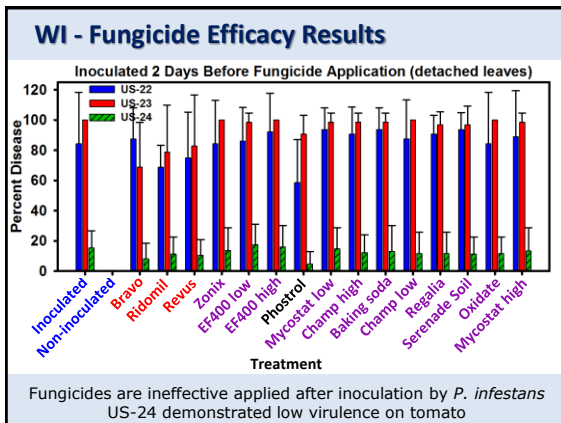
Fungicide	Active Ingredient	
Inoculated control	NA	CONTROLS
Non-inoculated control	NA	
Ridomil Gold SL (45% ai)	mefenoxam	CONVENTIONAL COMPARISONS
Revus	mandipropamid	
Bravo Ultrex	chlorothalonil	
Phostrol	phosphorous acids	SIMPLE INORGANIC
Champ Formula 2 (two rates)	copper hydroxide	
Zonix	rhannolipid biosurfactant	ORGANIC or BIORATIONALS
EF400 (two rates)	horticultural oil blend	
Mycostat (two rates)	oil extract	
Baking soda	sodium bicarbonate	
Oxidate	hydrogen dioxide	
Serenade Soil	<i>Bacillus subtilis</i>	
Regalia	extract of <i>Reynoutria sachalinensis</i>	

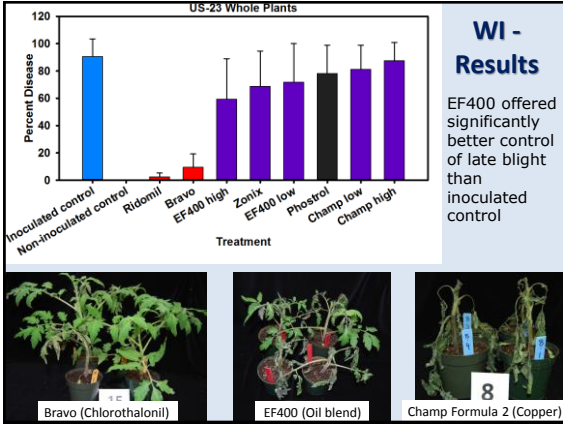
WI methods – Fungicide efficacy

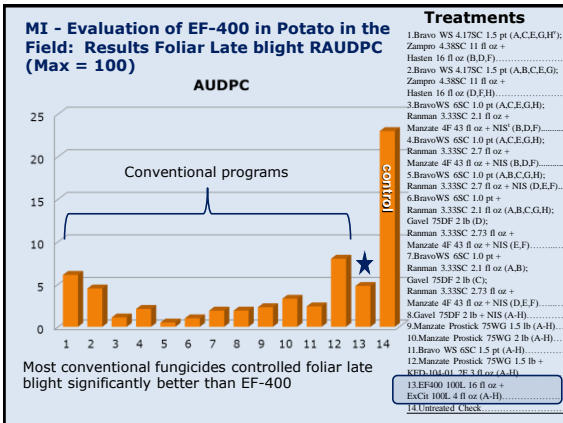
- Detached tomato leaf assay ('Brandywine Red')
- *P. infestans* US-22, US-23, and US-24
- Fungicides applied preventatively 2 hr before inoculation with sporangial suspension
- Fungicides applied 2 days post-inoculation

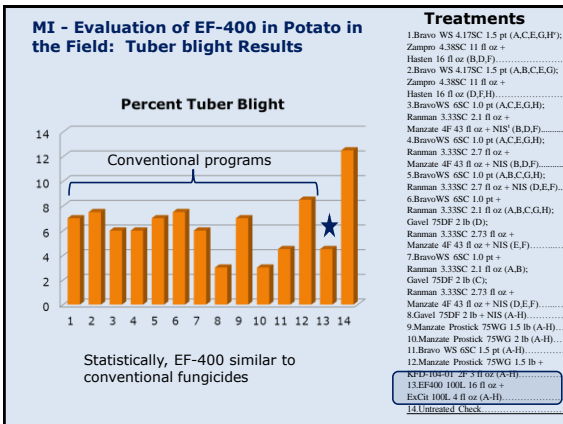
WI methods – Fungicide efficacy

- Potted plants ('Brandywine Red')
- *P. infestans* US-23 (most common in 2012-13)
- Screened subset of most effective fungicides from detached leaf assay
- Fungicides applied preventatively 2 hr before inoculation with sporangial suspension









Conclusions – WI and MI Research

- ➡ As previously recognized, preventative applications of fungicides were effective in controlling late blight
- ➡ Post-inoculation fungicide applications were ineffective in limiting late blight
- ➡ EF400, Zonix, and Phostrol provided significant control of late blight on detached tomato leaves and potted tomato plants in WI, and EF400 on field-grown potatoes in MI
- ➡ Less effective organic fungicides may be useful for reducing inoculum as they act as contact antispore germinants
- ➡ In potato trial at MSU, season long EF-400 performed on par with several conventional fungicides for limiting tuber late blight and protecting US-1 quality yield

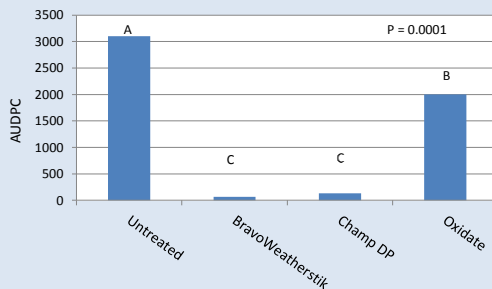
2011 Treatments-FL

Trt	Fungicide	Rate	Dates Applied	Day 0, +8, +15, +22			
				A	B	C	D
1	Untreated Control (water)		A,B,C,D				
2	Bravo WeatherStik 720 (chlorothalonil)	1.5 pt/A	A,B,C,D				
3	Champ DP (copper hydroxide)	1.5 lb/A	A,B,C,D				
4	Oxidate (hydrogen dioxide)	128 fl/A	A,B,C,D				

Tomato "Sanibel" transplanted January 10
 A=14 Mar; B=21 Mar; C=29 Mar; and D=4 Apr
 Late blight first observed on March 30



Area Under Disease Progress Curve for Late Blight on tomato, 2011, FL





Plots of tomato plants within same trial:
Untreated plants compared to highly effective fungicide

2012 Treatments-FL

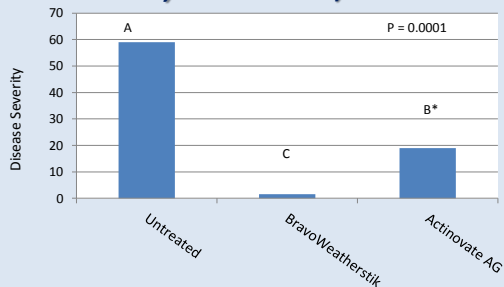
Day 0, +8, +15, +22, +29, +36

Trt	Fungicide	Rate	Dates Applied	A	B	C	D	E	F
1	Untreated Control (water)		A,B,C,D,E,F						
2	Bravo WeatherStik 720 (chlorothalonil)	1.5 pt/A	A,B,C,D,E,F						
3	Actinovate AG 0.03% <i>treptomyces lydicus</i> WYEC 108	6 oz/A	A,B,C,D,E,F						



Tomato 'FL47' transplanted on January 11
A= 24 Jan; B= 1 Feb; C= 8 Feb; D= 15 Feb, E= 22 Feb, F= 29 Feb
Late blight first observed on February 17

Disease Severity for Late Blight on Tomato, 2 Mar 2012, Florida



*Similar results with Actinovate AG at 12 oz/A were obtained in 2008

Summary from Florida

- ➡ Actinovate AG and Oxidate reduced disease severity of late blight compared to untreated but were not as effective as Bravo Weatherstik or other conventional fungicides (data not shown)

Disease forecasting as a tool for late blight management

- ➡ Facilitates timing of fungicide applications based on the favorability of the weather for disease development
- ➡ Assumes that the pathogen is present
- ➡ **Blitecast model** (Hyre & Wallin)

1st fungicide application based on accumulation of 18 disease severity values (DSV) = relationship between ave. temperature and hours above 90% RH (0 to 4 scale)

Subsequent applications based on accumulated DSV and the number of rain-favorable days over the last 7 days (prev. 5d mean T < 75F & prev. 10 d > 1.2 in rain)

Disease forecasting as a tool for late blight management

- ➡ **Cornell Late Blight Decision Support System (DSS)** (Fry et al.)

More comprehensive tool containing:

1. Location-specific weather data

Number of partners

2. Disease forecasting tools based on:

Blitecast and Simcast (blight units, fungicide units and accounts for host resistance)

3. Late blight disease simulator

4. Alerts (email or text)

Late Blight Management in Potato and Tomato

- * Select tomato cultivars with resistance when possible
- * Use only certified disease-free transplants and tubers
- * Some potato varieties are late-reducing resistant

Infected patio tomato purchased at a big-box store.



Infected tuber produced and infected seedling.

Late Blight Management in Potato and Tomato

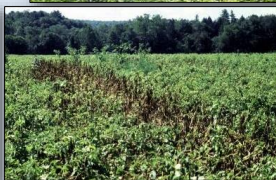
- * Avoid adjacent plantings with older, infected crops.
- * Eliminate cull piles and volunteers.
- * Remove weeds, particularly solanaceous weeds



Bittersweet nightshade

Late Blight Management in Potato and Tomato

- * Scout fields regularly, particularly in wetter parts of fields or where spray applications might miss.
- * Rogue infected plants and/or destroy hotspots.



Late Blight Management in Potato and Tomato

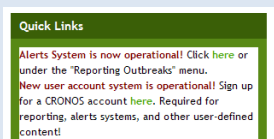
- * Minimize leaf wetness when possible
- * Use a late blight forecasting system, where available
- * Maintain preventative, organic fungicide schedule with good coverage



Late Blight Management in Potato and Tomato

- * Check local and state newsletters for disease outbreaks and updates!

Alert System – Free to all!



Sign up for automatic text or e-mail alerts when confirmed outbreaks are reported

Late Blight Webinar – Summary Points

- * Late blight has been occurring more often in recent years, esp. on tomato. Expected to continue.
- * New pathogen genotypes; affect disease occurrence.
- * Both mating types of the pathogen are in the U.S.; sexual reproduction is a concern.
- * Resistant varieties are effective (*Ph-2* and *Ph-3* genes).
- * USABlight website provides current information on late blight occurrence; other topics as well.
- * Several copper and other organic fungicides available, vary in efficacy.
- * Decision Support System (DSS) useful for timing fungicide applications to maximize control.

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.

Poll Question #3

Growers: what products and management practices have been effective for you?

Please type your answer.

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