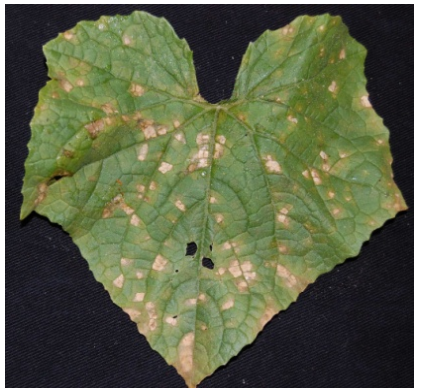
Late blight and downy mildew updates for vegetable crops in Wisconsin



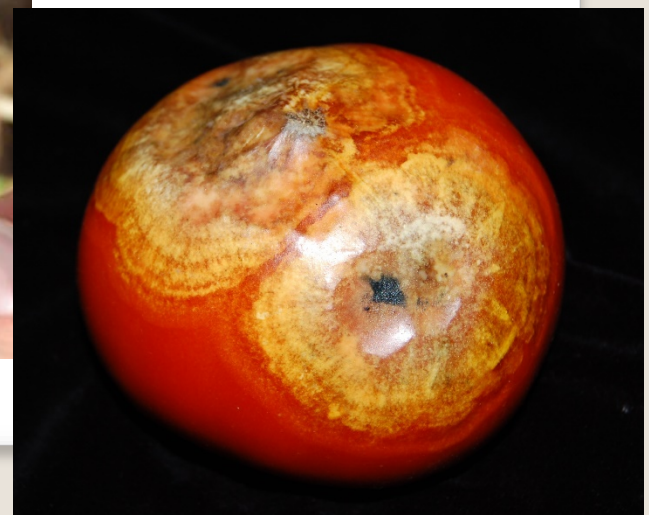


Amanda Gevens
Assistant Professor & Extension Plant Pathologist, Dept. of Plant Pathology, Univ. of Wisconsin-Madison

January 15, 2015 – 9:00-9:25AM
Alliant Energy Center
Madison, WI

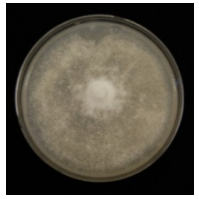
Late blight

- **U.S. – $77 million spent on control; despite control, losses are estimated at $288 million annually**
- **Current strains can infect tomato & potato**
- **National resurgence in late blight reports**



National Late Blight Research & Extension Collaboration, 2011-2016

NIFA



National Institute of Food & Agriculture - AFRI Coordinated Ag Project

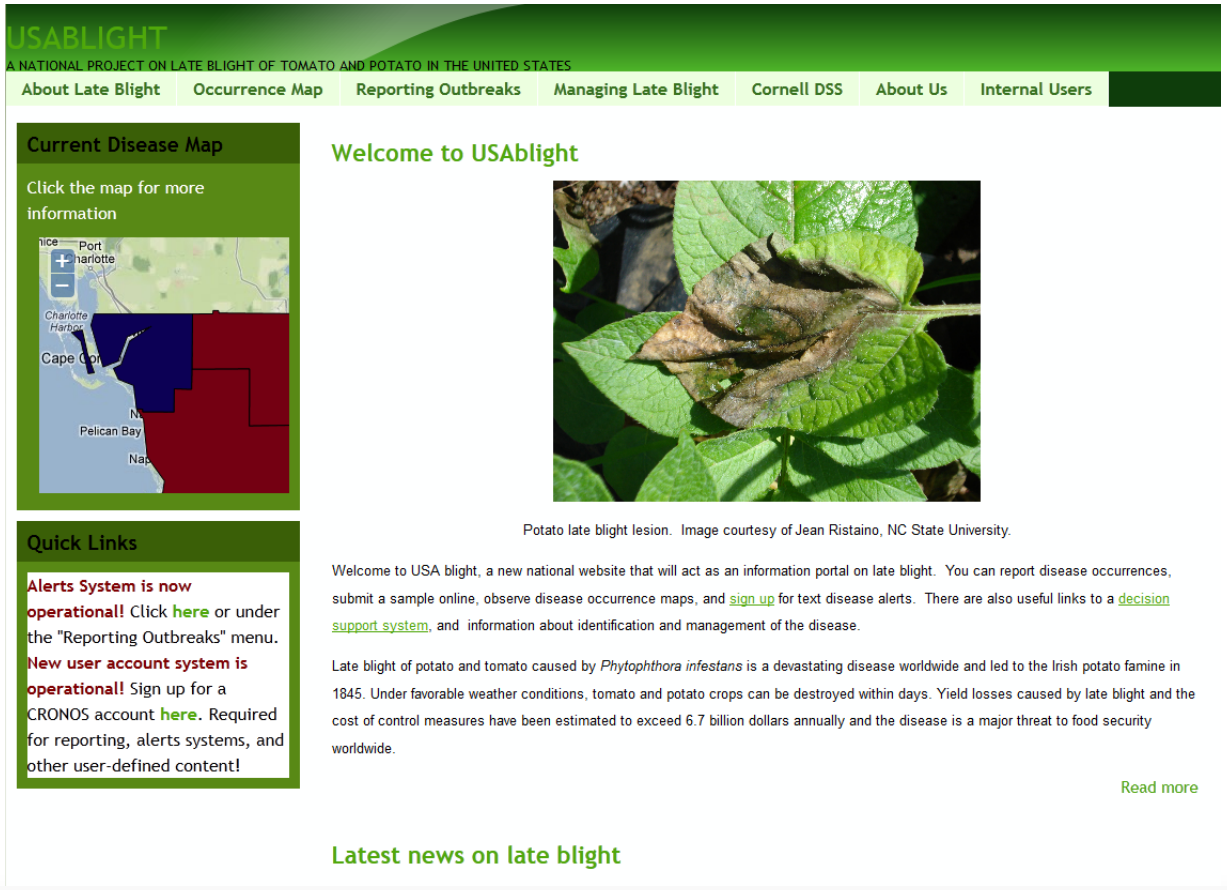
Reducing losses to potato and tomato late blight by enhanced monitoring of pathogen populations and improved resistant plants, education, and extension

UW-Vegetable Pathology: report disease to website, characterize *P. infestans* for phenotype, develop decision support system including new rapid techniques for determining mefenoxam sensitivity, evaluate new tomato varieties for resistance, and distribute information in WI for improved disease control

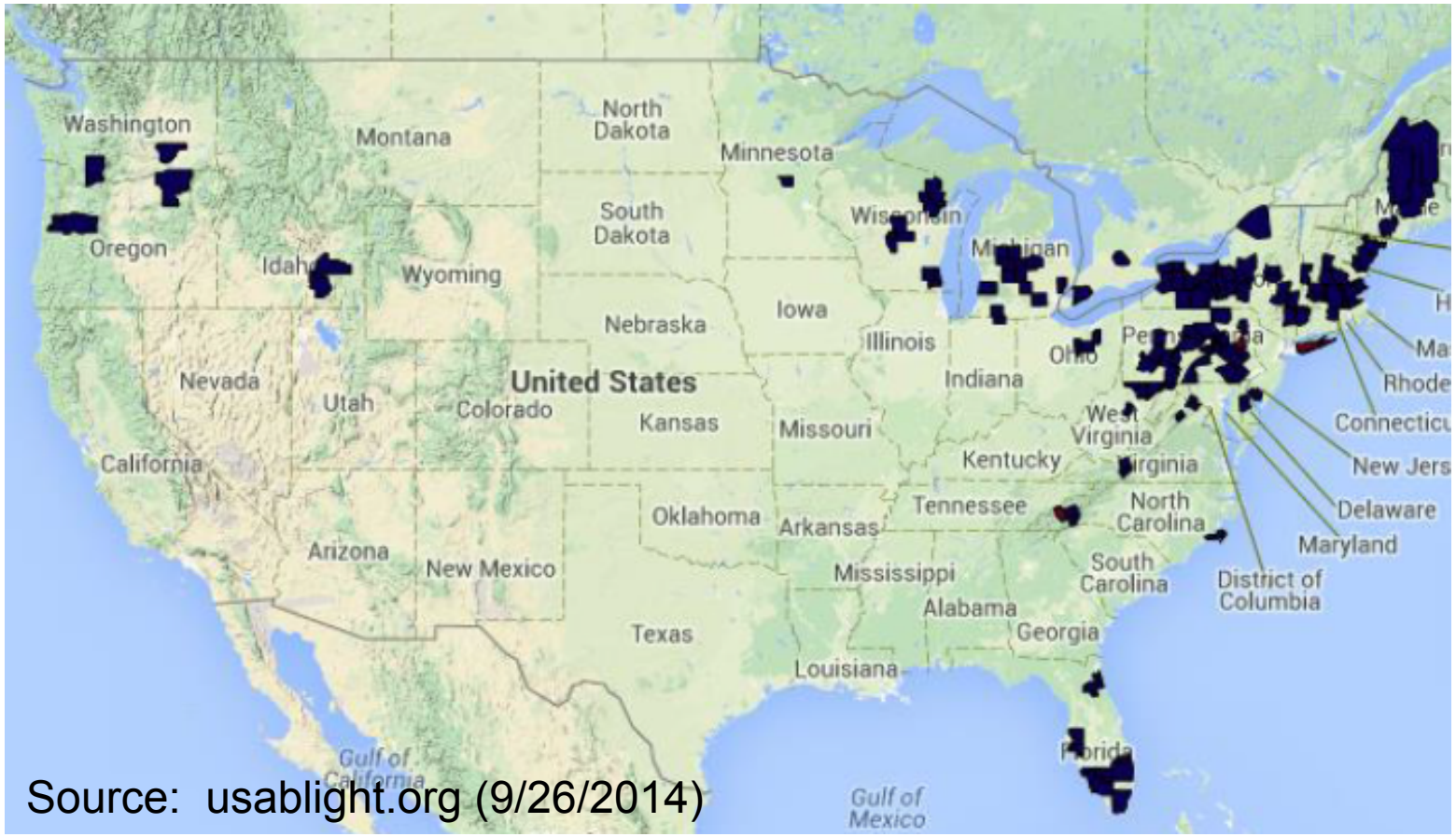
Collaborators: Judelson, Fry, Ristaino, Grunewald, Smart, Gevens, Roberts, McGrath, Besley, Xiao, McComas, Klessig, Gloy, Boyles, Girke, Seebold, Johnson, Stone, Gugino, Everts, Scott, Birch, Gay

Late Blight Reporting and Information

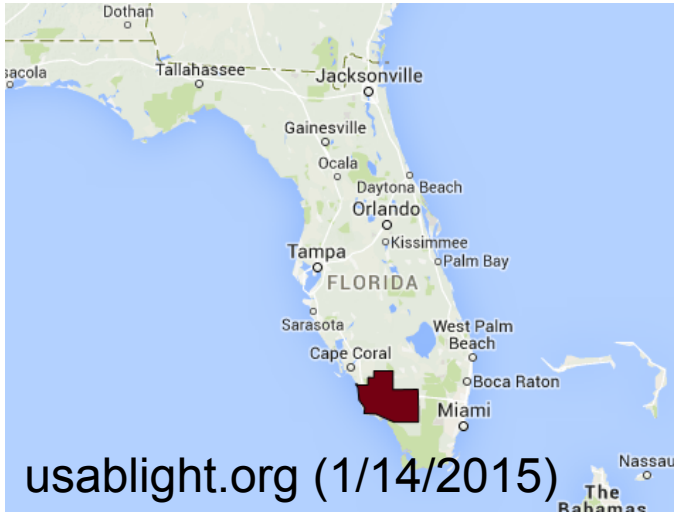
usablight.org



Distribution of Late Blight in U.S., 2014



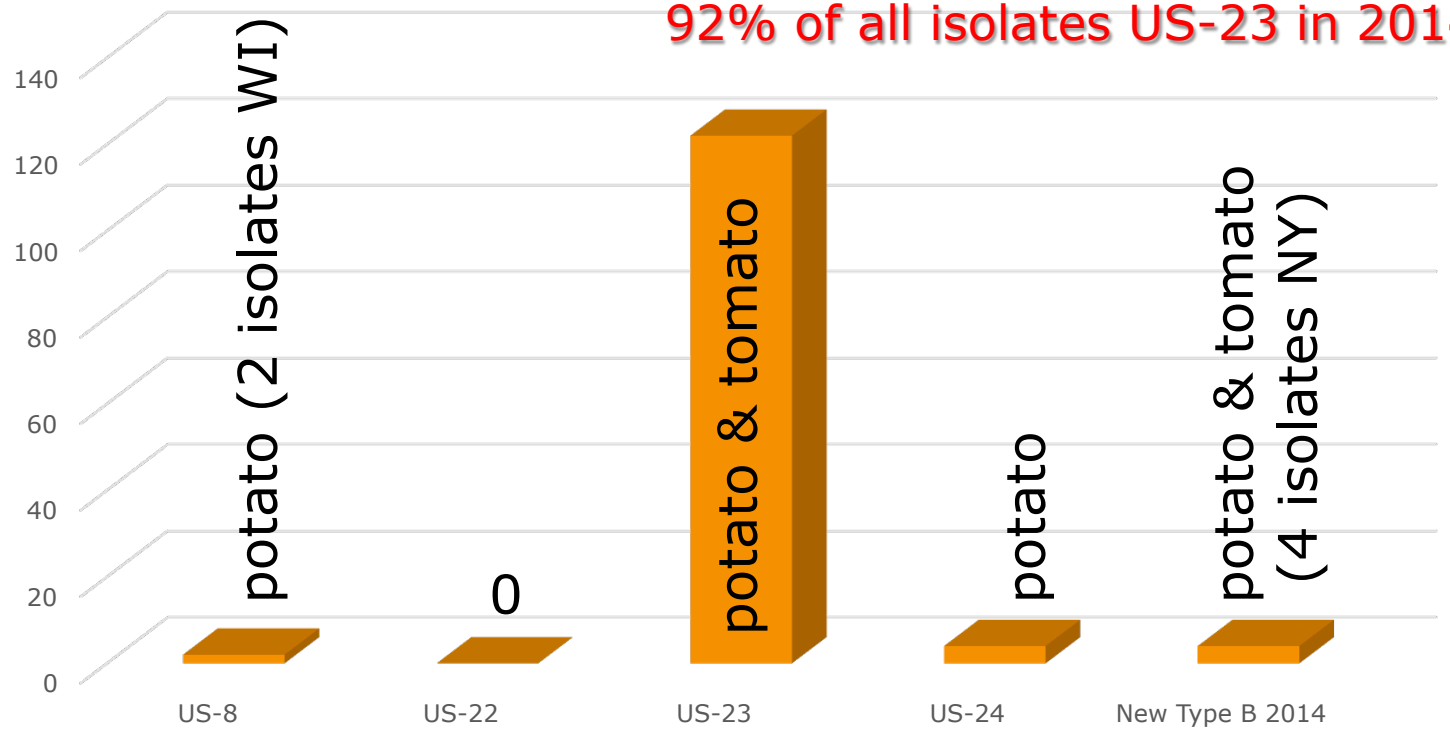
Source: usablight.org (9/26/2014)

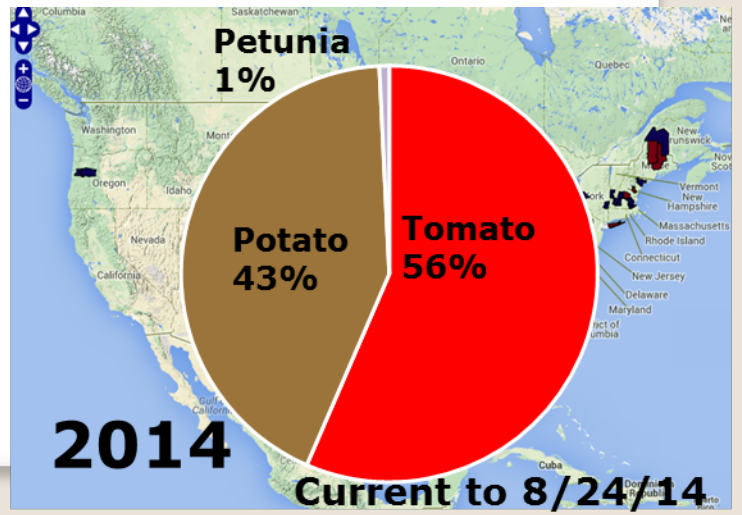


usablight.org (1/14/2015)

Phytophthora infestans Genotype Incidence in the U.S. in 2014 (to Aug 24)

92% of all isolates US-23 in 2014





Late Blight in Wisconsin in 2014

- **Low risk of pathogen overwintering in unharvested potatoes from the 2013-2014 winter**
- WI locations had prolonged periods of soil temperatures below 27°F at 2 and 4" depths
- 204 hours at 2" and 120 hours at 4" in Hancock; 984 hours at 2" and 563 hours at 4" in Arlington indicating **low to no risk of volunteer & pathogen survival**

- Weather was favorable for late blight starting in mid-June based on Blitecast threshold
- First report of late blight in WI was in mid-July in Portage Co.

County	Host(s)	Clonal Lineage
Portage	Potato/Tomato	US-23, US-8
Milwaukee	Tomato	US-23
Adams	Potato	US-23, US-8
Racine	Tomato	US-23
Waushara	Potato	US-23, US-8
Brown	Tomato	US-23
Marinette	Tomato	US-23
Oconto	Potato/Tomato	US-23

Genotypes of *P. infestans*

Genotype/strain is the genetic makeup of an organism

Determination of genotype is valuable as associations indicate host preference and resistance to fungicide(s)

24 genotypes have been identified in US (since initial introduction in mid-1800s)

Typically US epidemics have just a few genotypes active in a year

Predominant *P. infestans* clonal lineages in the U.S. 1840-present

Clonal Lineage	Mating Type	Host (s)	Years Found	Mefenoxam Sensitivity
US-1	A1	potato	1840-present	sensitive
US-6	A1	potato/tomato*	1979-94	sensitive
US-7	A2	potato/tomato*	1992-95	resistant
US-8	**A2**	**potato*/tomato**	**1992-present**	**resistant**
US-11	A1	potato/tomato	1994-present	resistant
US-17	A1	tomato	1996	resistant
US-18	A2	tomato	1995-98	sensitive
US-22	**A2**	**potato/tomato***	**2009-present**	**sensitive**
US-23	**A1**	**potato/tomato***	**2010-present**	**sensitive**
US-24	**A1**	**potato*/tomato**	**2010-present**	**resistant**

*= favored host if two hosts are shown

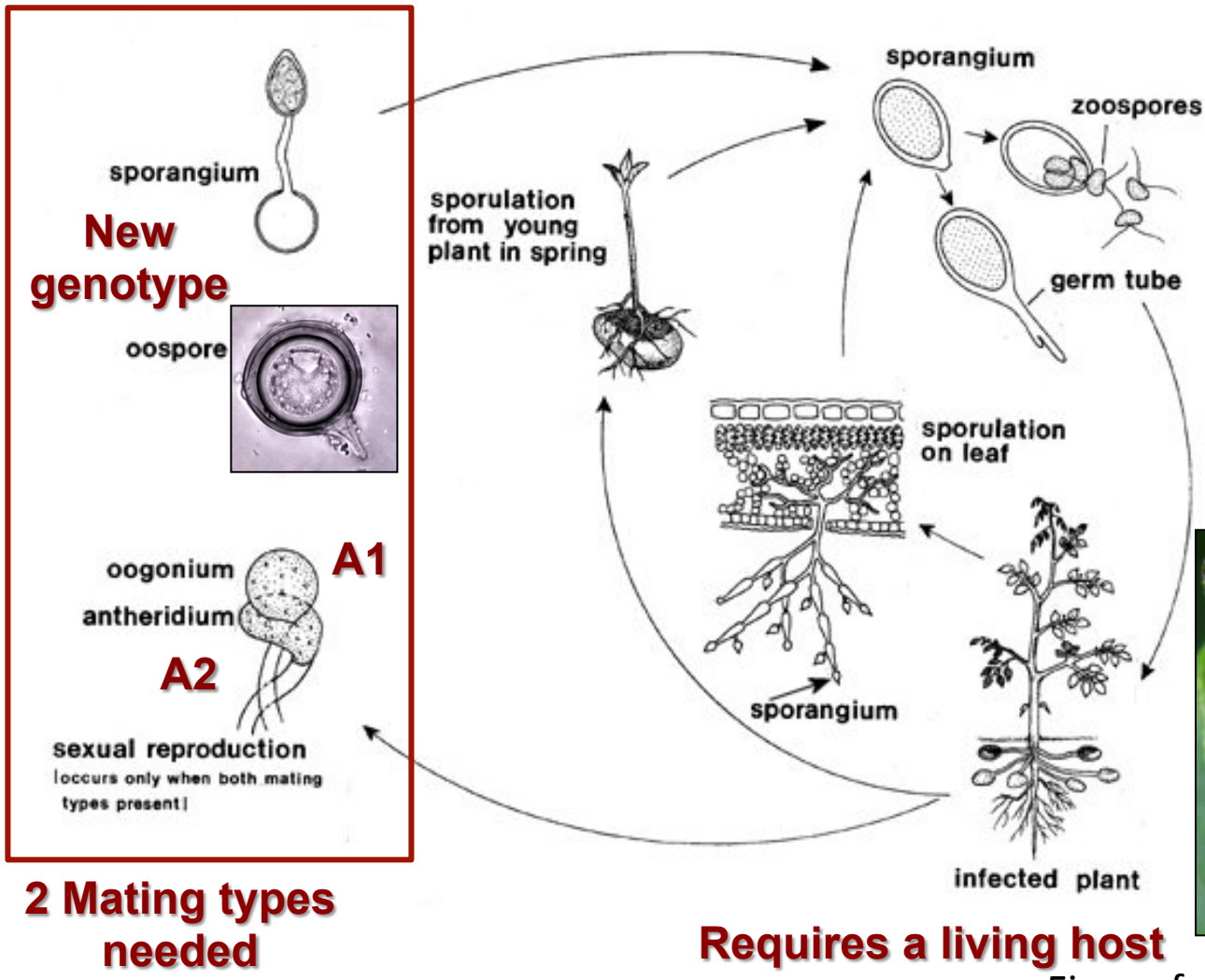
Fig. from Halterman & Gevens, *Phytophthora infestans* in the U.S., book chapter , Phytophthora: A Global Perspective, Edited by K. H. Lamour. CABI published 2013.

What happens when both mating types are active on the same plant?

US-8 is an A2 & **US-23** is an A1

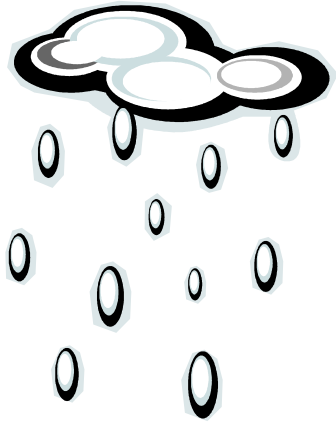
Hormone stimulation produces 'male' and 'female' fungal components which merge/ sexually recombine to produce **oospores**

Disease Cycle of Late Blight (*Phytophthora infestans*)



2 Mating types needed

Requires a living host

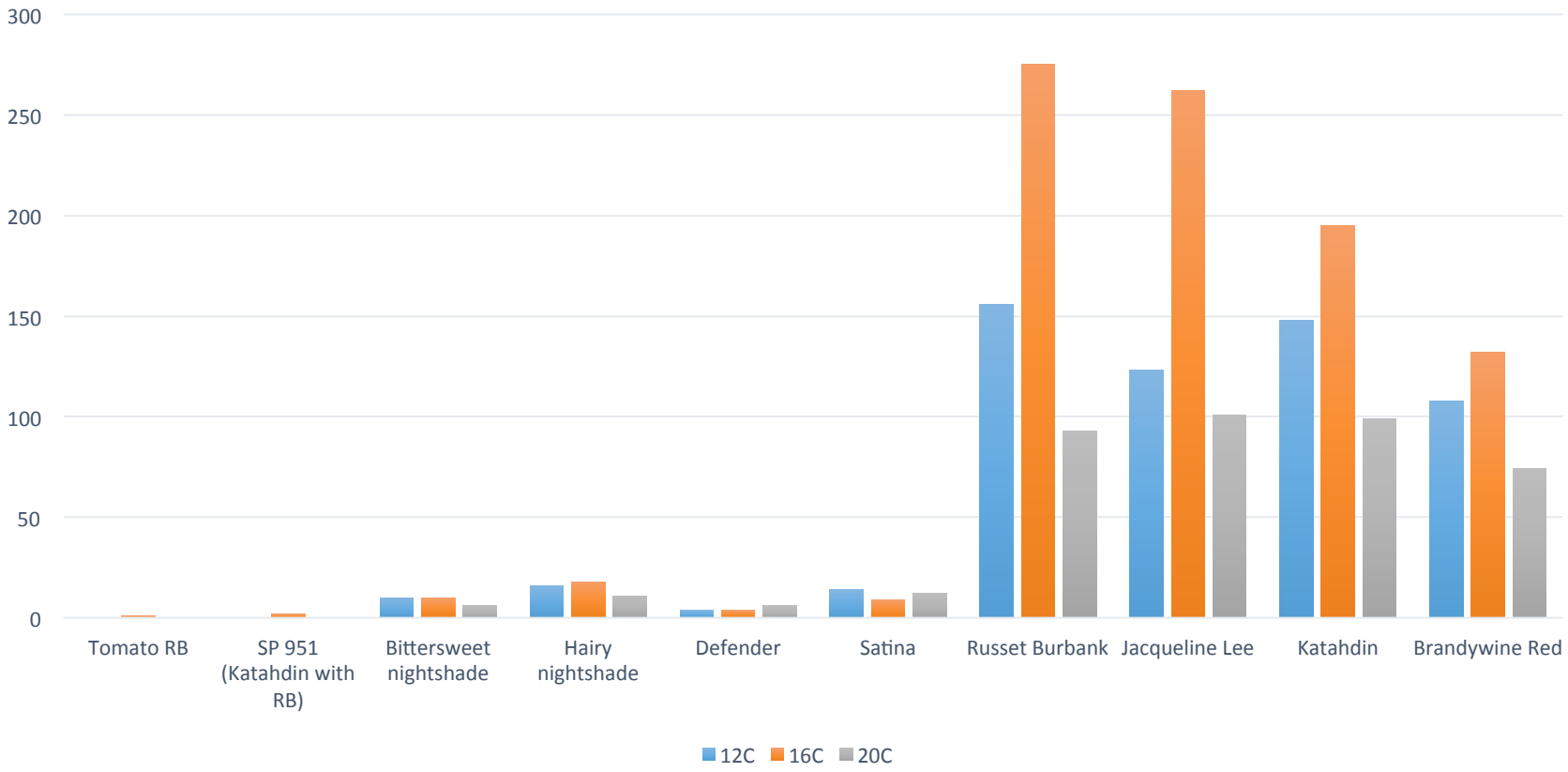


Optimum temps
60 - 75F day
50 - 60F night

Figure from Smart, Cornell, 2014

- ~85% of oospores are viable or alive when removed from leaf tissues
- Of the living oospores, ~40% can germinate with potential to cause disease

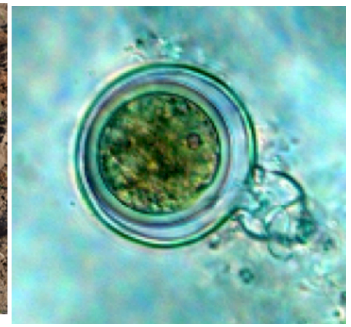
Number of oospores per sq mm of leaf tissue (US-22xUS-23)

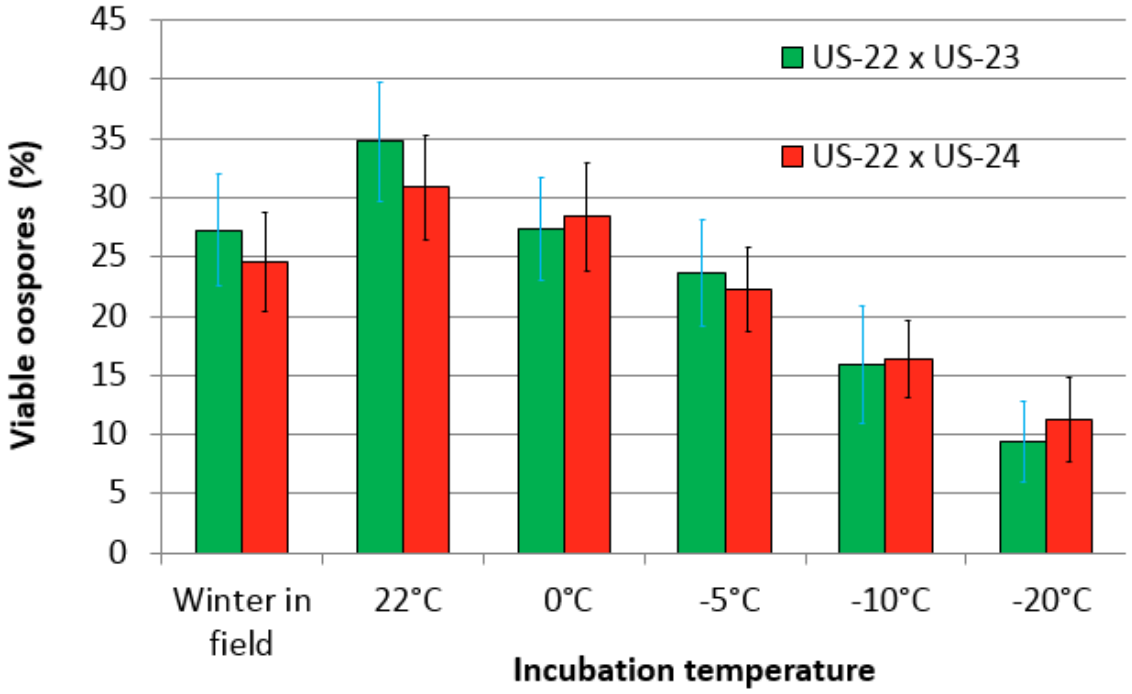


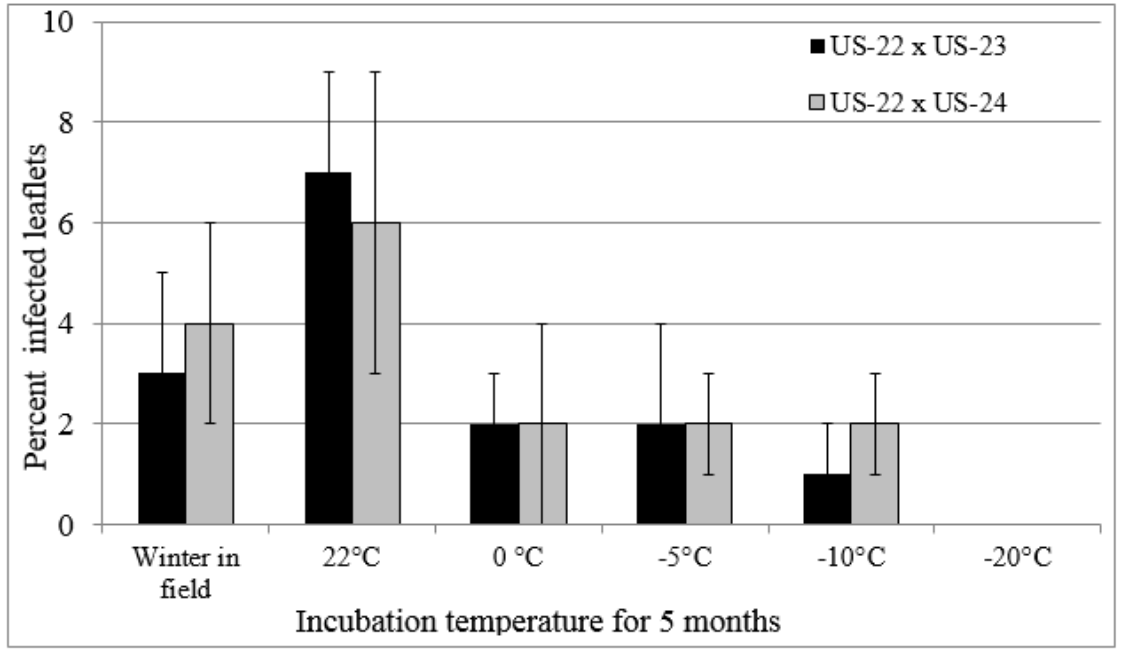
Oospores can survive winter temperatures and are infective

US-8 and US-22 are A2

US-23 and US-24 are A1



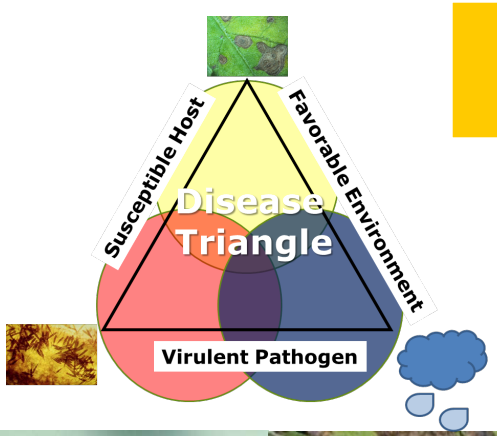




Potato Disease Timeline

April-May	June	July	August	September	October

Poor emergence, Rhizoctonia, Fusarium seed piece decay, **Late blight**



Early blight, Blackleg, White mold, Botrytis, Brown spot

Late blight, Potato early dying, Black dot, Pink rot

Silver scurf, Pythium leak, **Late blight**, Scabs, Fusarium, Bac soft rot

Potato Late Blight Management

Multifaceted and season-long cultural and chemical strategies

- Certified disease-free seed potatoes
- Cultivar selection for resistance is limited
- Destroy cull piles (20 May deadline in WI)
- Good seed handling, cutting, and curing practices with seed trt to limit seed piece-seed piece spread of late blight (mancozeb)
- Keep informed of late blight incidence in your region
- Foliar fungicide applied at ~50% emergence to limit seed to seedling late blight (if seed exposure was high)
- Use Blitecast or other disease forecasting tool to aid in timing of preventative fungicide applications
- Select effective fungicides and maintain a 7-day preventative program including base protectants and late blight-specific fungicides (5-day intervals in conducive weather on sus cultivars; 10-day intervals in dry/hot weather on tol cultivars)
- Scout routinely and critically in risk zones (around irrig towers, field edges, etc.)
- Control volunteers in area fields; control nightshade weeds
- Maintain foliar fungicide program beyond vine kill to harvest
- Consider post-harvest fungicides

Considerations for foliar fungicide programs to manage late blight

There is not one recommended fungicide program for all late blight susceptible potato fields in WI.

Fungicide selections **vary** based on type of inoculum introduction, proximity to infected fields, crop stage, late blight strain, disease progress, and other diseases that may be in need of management.

Considerations for foliar fungicide programs to manage late blight

Each application should contain a base protectant such as chlorothalonil or mancozeb

QoI inhibitors Headline, Quadris, Reason (Group 11) can offer good late blight control at high rates under moderate pressure. Follow label for resistance management.

Under high late blight pressure

Effective fungicides to include in programs are:

Revus Top, Forum, Curzate 60DF, Ranman, Tanos, Gavel, Previcur Flex, or Omega.

Mefenoxam containing fungicides such as Ridomil Gold MZ can also be highly effective in controlling late blight caused by strain US-23 (not US-8).

Zampro is a newly registered late blight fungicide offering a novel mode of action fungicide in an effective pre-mix for late blight control.

Maintain fungicide applications post vine kill to harvest (mancozeb) to limit tuber infection

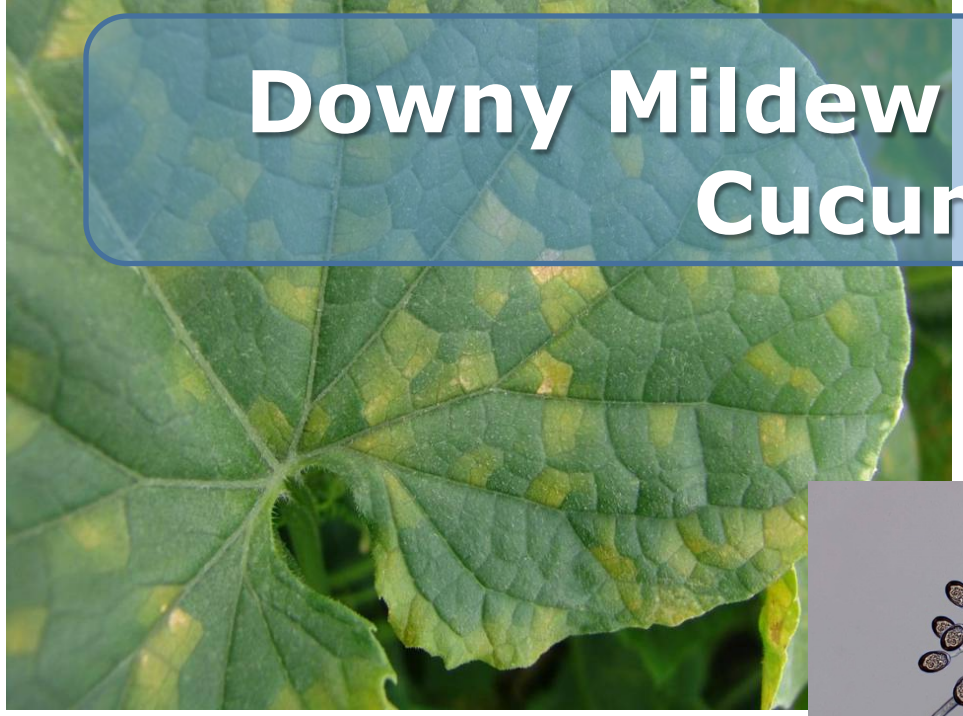
Post-harvest Late Blight Control

- Ozone reduced late blight incidence compared to the control, but was not as effective as other treatments
  - limited external mycelia and other secondary decay species
  - may be effective in limiting a disease 'hot spot' in bin
- Oxidate significantly reduced incidence in 2011, not in 2010
- Phostrol significantly reduced incidence and severity of infection
- Stadium significantly reduced incidence for 2010-2012 trials
  - azoxystrobin component responsible for late blight control
  - not currently labeled for late blight control

Late blight summary points

- Late blight has been occurring more often in recent years. Expected to continue.
- New pathogen genotypes affect disease occurrence. Genotype info important for efficacy of mefenoxam/metalaxyl.
- Both mating types of the pathogen are in US; sexual reproduction is a concern.
- USABlight website and university extension resources provide current info on occurrence and control
- Disease forecasting aids in preventative management
- Use of fungicides is effective in limiting late blight at multiple stages of production cycle

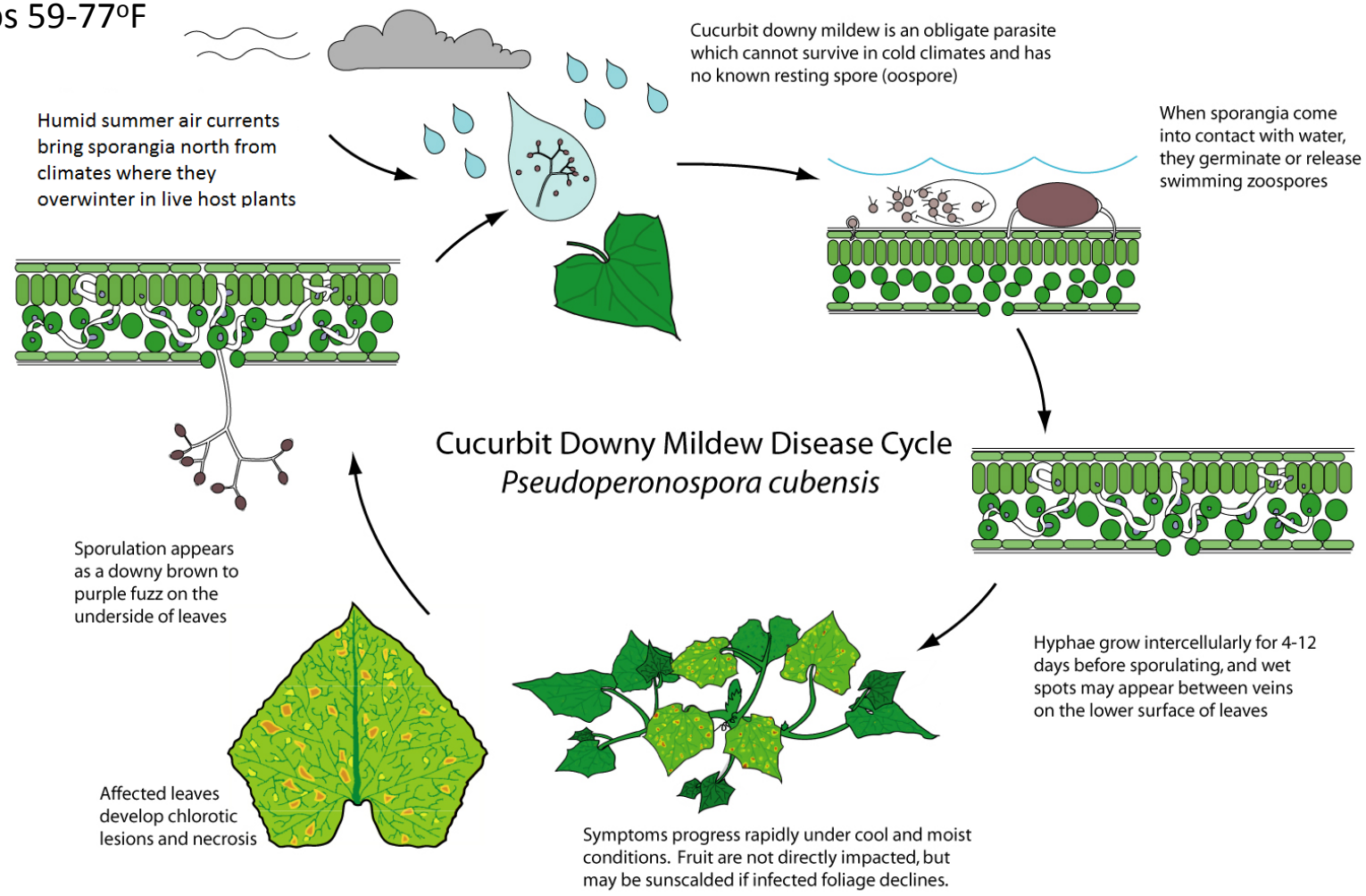
Downy Mildew Symptoms on Cucumber



Caused by the water mold *Pseudoperonospora cubensis*

Cucurbit Downy Mildew Disease Cycle

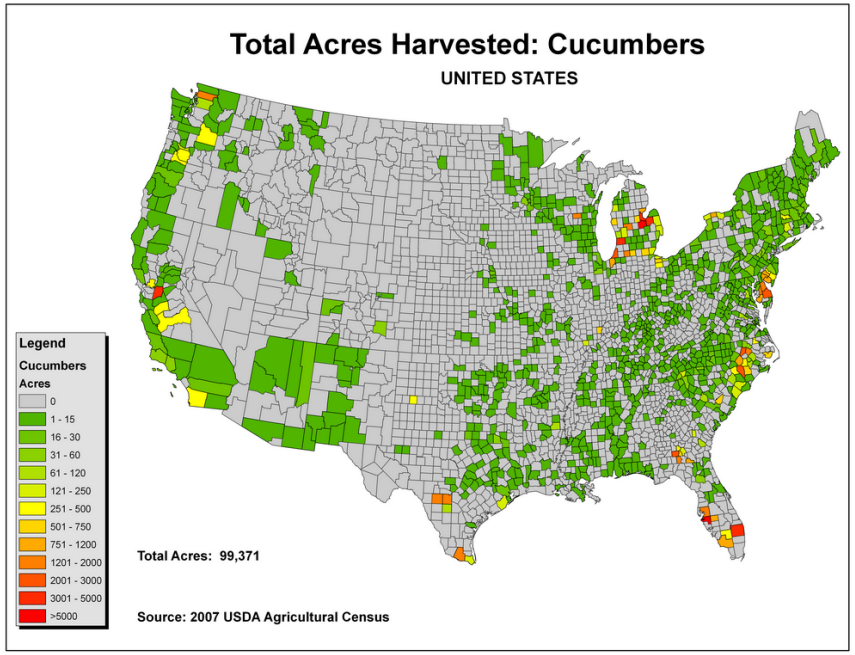
High humidity (>6 hrs 100% RH)
Foggy mornings, cloudy skies
Air temps 59-77°F

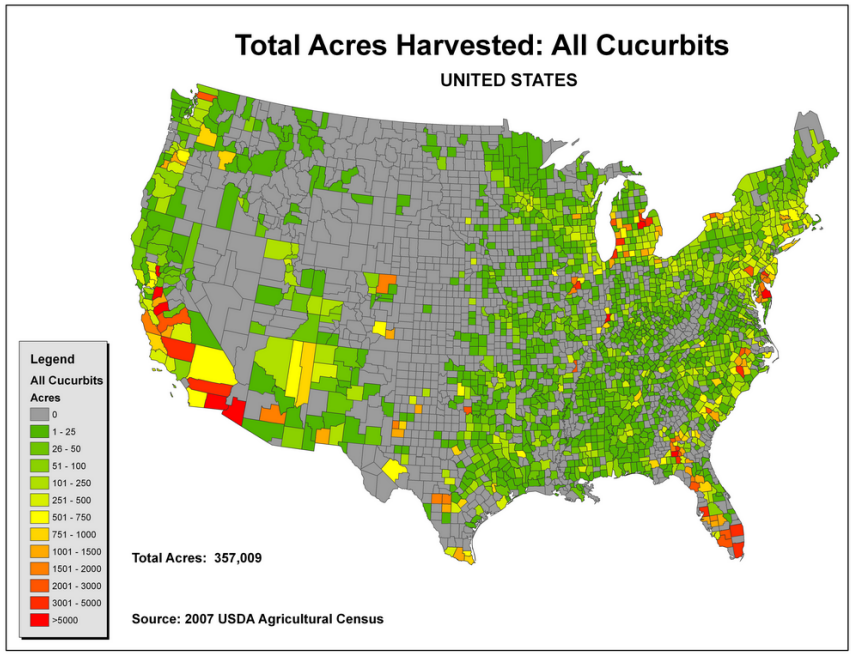


Cucurbit Production in the U.S.

Downy mildew requires living plants to remain viable

Movement of production from south to north through the production season acts as a pathogen ‘highway’





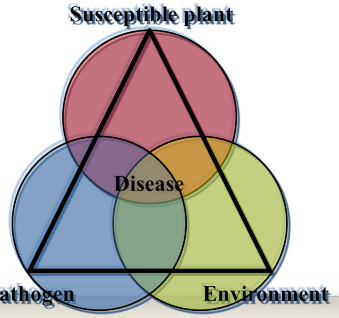
What happened with Downy Mildew in WI in 2014? 2015?

Few confirmed reports in Dane, Green Lake, and Calumet Counties primarily on cucumber

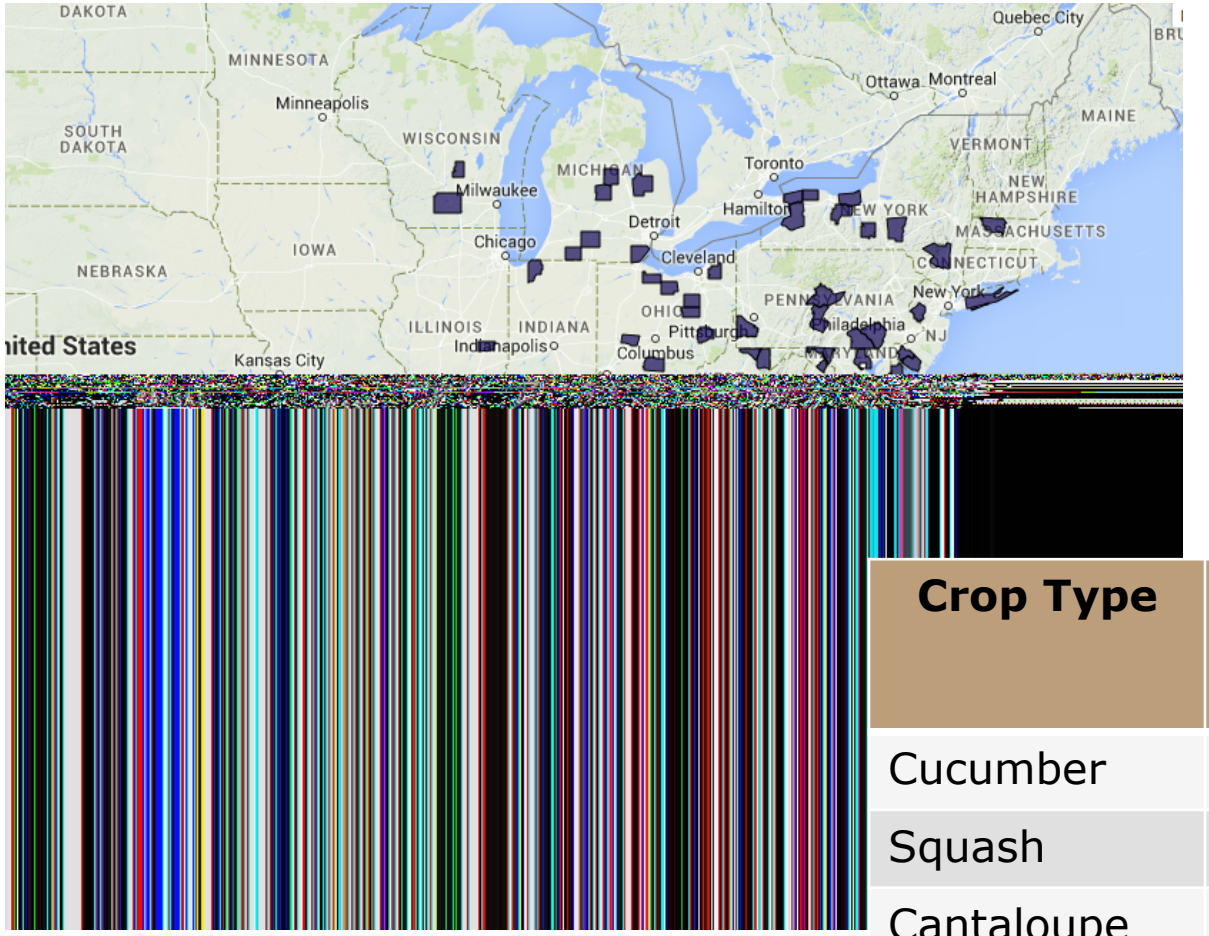
In recent years, WI has had mid- and late-season downy mildew on primarily cucumber

There is risk of downy mildew to WI cucurbits in 2015 likely through spores moving in air from southerly growing regions

Incidence and severity is dependent upon temperature and moisture



National Cucurbit Downy Mildew Reports in 2014 by State and Crop



21 states and Ontario Canada reported disease

Map from http://cdm.ipmpipe.org/ 12/2/2014

Crop Type	# of Reports in 2014	% of Total Reports
Cucumber	96	**45**
Squash	59	**28**
Cantaloupe	25	**12**
Pumpkin	22	**10**
Watermelon	11	**5**

Pathogen Overwintering?

Until recently, the pathogen was not known to make resting spores and overwinter in the soil in the U.S.

-re-introduction of pathogen from airborne spores each year

-relatively stable pathogen population, defined strain host range

Pathogen in Europe produces resting spores and can overwinter in soils outside of plant tissues

-local and soilborne inoculum, earlier season risk

-highly variable pathogen population, loss of strain host range

-fungicide resistance

Recent studies at North Carolina State Univ. indicated the presence of both mating types in southeastern US

No mating pairs (A1 and A2) detected from Midwestern US

Managing Cucurbit Downy Mildew

- Use cultivar resistance – selections limited

- Be vigilant – if you hear of DM in your region apply preventive fungicides & SCOUT

- Apply fungicides at first sign of DM – the longer you wait, the harder it is to control

- Rotate between fungicide modes of action: it is important to prevent resistance

- Include a protectant (chlorothalonil or mancozeb) in every application

Coppers can be used in organic systems, but are not as effective as conventional fungicides when used alone

Cucurbit

ipmPIPE™

Pest Information Platform For Extension & Education

Cucurbit Downy Mildew Forecasting

Site offers various resources including pathogen and disease information, management guidance, forecasts, and serves as a link for collaborators of the national program

http://cdm.ipmpipe.org/

Effective Fungicide Programs for Downy Mildew Control in Cucumber

If program is initiated **before** disease onset: adhere to a **7-day** interval.
If program is initiated **after** disease onset: adhere to a **5-day** interval.

Recommendations based on multiple years of field research by M.K. Hausbeck, Michigan State Univ., 2013

Use of the highest labeled rate of products is recommended.

- *Previcur Flex 6SC (2 day PHI) propamocarb 28
- *Ranman 3.6SC (0 day PHI) cyazofamid 21
- Gavel 75WG (5 day PHI) mancozeb M3+zoxamide 22
- Presidio 4FL (2 day PHI) fluopicolide 43
- Tanos 50WG (3 day PHI) famoxadone 11+cymoxanil 27
- Zampro 4.4SC (0 day PHI) ametoctradin 45+dimethomorph 40

Alternate products and mix each with either:

- Dithane (mancozeb) 3 lb or
- Bravo (chlorothalonil) 2 pt

*Especially effective when disease pressure is severe.

Thank you!
Information Resources

UW Vegetable Extension Team Website
http://vegetables.wisc.edu/vegetable-team

University of Wisconsin Vegetable Disease Website (newsletter access)
http://www.plantpath.wisc.edu/wivegdis/

www.usablight.org

Plant Pathology
at the University of Wisconsin - Madison

HOME GROWN WISCONSIN POTATOES

THE UNIVERSITY of WISCONSIN MADISON

UW Extension
Learning for life

Reduced risk fungicides with specific late blight activity

Fungicide	a.i.	FRAC	PHI potato	Activity
Forum	dimethomorph	40	4 days	**Systemic** *adjuvant enhances management/can be applied post vine kill;* ***antisporulant****; rainfast*
Curzate	cymoxanil	27	14 days	**Locally Systemic** *rainfast 2 hrs/mix with protectant;curative*
Fosphite, Phostrol, Crop-Phite, Prophyt, Rampart	phosphorous acid formulations	NC	0 days	**Systemic** *phytotox possible applied at low carrier volumes;****tuber late blight control*** *at multiple apps + hi rates; post-harvest applic; not great antisporulant*
Gavel	mancozeb + zoxamide	M3+22	3 days	**Protectant** *do not apply >6 apps/crop/yr; reduce tuber blight;rainfast*
Omega	fluazinam	29	14 days	**Protectant** *excellent tuber blight control; rainfast*
Previcur Flex	propamocarb hydrochloride	28	14 days	**Systemic and Contact** ***antisporulant****;rainfast;curative; good protectant on leaf, new growth, stem*

Reduced risk fungicides with specific late blight activity

Fungicide	a.i.	FRAC	PHI potato	Activity
Ranman	cyazofamid	21	7 days	**Protectant, Limited Systemic** *Good on leaf and tuber blight;rainfast*
Revus Top	difenoconazole + mandipropamid	3 + 40	14 days	**Preventative, Systemic, Curative** *rainfast;excellent protectant on leaf blight*
Ridomil Gold MZ, Ridomil Gold Copper	mefenoxam + mancozeb	4 + M3	14 days	**Systemic** *works on US-23* ***not*** *US-8*
Tanos	cymoxanil + famoxadone	27+11	14 days	**Locally Systemic, Curative** *tank mix with protectant; excellent curative;good leaf protectant;rainfast*
Zampro	ametoctradin + dimethomorph	45 + 40	4 days	**Systemic and Protectant** *New registration includes two a.i.s with excellent activity on late blight, Forum plus new a.i.*