Advances in Early Blight Management of Potato

Amanda J. Gevens
Extension Plant Pathologist
Stephen A. Jordan
Associate Researcher
University of Wisconsin-Madison

UWEX/WPVGA Grower Ed Conference
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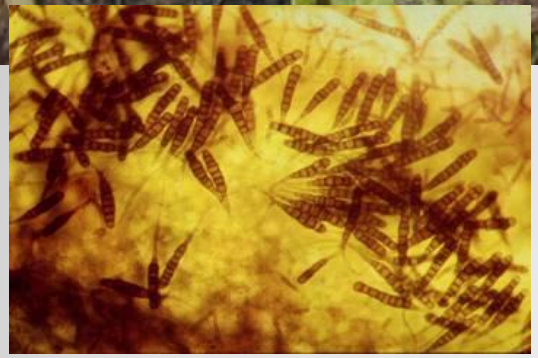
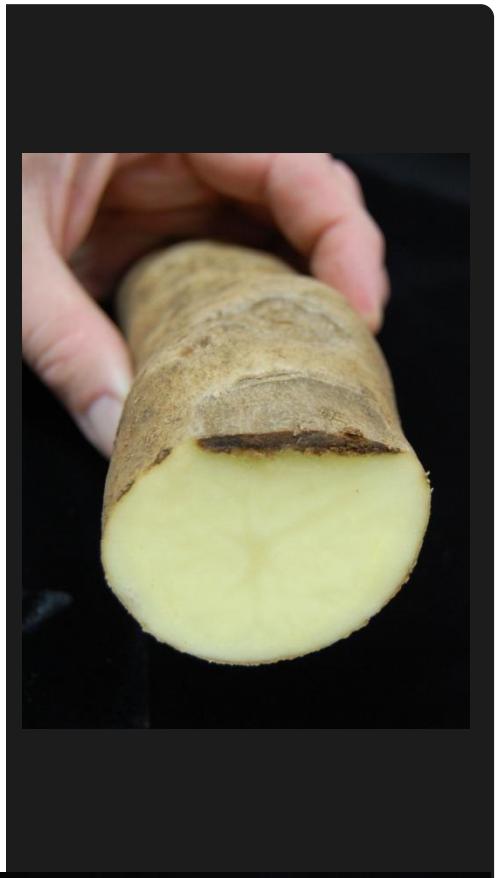
Holiday Inn, Stevens Point, WI

Early Blight
Alternaria solani

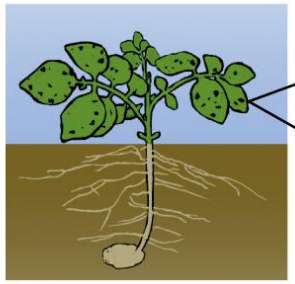




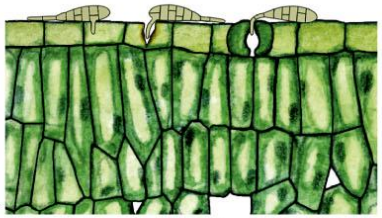
Tuber Early Blight

dependent upon cultivar
and conditions leading to
harvest and early storage

Early Blight Disease Cycle



Disease develops on first fully expanded leaves near soil.

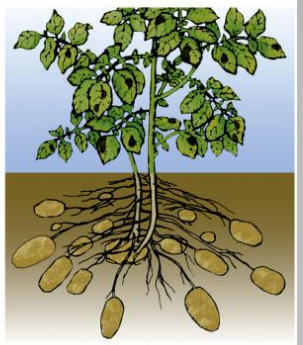


Any cell can germinate. Conidia germinate in presence of free water and may penetrate tissues directly, or through stomata or wounds.

SUMMER

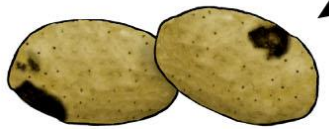
Leaf lesions may be circular when between veins and angular when bordered by veins.

LATE SUMMER



Early blight is prevalent on senescing tissue and plants stressed from low nitrogen and pest pressure.

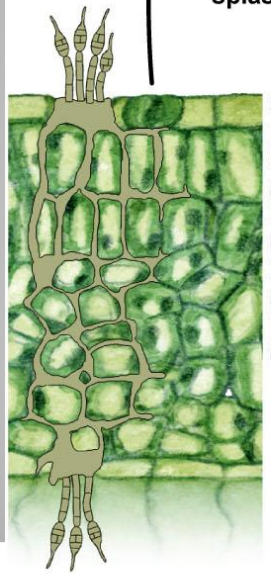
FALL



Tubers are inoculated during harvest. Circular sunken lesions form on infected tubers.

Pathogen survives winter in infested potato plant debris.

WINTER



Spores are produced on infested plants and plant debris between 41 and 86F. Sporulation is favored by alternating periods of wet and dry.

SPRING

Conidia dispersed by wind and rain splash

There are multiple cycles per season.

Secondary spread of conidia to neighboring leaves and plants is important in the spread of the disease.

W.Kirk, P. Wharton, MSU

Brown Spot
Alternaria alternata

- Caused by a "cousin" of *A. solani*
- Lesions tend to be smaller and darker in color
- Typically appear near the middle/top of canopy first

- Similar to early blight in i
- Often considered "weaker
- Causes black pit on tuber

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- Often considered "weaker" pathogen
- Causes black pit on tuber

Early blight & Brown spot occurrence in WI – azoxystrobin resistance

We identified *A. solani* and *A. alternata* from northern WI potato fields in Aug 2011

Results of azoxystrobin resistance assay indicated resistance to azoxystrobin in ‘poison plate’ spore assays of both Alternaria species

We have expanded our survey over location and time

Results suggest that late season efficacy of azoxystrobin on early blight and brown spot in some northern WI fields may be limited

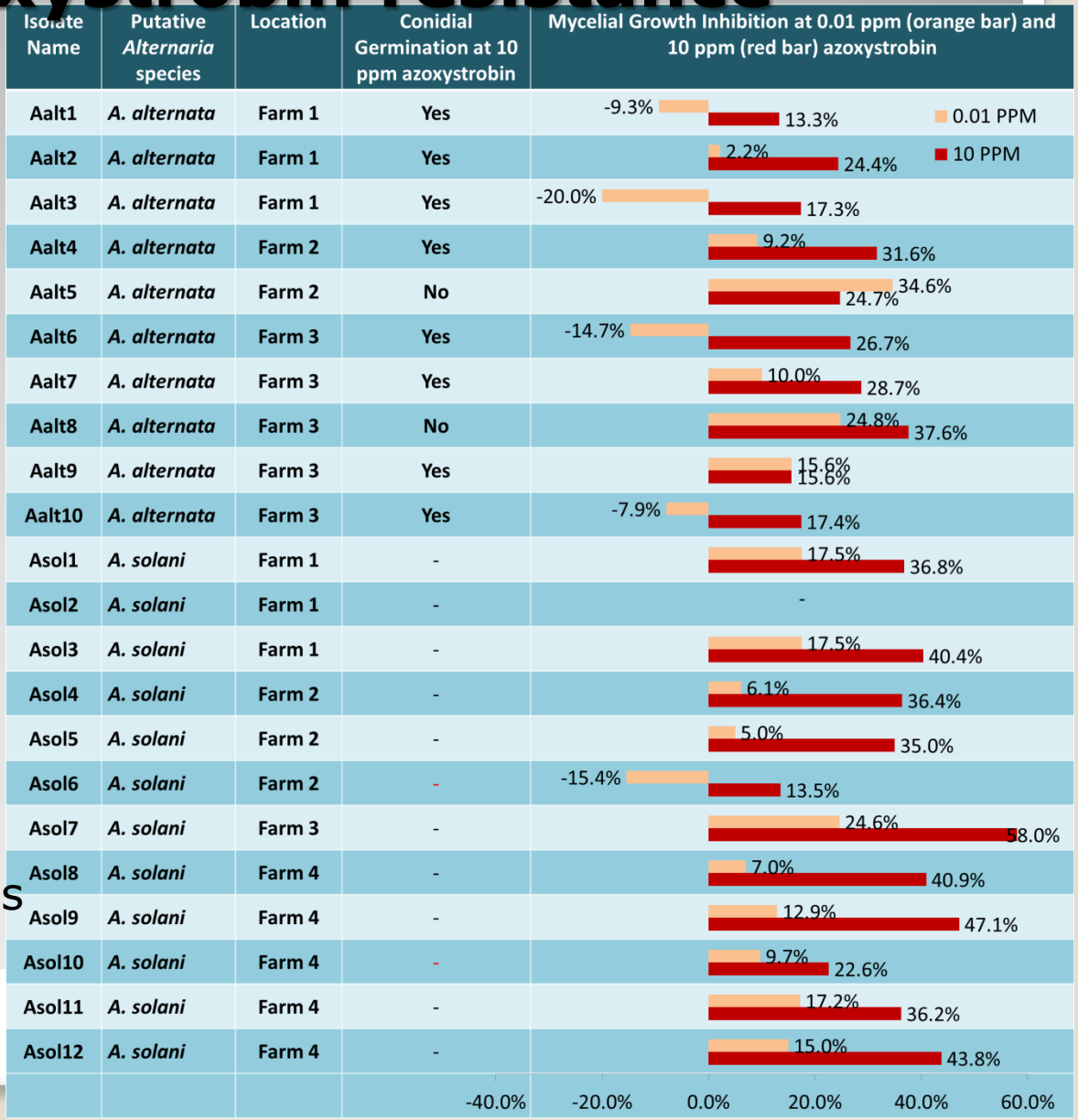
Early blight & Brown spot occurrence in WI – azoxystrobin resistance

Sampling field populations for fungicide resistance screening provides useful info

However, keep in mind that populations have variability and small sampling may offer info on just a small portion of population

Resistance test results should be used along with knowledge of Performance of fungicides in a specific field

Isolate Name	Putative *Alternaria* species	Location	Conidial Germination at 10 ppm azoxystrobin	Mycelial Growth Inhibition at 0.01 ppm (orange bar) and 10 ppm (red bar) azoxystrobin
Aalt1	*A. alternata*	Farm 1	Yes	-9.3% / 13.3%
Aalt2	*A. alternata*	Farm 1	Yes	2.2% / 24.4%
Aalt3	*A. alternata*	Farm 1	Yes	-20.0% / 17.3%
Aalt4	*A. alternata*	Farm 2	Yes	9.2% / 31.6%
Aalt5	*A. alternata*	Farm 2	No	34.6% / 24.7%
Aalt6	*A. alternata*	Farm 3	Yes	-14.7% / 26.7%
Aalt7	*A. alternata*	Farm 3	Yes	10.0% / 28.7%
Aalt8	*A. alternata*	Farm 3	No	24.8% / 37.6%
Aalt9	*A. alternata*	Farm 3	Yes	15.6% / 15.6%
Aalt10	*A. alternata*	Farm 3	Yes	-7.9% / 17.4%
Asol1	*A. solani*	Farm 1	-	17.5% / 36.8%
Asol2	*A. solani*	Farm 1	-	-
Asol3	*A. solani*	Farm 1	-	17.5% / 40.4%
Asol4	*A. solani*	Farm 2	-	6.1% / 36.4%
Asol5	*A. solani*	Farm 2	-	5.0% / 35.0%
Asol6	*A. solani*	Farm 2	-	-15.4% / 13.5%
Asol7	*A. solani*	Farm 3	-	24.6% / 58.0%
Asol8	*A. solani*	Farm 4	-	7.0% / 40.9%
Asol9	*A. solani*	Farm 4	-	12.9% / 47.1%
Asol10	*A. solani*	Farm 4	-	9.7% / 22.6%
Asol11	*A. solani*	Farm 4	-	17.2% / 36.2%
Asol12	*A. solani*	Farm 4	-	15.0% / 43.8%



Early blight & Brown spot occurrence in WI

- Survey for Alternaria spp. in WI
- Began in 2012 to identify species at 4 locations over duration of growing season
- Results will help us better understand the Alternaria complex
- due to potential differences in fungicide activity on the pathogens
- may aid in optimizing use of newer reduced risk fungicides in control programs

Early blight & Brown spot occurrence in WI

- Mid-July to Mid-August collections 2012:
  GM, Hancock, Plover: *A. solani* identified
- Mid-August to season's end collections 2012:
  GM, Hancock, Plover, Antigo: *A. solani* identified

  Hancock, Plover: *A. alternata* also identified

Azoxystrobin resistance screening in process

Early Blight Management

- Cultivars differ in susceptibility
- Nitrogen management aids control
- Many good fungicide options
  - alternate fungicide modes of action
  - follow resistance management recommendations on label
  - tank mixes
  - good coverage is important
  - appropriate timing of first spray (Pday 300 or prior to canopy closure)

Early Blight Fungicides

Standard protectants

- chlorothalonil (Bravo, Echo, Equus)
- mancozeb (Dithane, Manzate, Penncozeb)

Group M5
Group M3

Reduced risk early blight fungicides

- boscalid (Endura)[res?]
- fluopyram + Scala/pyrimethanil (Luna T)[sens]
- penthiopyrad (Vertisan)[res?]

SDHIs
Group 7

- azoxystrobin (Quadris)
- fluoxastrobin (Evito)
- pyraclostrobin (Headline)
- trifloxystrobin (Gem)
- famoxadone+cymoxanil (Tanos)
- fenamidone (Reason)
- picoxystrobin (Aproach)

QoI inhibitors
Group 11

Early Blight Fungicides (continued)

Reduced risk early blight fungicides

- pyrimethanil (Scala)
- fluopyram + pyrimethanil (Luna Tranquility)

Group 9
Anilino-pyrimidines

- mandipropamid (40)+difenoconazole (Revus Top)
- azoxystrobin (11)+difenoconazole (Quadris Top)
- metconazole (Quash)

Group 3 Triazoles

What the FRAC?

http://www.frac.info/index.htm

MOA	TARGET SITE AND CODE	GROUP NAME	CHEMICAL GROUP	COMMON NAME	COMMENTS	FRAC CODE
C. respiration	**C1:** complex I NADH Oxido-reductase	pyrimidinamines	pyrimidinamines	diflumetorim	Resistance not known.	39
	C2: complex **II**: succinate-dehydro-genase	SDHI (**S**uccinate **deh**ydrogenase **i**nhibitors)	phenyl-benzamides	benodanil flutolanil mepronil	Resistance known for several fungal species in field populations and lab mutants. Target site mutations in sdh gene, e.g. H/Y (or H/L) at 257, 267, 272 or P225L, dependent on fungal species. Resistance management required. **Medium to high risk.** **See FRAC SDHI Guidelines for resistance management.**	7
			pyridinyl-ethyl-benzamides	fluopyram		
			furan- carboxamides	fenfuram		
			oxathiin-carboxamides	carboxin oxycarboxin		
			thiazole-carboxamides	thifluzamide		
			pyrazole-carboxamides	benzovindiflupyr bixafen fluxapyroxad furametpyr isopyrazam penflufen penthiopyrad sedaxane		
			pyridine-carboxamides	boscalid		
	C3: complex **III**: cytochrome bc1 (ubiquinol oxidase) at Qo site *(cyt b gene)*	**QoI**-fungicides (**Q**uinone **o**utside **I**nhibitors)	methoxy-acrylates	azoxystrobin coumoxystrobin enoxastrobin flufenoxystrobin picoxystrobin pyraoxystrobin	Resistance known in various fungal species. Target site mutations in cyt b gene (G143A, F129L) and additional mechanisms. Cross resistance shown between all members of the QoI group. **High risk.** **See FRAC QoI Guidelines for resistance management.**	11
			methoxy-carbamates	pyraclostrobin pyrametostrobin triclopyricarb		
			oximino acetates	kresoxim-methyl trifloxystrobin		
			oximino-acetamides	dimoxystrobin fenaminostrobin metominostrobin orysastrobin		
			oxazolidine-diones	famoxadone		
			dihydro-dioxazines	fluoxastrobin		
			Imidazolinones	fenamidone		
			benzyl-carbamates	pyribencarb		
	C4: complex **III**: cytochrome bc1(ubiquinone reductase) at Qi site	**QiI** - fungicides (**Q**uinone **i**nside **I**nhibitors)	cyano- imidazole	cyazofamid	Resistance risk unknown but assumed to be medium to high (mutations at target site known in model organisms). Resistance management required.	21
			sulfamoyl-triazole	amisulbrom		
	C5: uncouplers of		dinitrophenyl crotonates	binapacryl meptyldinocap dinocap	Resistance not known. Also acaricidal activity.	29
			2,6-dinitro-		Low risk. However, resistance	

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			furan- carboxamides	fenfuram		
			oxathiin-carboxamides	carboxin oxycarboxin		
			thiazole-carboxamides	thifluzamide		
			pyrazole-carboxamides	benzovindiflupyr bixafen fluxapyroxad furametpyr isopyrazam penflufen penthiopyrad sedaxane		
			pyridine-carboxamides	boscalid		
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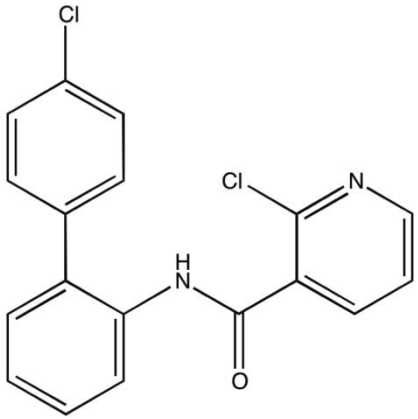
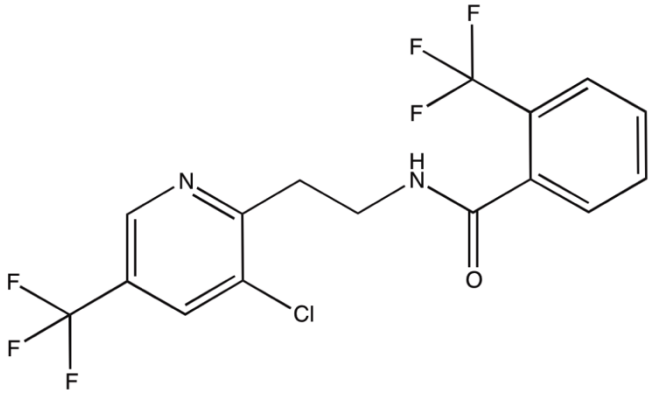
Succinate dehydrogenase inhibitors (SDHIs)

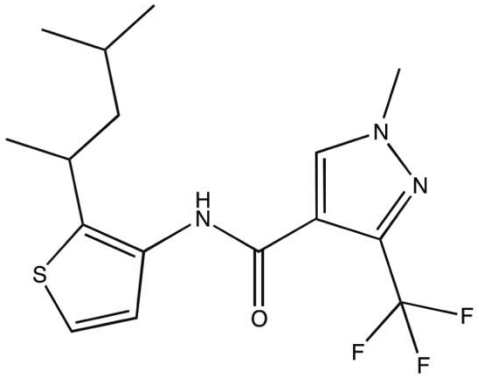
Three different active ingredients labeled for early blight control (FRAC group 7)



Boscalid



Fluopyram



Penthiopyrad

Phill Wharton

Resistance to SDHI Fungicides

- Resistance to boscalid in a number of fungi, including *A. alternata*
- First reported in *A. solani* in ID in 2009 (Wharton)
- 2010, reports of poor early blight control in field where Endura (boscalid) was applied (ID,NE,ND)
- *A. solani* isolates collected in 2010-11 and assayed for resistance to boscalid, penthiopyrad, and fluopyram (Gudmestad)
  - ND (26), ID (43), NE (43, MN (29), TX (15), FL (2), WI (3)
    - No resistance to fluopyram (Luna)
    - Some isolates moderately to highly resistant to penthiopyrad Vertisan), 2/3 WI isolates were mod resistant
    - Majority of isolates highly resistant to boscalid, including all 3 WI isolates (collected from one field, west side)

2012 Potato Early Blight Fungicide Evaluation

Treatment and rate/acre	Application Timing[w]	Yield (cwt/ton)				RAUDPC[x]	Brown Spot Rating[y]
		Culls	B Grade	US #1	Total		
1.Untreated Control.....	NA	23.7	59.7	302.2	385.6	0.270 fg[z]	2.50 ef
2.Echo Zn 4.17 F 2.0 pt.....	1-10	32.2	72.5	304.6	409.3	0.177 abcd	1.75 cd
3.Quadris 2.08 SC 6 fl oz	1,3,5						
Echo Zn 4.17 F 2.0 pt.....	2,4,6,7-10	37.8	90.5	318.0	446.3	0.167 abcd	1.00 ab
4.Moncoat seed trt							
Echo Zn 4.17 F 2.0 pt	1,2,4,						
Headline SC 10 fl oz Echo Zn 4.17 F 2.0 pt	3,6						
Endura WG 3.5 oz + Echo Zn 4.17 F 2.0 pt	5,7						
Dithane DF 2 lb + Super Tin 80 WP 2.5 fl oz.....	8-10	56.6	52.2	377.5	486.3	0.191 bcde	1.00 ab
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Dithane DF 2 lb + Super Tin 80 WP 2.5 fl oz.....	8-10	37.1	70.0	313.3	420.4	0.187 abcde	0.75 a
6.Echo Zn 4.17 F 2.0 pt	1,3,7,9						
Reason 4.0 fl oz + Echo Zn 4.17 F 1.5 pt	2,5						
Luna Tranquility 8 fl oz + Manzate DF 24 oz	4,6						
Scala 7 fl oz + Manzate DF 24 oz	8,10						
Previcur Flex 1.2 pt.....	7	27.9	100.3	356.5	484.7	0.138 a	1.00 ab
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Grower Standard – no seed trt

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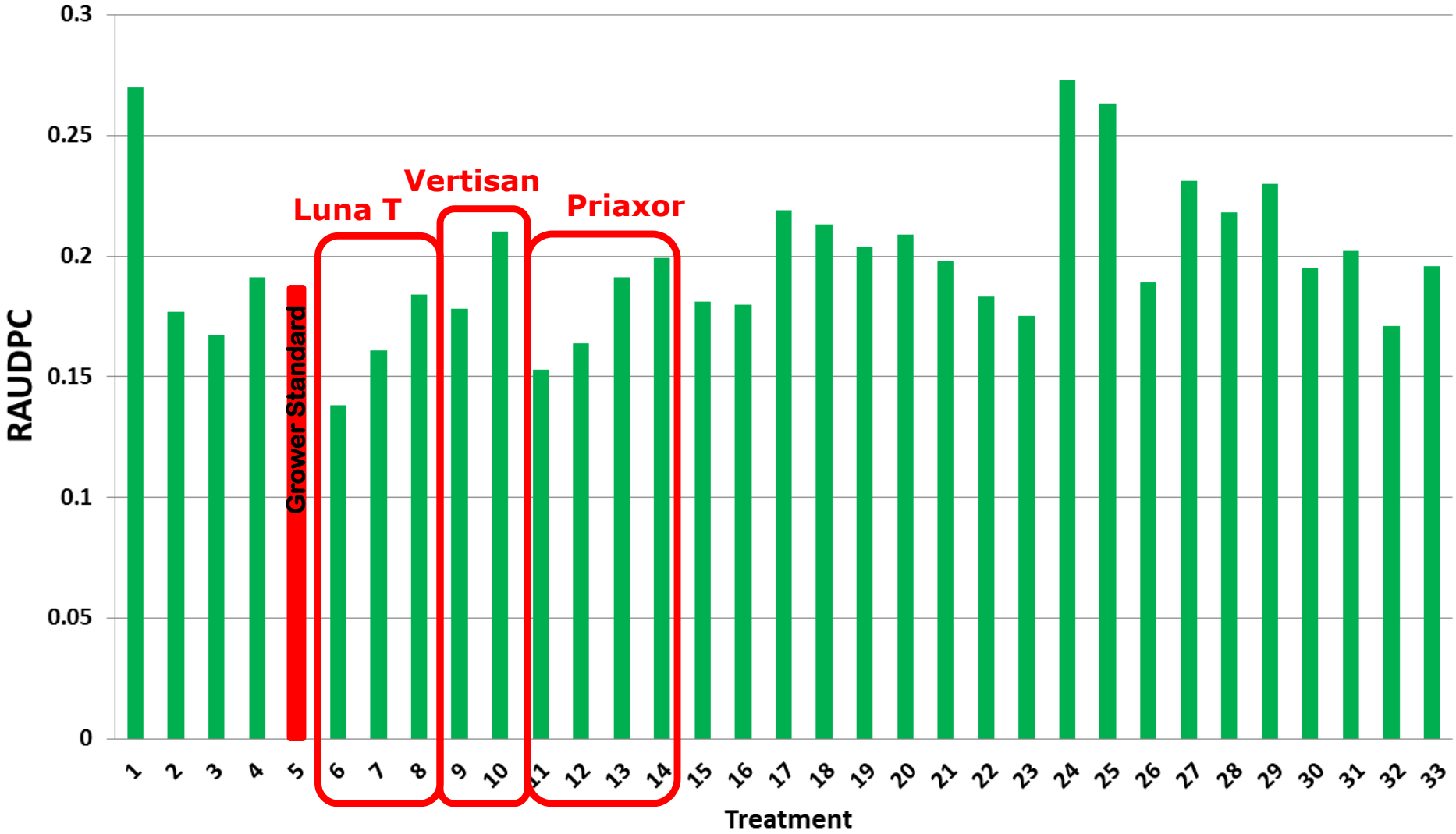
	1,2,4,8,1						

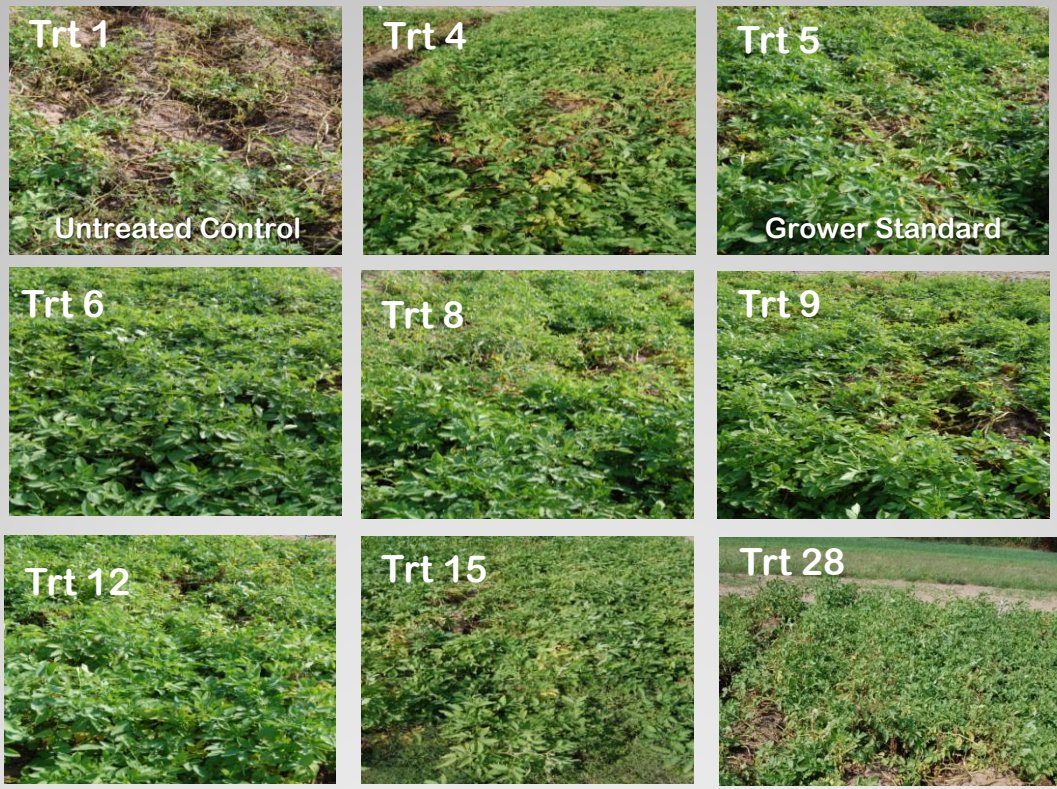
Grower Standard – with Moncoat Seed trt (+~60 cwt/a)

- Cumulative Early Blight, 2012 HARS

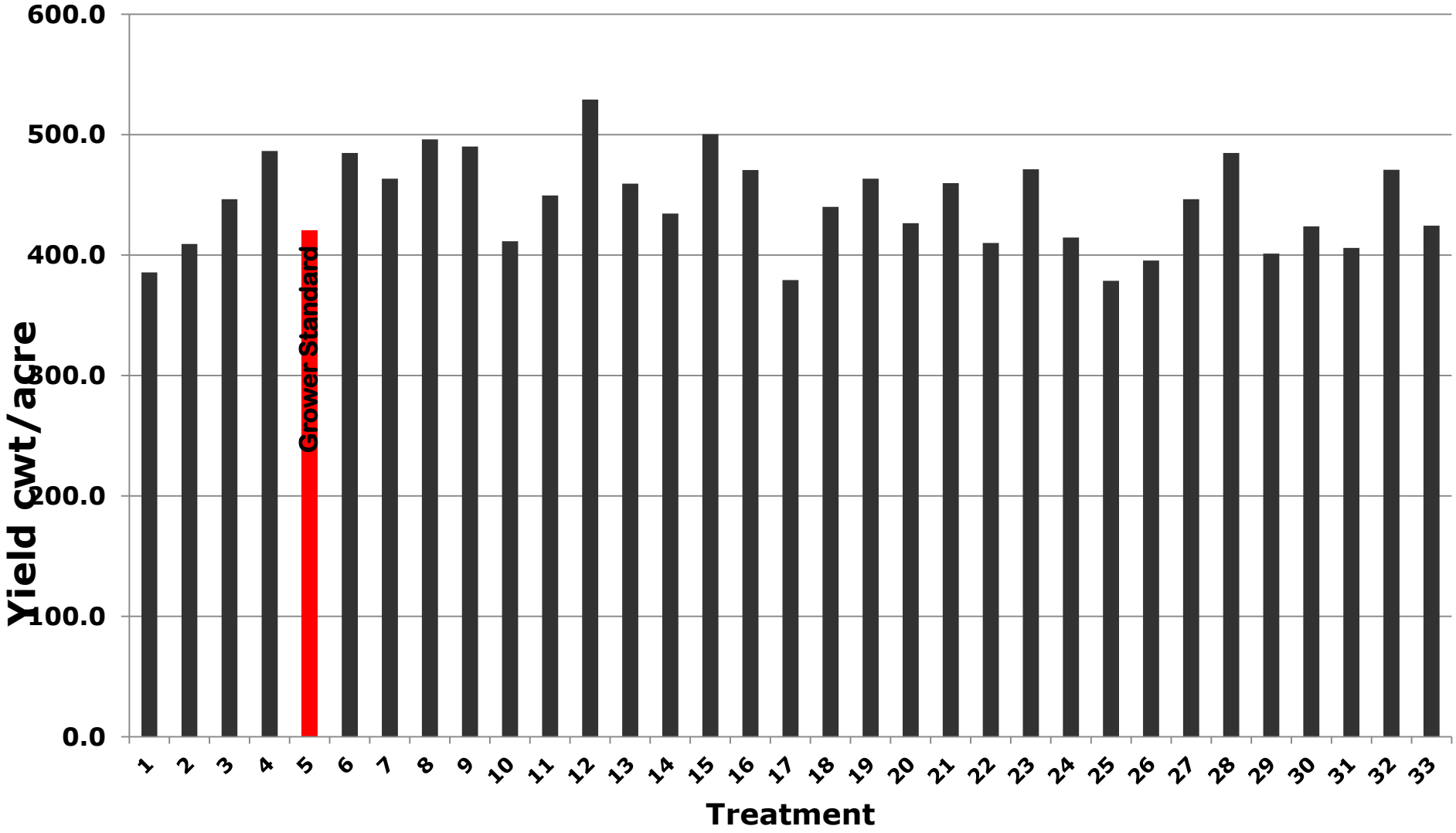


Top Yielding Treatments

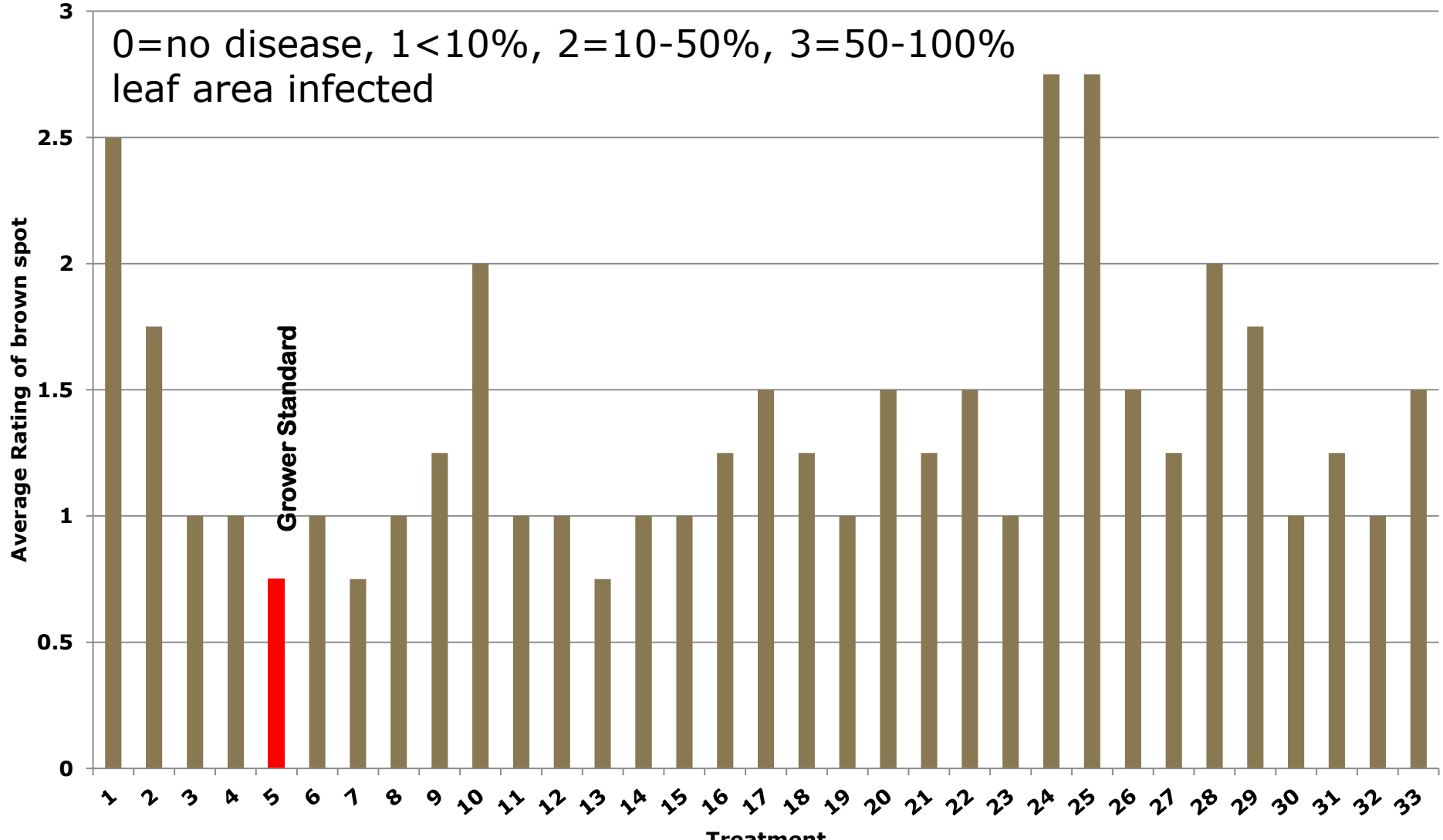
>480 cwt/acre total yield – photos taken on 28 Aug 2012



- Yield data, 2012 HARS
  - No significant differences (Fisher's LSD)



- Brown spot disease data, 2012 HARS



2012 EB Potato Trial Summary

- No significant differences in total yield, or US-1s across all treatments
- Of treatments that did not significantly limit disease, most were individual experimental compounds that were not integrated into a season-long program and 2 were season-long copper applications
- Most top-yielding fungicide programs for early blight control:
  - controlled brown spot in the upper canopy late season
  - contained multiple active ingredients including new registrations
  - utilized chlorothalonil as the base protectant
- No evidence of pathogen resistance to strobilurin (QoI) or SDHI compounds based on field performance of fungicide programs
- New chemistries provide good options for building fungicide programs

Early Blight Management

- Cultivars differ in susceptibility
- Nitrogen management aids in control
- Many good fungicide options, but selection is getting trickier
  - management strategies to limit development of fungicide resistance
    - Alternate modes of action (FRAC groups)
    - Follow label for max # of apps + if subsequent apps of same fungicide is OK
    - Tank-mix with a base protectant
    - Treat preventatively

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/

Plant Pathology
at the University of Wisconsin - Madison

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