Disease Monitoring and Management: In-field and Post-harvest

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Winter Potato Conference
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2024 Late Blight

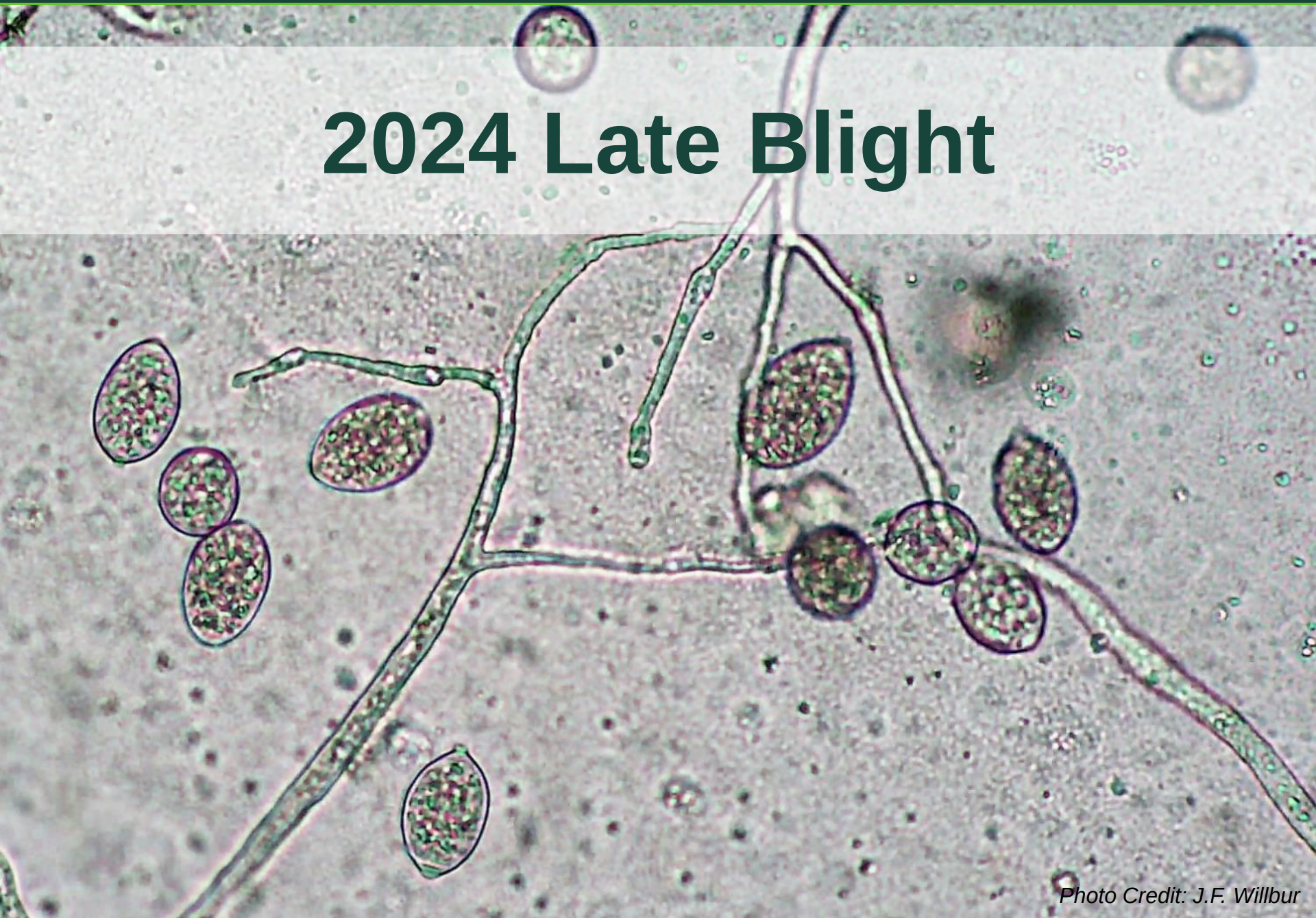
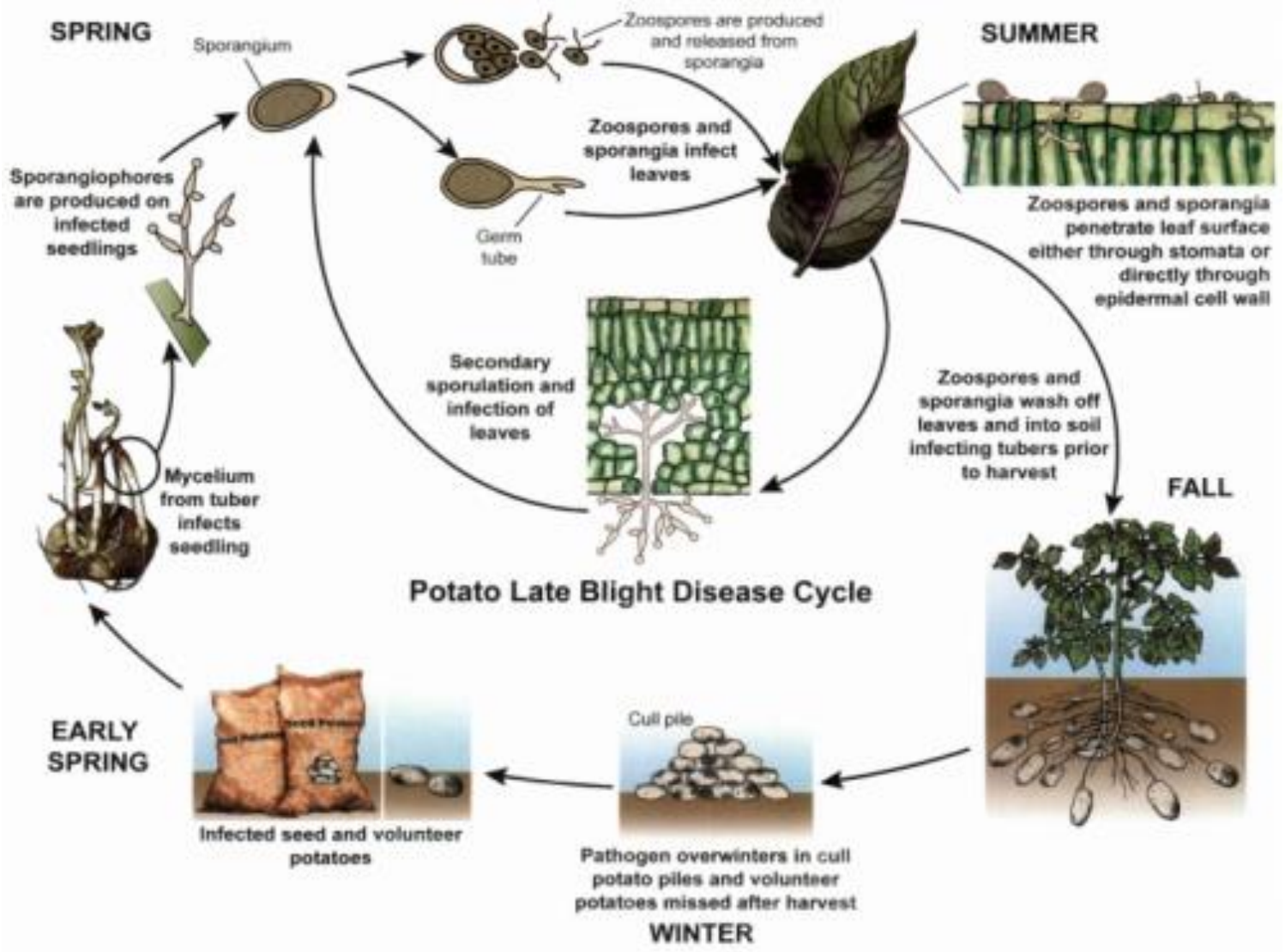
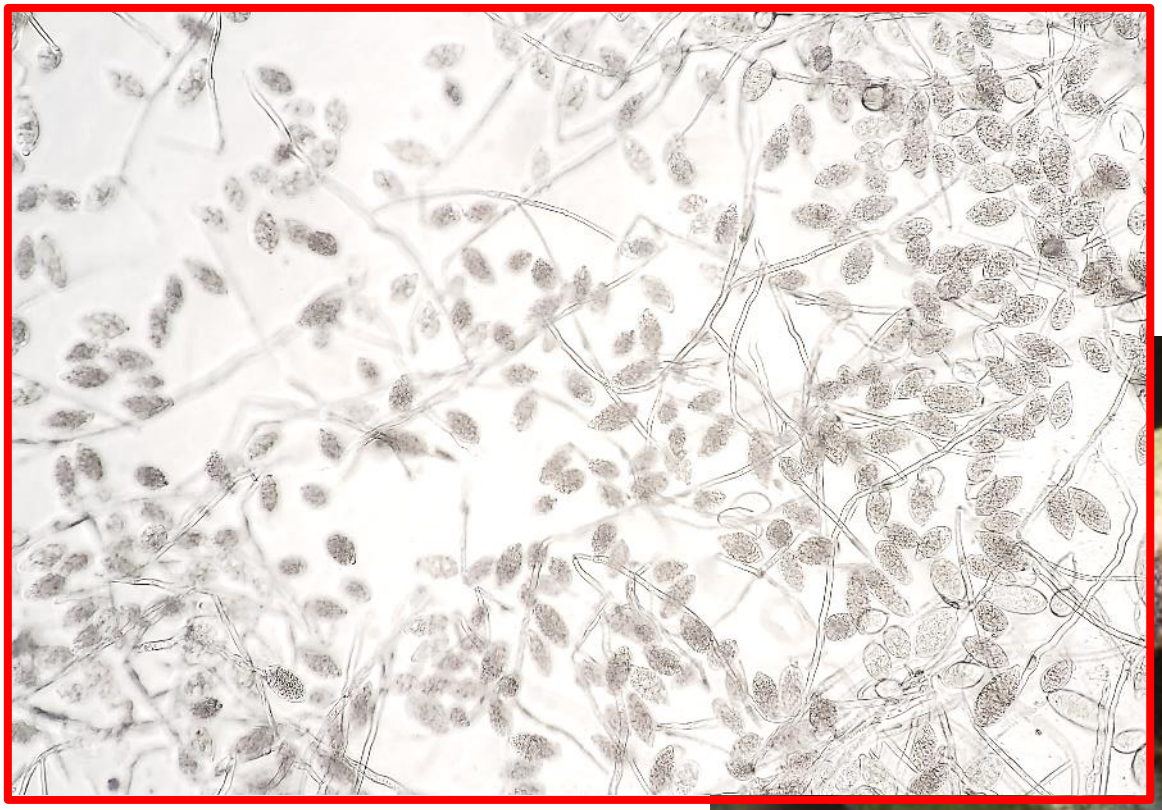


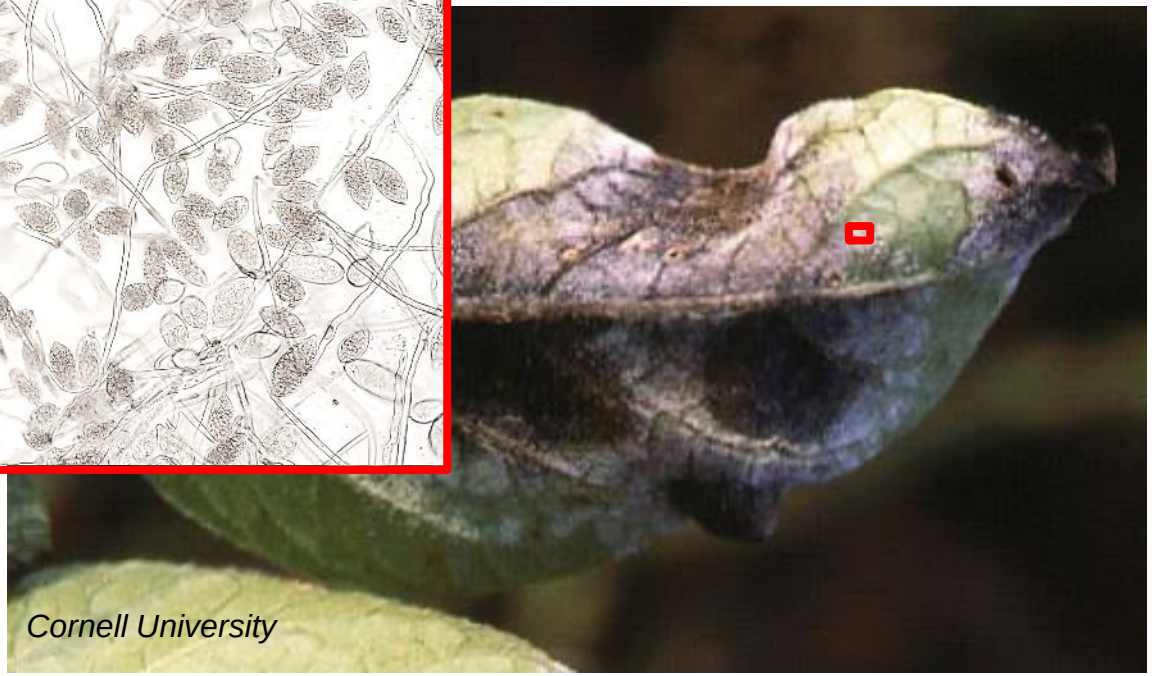
Photo Credit: J.F. Willbur

Late Blight


SPRING
Sporangium
Zoospores are produced and released from sporangia
SUMMER
Zoospores and sporangia infect leaves
Sporangiophores are produced on infected seedlings
Germ tube
Zoospores and sporangia penetrate leaf surface either through stomata or directly through epidermal cell wall
Secondary sporulation and infection of leaves
Zoospores and sporangia wash off leaves and into soil infecting tubers prior to harvest
FALL
Mycelium from tuber infects seedling
Potato Late Blight Disease Cycle
EARLY SPRING
Cull pile
Infected seed and volunteer potatoes
Pathogen overwinters in cull potato piles and volunteer potatoes missed after harvest
WINTER

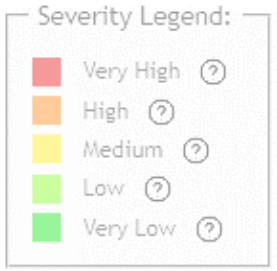
Secondary sporulation is abundant

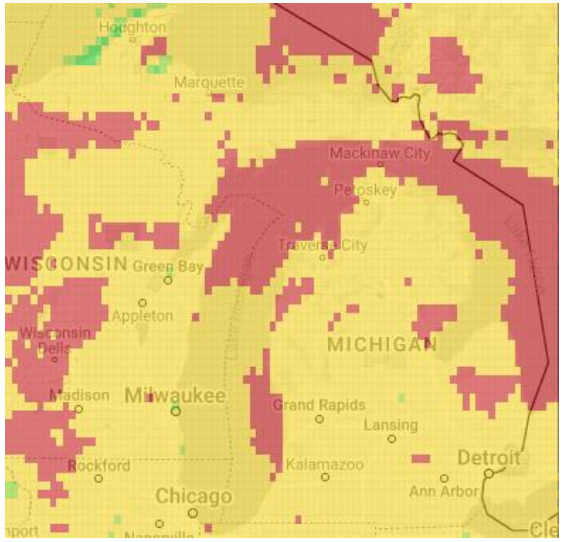




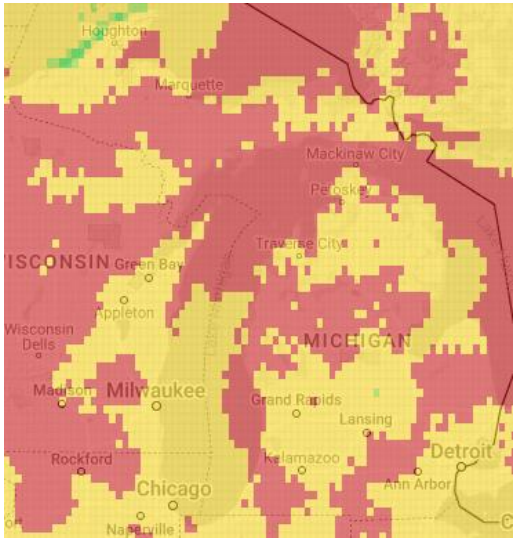
Cornell University

2024 Michigan Late Blight Risk

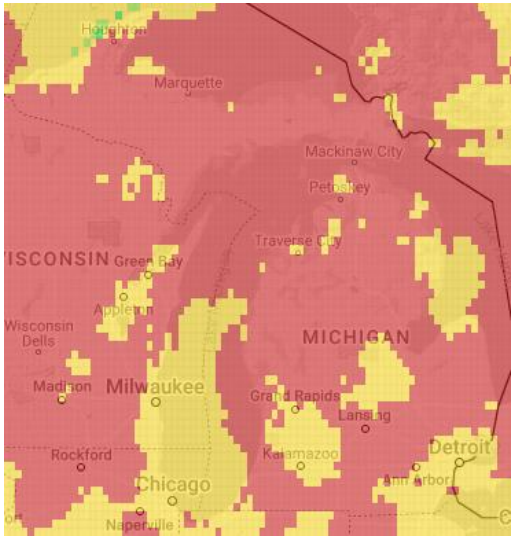




July 15



August 15



September 15

Medium to high risk predicted July to September

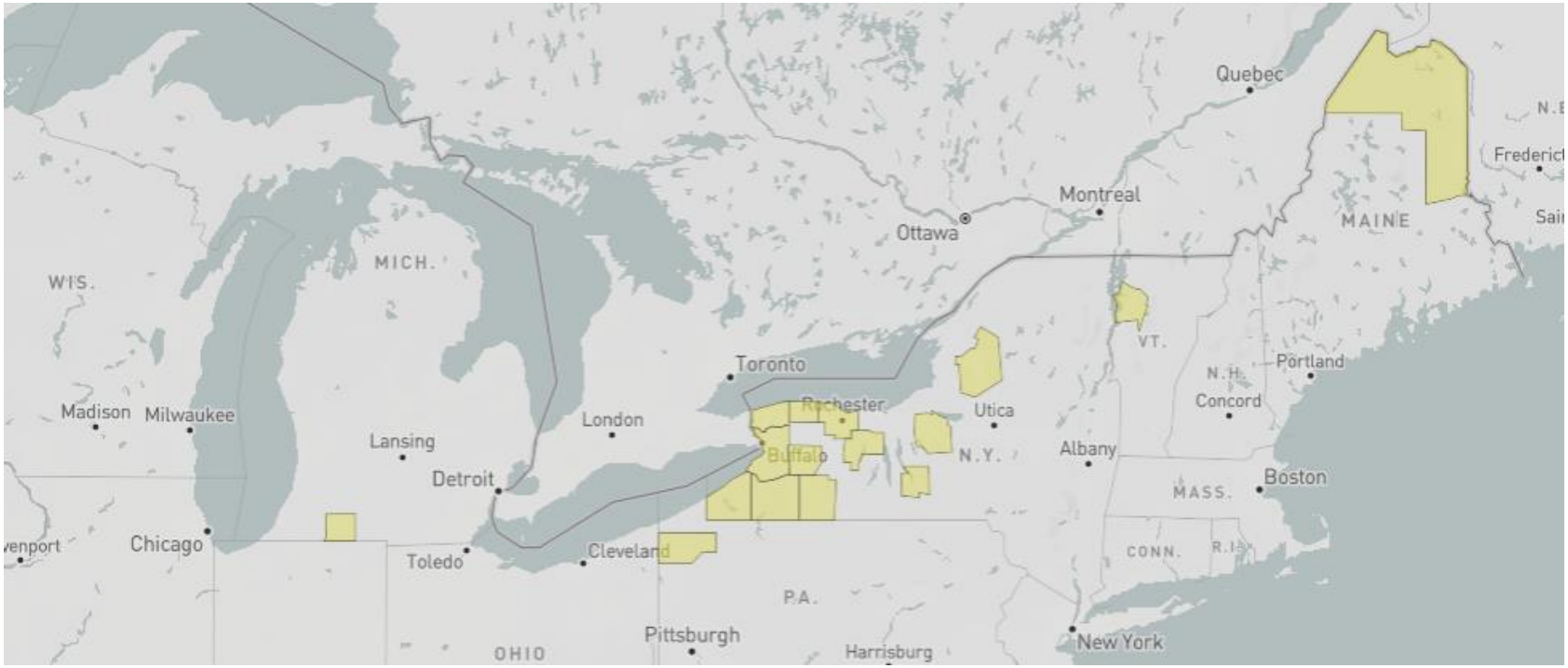
Estimates generated by the University of Wisconsin-Madison Vegetable Disease & Insect Forecasting Network: https://agweather.cals.wisc.edu/vdifn

2024 Regional Late Blight Reports

- Jul 3-10 – Potato and tomato in Kent, Elgin, and Simcoe counties in Ontario, Canada (US-23).
- Jul 23 and Aug 5 – Potato in St. Joseph County, Michigan (US-23).
- Aug 9 – Late blight was detected on a few potato plants in a commercial field in Presque Isle, Maine (US-23).
- Aug 20 – Late blight confirmed in Crawford County, Pennsylvania and two bordering New York counties (US-23).

2024 USAblight.org Reports

https://usablight.org/map/



Date	State/Province	County	Host Crop	Clonal Lineage
Jul 3-10	Ontario, Canada	Kent, Elgin, Simcoe	Potato and tomato	US-23
Jul 23 and Aug 5	Michigan	St. Joseph	Potato	US-23
Aug 9	Maine	Presque Isle	Potato	US-23
Aug 20	Pennsylvania	Crawford	Tomato	-
Aug-Oct	New York	12 counties	Tomato and potato	US-23

All tested samples confirmed to be US-23 genotype
(still believed to be sensitive to mefenoxam/metalaxyl).

Registered Products for Late Blight

Products	Active Ingredient	FRAC Group	Rate (per A)	PHI (days)
Bravo®, Echo®, and Equus®, Initiate®	Chlorothalonil	M5	Various	7
Curzate 60DF®	Cymoxanil	27	3.2 oz	14
Gavel 75DF®	Mancozeb + Zoxamide	M3, 22	1.5-2.0 lbs	14 (3 MI)
Dithane®, Manzate®, and Penncozeb®, etc.	Mancozeb	M3	Various	14 (3 MI)
Orondis Opti® (Premix)	Chlorothalonil + Oxathiapiprolin	M5, U15	1.75-2.5 pts	7
Orondis Ultra® (Premix)	Oxathiapiprolin + Mandipropamid	U15, 40	5.5-8.0 fl oz	14
Omega 500F®	Fluazinam	29	5.5 fl oz	14
Previcur Flex®	Propamocarb hydrochloride	28	0.7-1.2 pts	14
Ranman 400SC®	Cyazofamid	21	1.4-2.75 fl oz	7
Revus Top 2.08SC®	Mandipropamid + Difenoconazole	3, 40	5.5-7 fl oz	14
Tanos 50 WDG®	Cymoxanil + Famoxadone	27, 11	6.0-8.0 oz	14
Zampro®	Ametoctradin + Dimethomorph	45, 40	11-14 fl oz	4
Zing!®	Zoxamide + Chlorothalonil	22, M5	30-34 fl oz	7

2024 Midwest Vegetable Production Guide:
https://extension.purdue.edu/extmedia/ID/ID-56.pdf

2024 MSU Late Blight Trial

(Bloomingdale and Willbur, 2024)

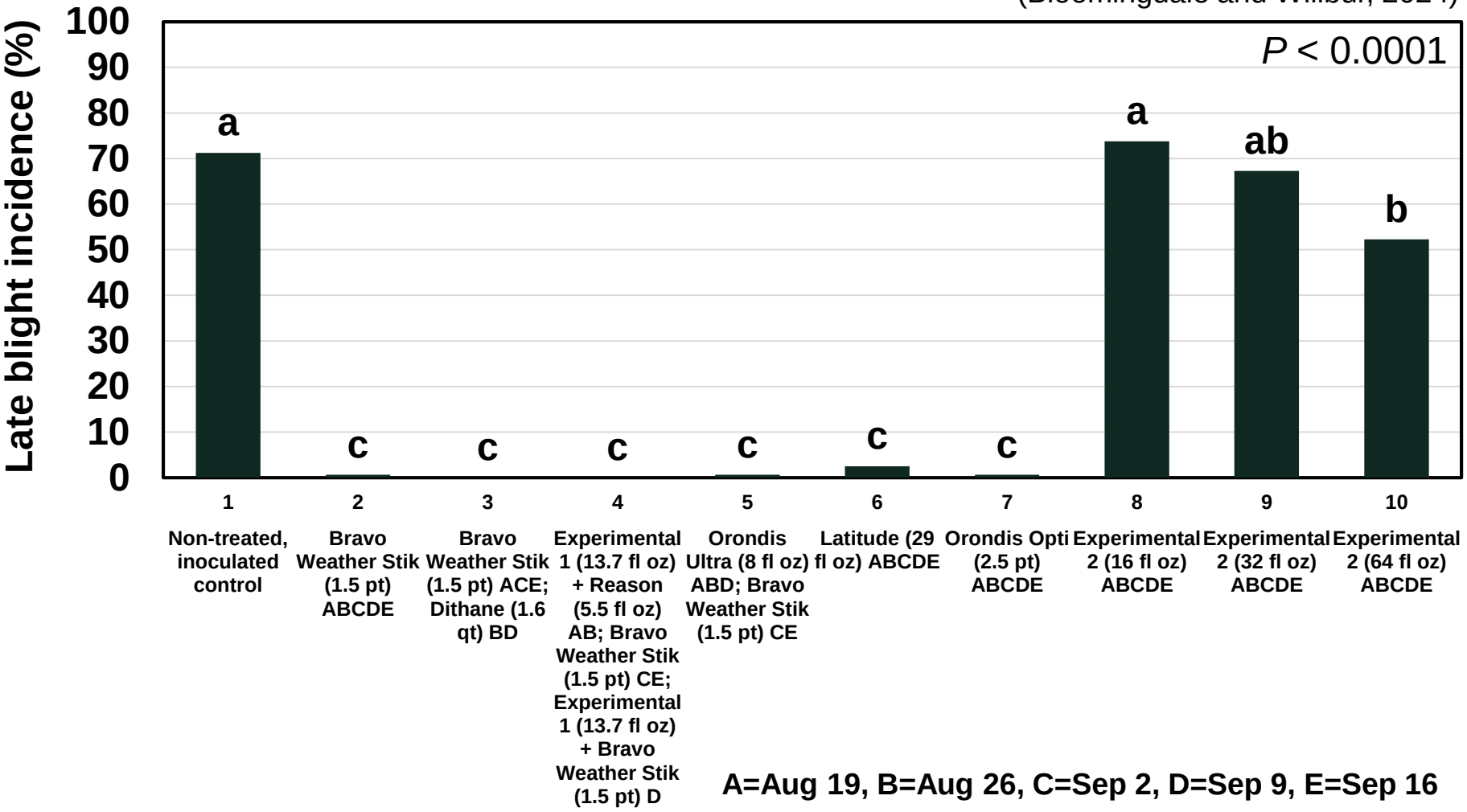
Trt	Treatment, rate (per A), timing [a]
1	Non-treated, inoculated control
2	Bravo Weather Stik (1.5 pt) ABCDE
3	Bravo Weather Stik (1.5 pt) ACE; Dithane (1.6 qt) BD
4	Experimental 1 (13.7 fl oz) + Reason (5.5 fl oz) AB; Bravo Weather Stik (1.5 pt) CE; Experimental 1 (13.7 fl oz) + Bravo Weather Stik (1.5 pt) D
5	Orondis Ultra (8 fl oz) ABD; Bravo Weather Stik (1.5 pt) CE
6	Latitude (29 fl oz) ABCDE
7	Orondis Opti (2.5 pt) ABCDE
8	Experimental 2 (16 fl oz) ABCDE
9	Experimental 2 (32 fl oz) ABCDE
10	Experimental 2 (64 fl oz) ABCDE

A=Aug 19, B=Aug 26, C=Sep 2, D=Sep 9, E=Sep 16

Letter comparisons indicate differences based on Fisher's Protected LSD (α = 0.05).

2024: All tested programs with registered products were effective

(Bloomingdale and Willbur, 2024)



A=Aug 19, B=Aug 26, C=Sep 2, D=Sep 9, E=Sep 16

Letter comparisons indicate differences based on Fisher's Protected LSD (α = 0.05).

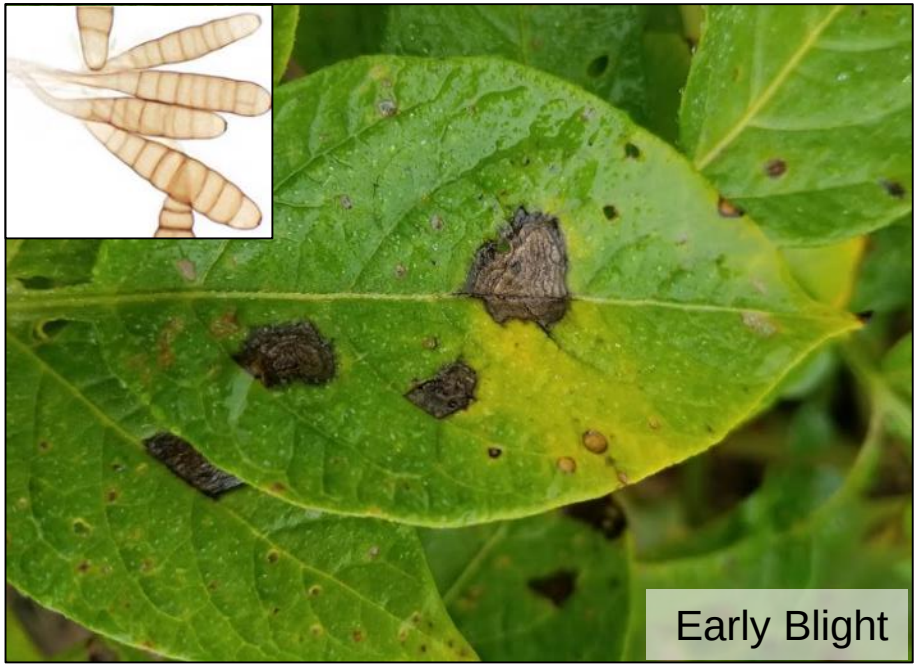
Non-treated Control

Chlorothalonil Program

3 weeks after late blight inoculation


Late Blight

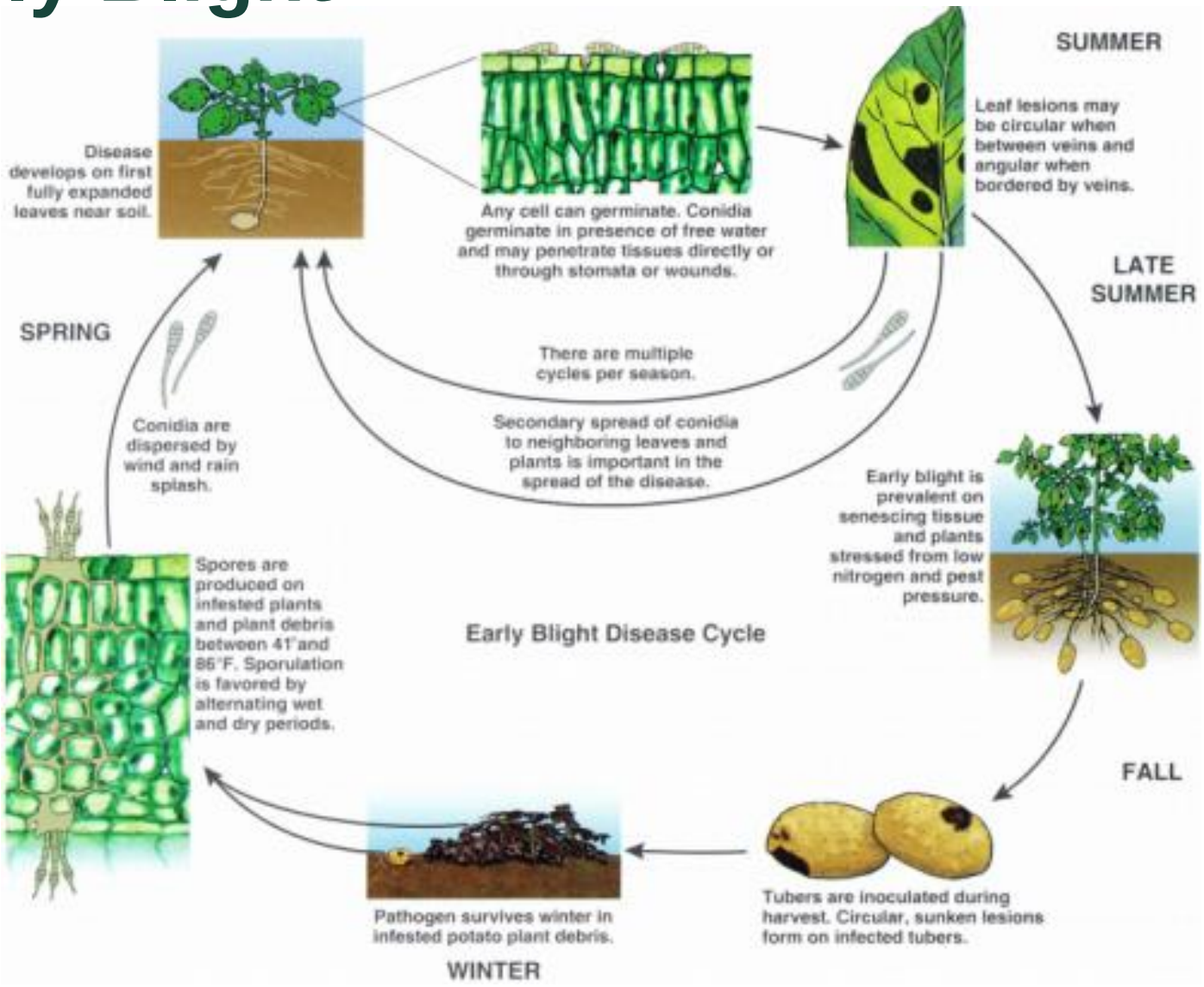

Brown Spot


Early Blight


Grey Mold

2024 Early Blight

Early Blight



Registered Products for Early Blight

Products	Active Ingredient	FRAC Group	Rate (per A)	PHI (days)
Azteroid (FC)®, Quadris (SC)®	Azoxystrobin	11	Various	14
Bravo®, Echo®, Equus®, Initiate®	Chlorothalonil	M5	Various	7
Dithane®, Manzate®, and Penncozeb®, etc.	Mancozeb	M3	Various	14
Endura (WG)®	Boscalid	7	3.5-4.5 oz	10
Gavel 75DF®	Mancozeb + Zoxamide	M3, 22	1.5-2.0 lbs	14 (3 MI)
Headline (SC)®	Pyraclostrobin	11	6-9 fl oz	3
Luna Tranquility (SC)®	Fluopyram + Pyrimethanil	7	8-11.2 fl oz	7
Miravis Prime (SC)®	Pydiflumetofen + Fludioxonil	7, 12	9.2-11.4 fl oz	14
Quadris Opti (SC)®	Chlorothalonil + Azoxystrobin	M5, 11	1.6 pt	14
Revus Top 2.08SC®	Mandipropamid + Difenoconazole	3, 40	5.5-7 fl oz	14
Rovral	Iprodione	2	1-2 pt	14
Scala (SC)®	Pyrimethanil	9	7 fl oz	7
Tanos 50 WDG®	Cymoxanil + Famoxadone	27, 11	6.0-8.0 oz	14
Velum Prime (SC)®	Fluopyram	7	6.5-6.84 fl oz	7
Zing!®	Zoxamide + Chlorothalonil	22, M5	30-34 fl oz	7

2024 Midwest Vegetable Production Guide: https://extension.purdue.edu/extmedia/ID/ID-56.pdf

2024 MSU Early Blight Trial

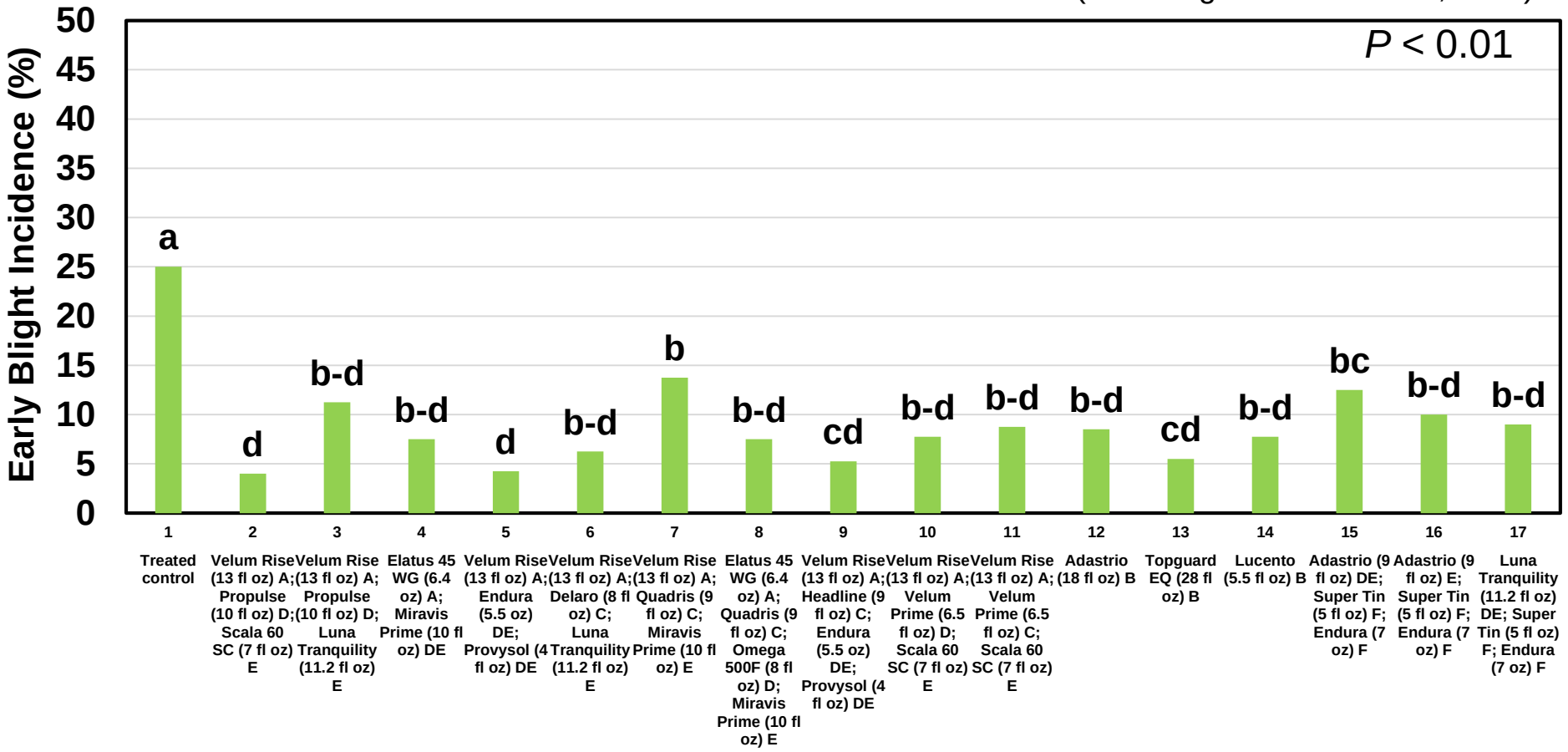
(Bloomingdale and Willbur, 2024)

Trt	Treatment, rate (per A), timing [a]
1	Treated control
2	Velum Rise (13 fl oz) A; Propulse (10 fl oz) D; Scala 60 SC (7 fl oz) E
3	Velum Rise (13 fl oz) A; Propulse (10 fl oz) D; Luna Tranquility (11.2 fl oz) E
4	Elatus 45 WG (6.4 oz) A; Miravis Prime (10 fl oz) DE
5	Velum Rise (13 fl oz) A; Endura (5.5 oz) DE; Provysol (4 fl oz) DE
6	Velum Rise (13 fl oz) A; Delaro (8 fl oz) C; Luna Tranquility (11.2 fl oz) E
7	Velum Rise (13 fl oz) A; Quadris (9 fl oz) C; Miravis Prime (10 fl oz) E
8	Elatus 45 WG (6.4 oz) A; Quadris (9 fl oz) C; Omega 500F (8 fl oz) D; Miravis Prime (10 fl oz) E
9	Velum Rise (13 fl oz) A; Headline (9 fl oz) C; Endura (5.5 oz) DE; Provysol (4 fl oz) DE
10	Velum Rise (13 fl oz) A; Velum Prime (6.5 fl oz) D; Scala 60 SC (7 fl oz) E
11	Velum Rise (13 fl oz) A; Velum Prime (6.5 fl oz) C; Scala 60 SC (7 fl oz) E
12	Adastrio (18 fl oz) B
13	Topguard EQ (28 fl oz) B
14	Lucento (5.5 fl oz) B
15	Adastrio (9 fl oz) DE; Super Tin (5 fl oz) F; Endura (7 oz) F
16	Adastrio (9 fl oz) E; Super Tin (5 fl oz) F; Endura (7 oz) F
17	Luna Tranquility (11.2 fl oz) DE; Super Tin (5 fl oz) F; Endura (7 oz) F

A=May 23 (in-furrow, at-plant), B=Jun 26 (at hilling), C=Jul 1 (50% row closure), D=Jul 8 (row closure/10% flower), E=Jul 22 (row closure + 2 weeks), F = Aug 8 (row closure + 4 weeks).

2024: all tested programs effectively reduced early blight

(Bloomingdale and Willbur, 2024)



Letter comparisons indicate differences based on Fisher's Protected LSD (α = 0.05)

Foliar Management Considerations

- Plant disease-free certified seed
- Use varieties less susceptible to early and late blight
- Destroy volunteers, alternate hosts, and culls
- Do not plant in sites shaded by trees or structures
- Promote air movement and reduce leaf wetness to slow secondary disease spread
- Inspect plants every week for symptoms
- Apply preventative fungicides weekly – copper, chlorothalonil, or mancozeb products
- Submit samples for diagnosis (overnight)
- Rogue diseased plants – within 100 ft radius from late blight infection

2023-24 Late Blight Spore Monitoring

- In 2022, potato late blight confirmed in Montcalm Co., MI - Sep 6, 7, and 14
- Severe volunteer potato pressure observed in following years
- Deployed low-cost rotating arm samplers in 2-3 counties
  - MSU Extension (Whittington)
  - MSU Potato Outreach Program (Long)
  - Michigan Potato Industry Cooperators

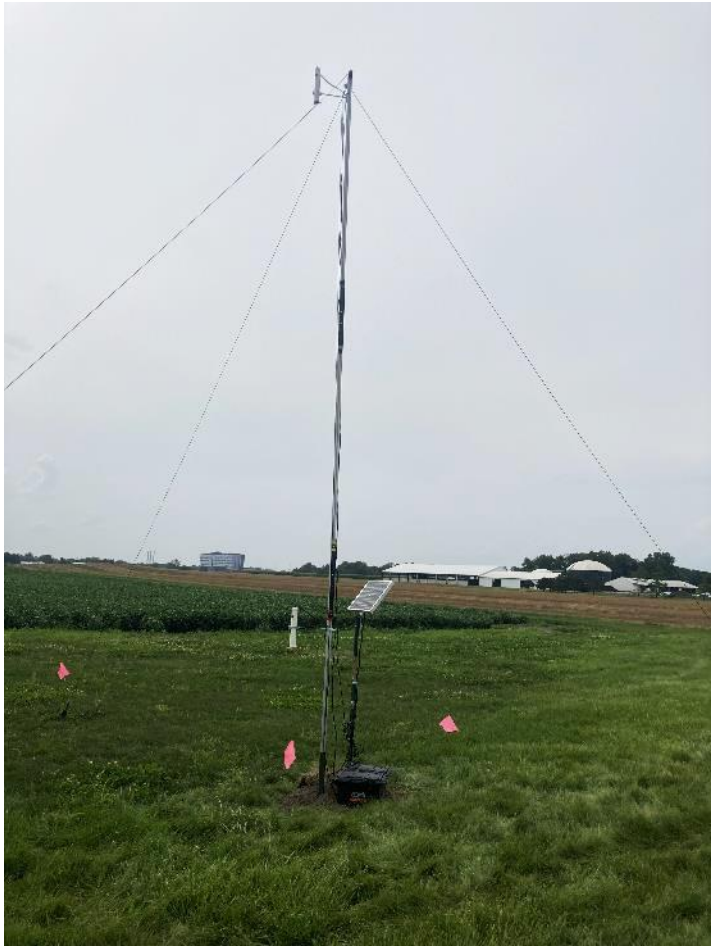
Project GREEEN

Samplers deployed in commercial fields

- Validated qPCR protocols (detection limit of 1 sporangia; processing time 4-6 hours)
- Confirmed *P. infestans* DNA detected the week of visual symptom development in inoculated field
- In 2024, no late blight was reported in Montcalm Co. and no *P. infestans* DNA was detected from samplers in commercial fields

Foliar Disease Summary

- Late blight was reported in St. Joseph County in 2024
- Semi-annual incidences and volunteer survival supports careful monitoring, and preventative management remains effective
- Spore samplers may help to support scouting efforts, consider sampler types and collection frequencies
- Additional comparisons are ongoing, and other foliar pathogens may be of interest



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2024 Storage Diseases

Storage Diseases

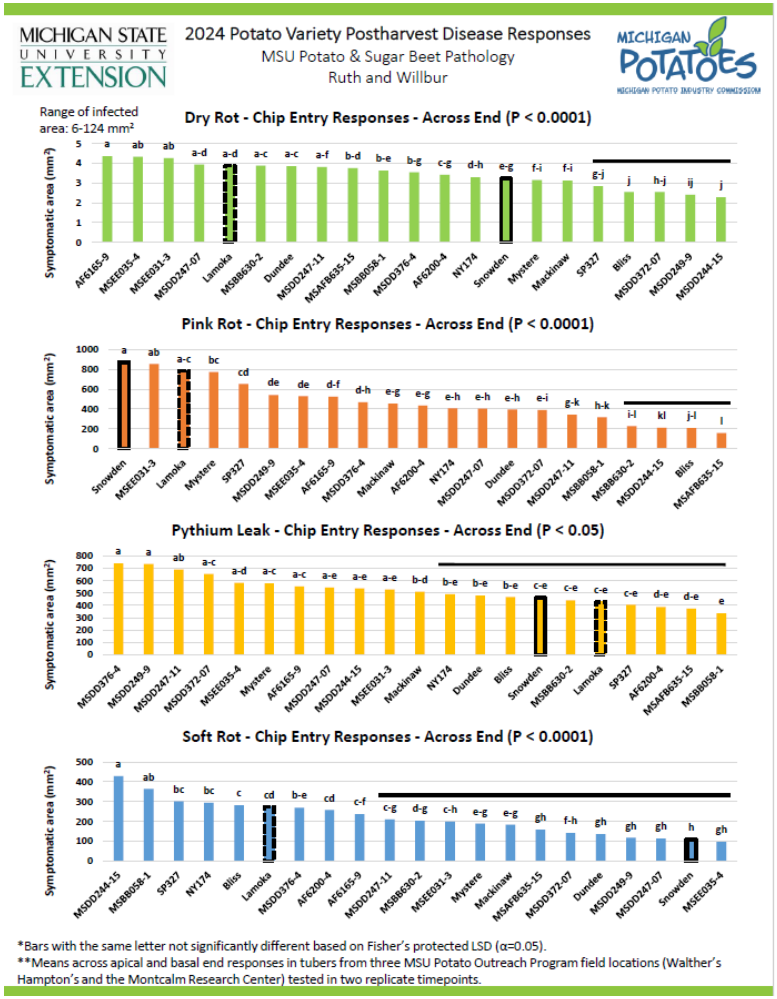
- Major diseases: dry rot, soft rot, leak, pink rot
- Limited information on variety resistance, especially with local Michigan pathogens
- Collaborated with MSU POP and PBG programs for on-farm variety and germplasm materials

Snowden

Bliss

Postharvest Screening

- Optimized methods for testing chip, red, yellow, and russet varieties for storage disease responses
- Significant differences in variety observed across all four diseases
- Resistance to multiple diseases was identified but rarely observed for all four



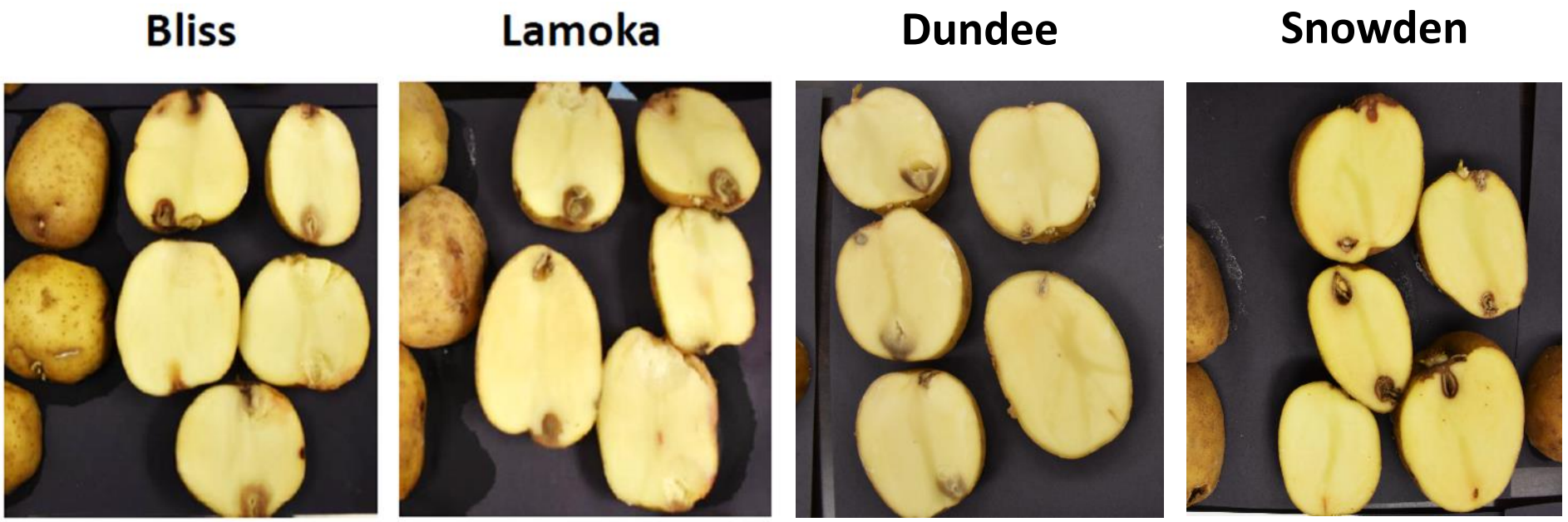
Ruth et al. 2023 and 2024.

Dry rot responses

Lamoka = Dundee (susceptible) > Snowden = Mackinaw > Bliss (resistant)

Soft rot responses

Bliss = Lamoka (moderate) > Mackinaw ≥ Dundee = Snowden (resistant)



Pink rot responses

Snowden = Lamoka (susceptible) > Mackinaw = Dundee > Bliss (resistant)

Snowden

Lamoka

Dundee

Bliss

Pythium leak responses

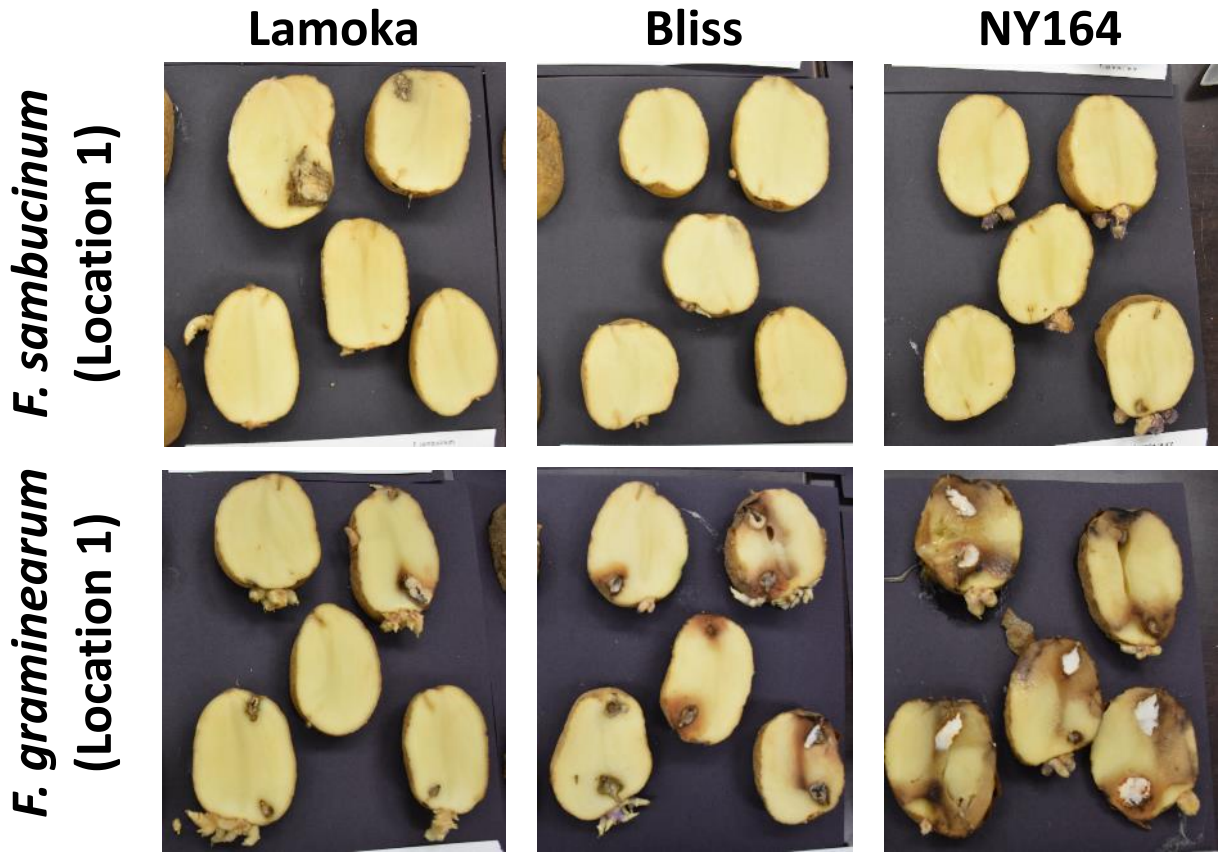
Mackinaw = **Dundee = Bliss = Snowden = Lamoka (moderate)**

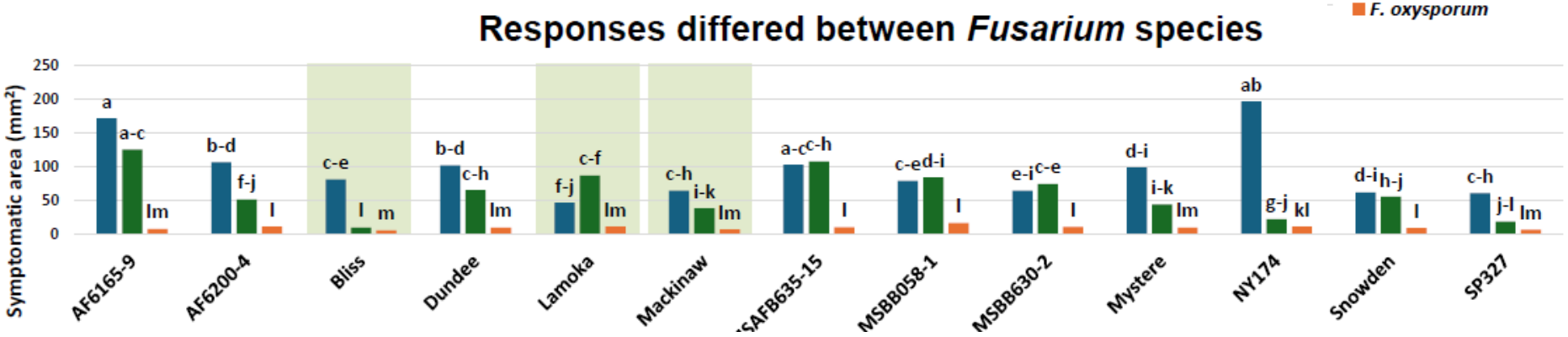
Dundee

Bliss

Snowden

Lamoka


Lamoka
Bliss
NY164
F. sambucinum (Location 1)
F. graminearum (Location 1)


Responses differed between Fusarium species
F. graminearum
F. sambucinum
F. oxysporum
Symptomatic area (mm²)
250
200
150
100
50
0
a
a-c
lm
b-d
f-j
l
c-e
l
m
b-d
c-h
lm
f-j
c-f
lm
c-h
i-k
lm
a-c
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d-i
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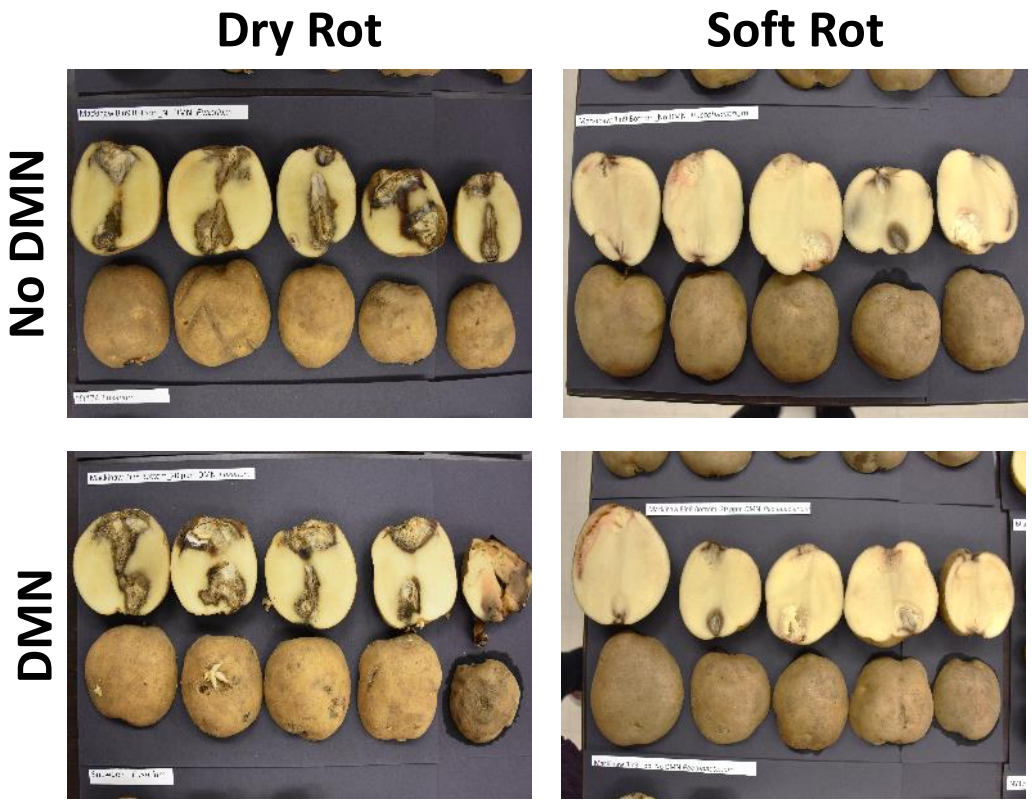
ab
g-j
kl
d-i
h-j
l
c-h
j-l
lm
AF6165-9
AF6200-4
Bliss
Dundee
Lamoka
Mackinaw
MSBB058-1
MSBB630-2
Mystere
NY174
Snowden
SP327

MPIC Demo Bins: Mackinaw

- 1,4-dimethylnaphthalene (DMN) sprout suppressor
- Exhibits fungistatic activity and reduces dry rot (Campbell et al. 2019; Santos et al. 2023)
- Monitor natural infections and artificial inoculation



Postharvest Summary

- Multiple diseases contribute to breakdown in potato storages
- Inherent varietal resistance or susceptibility may vary considerably by disease
- Postharvest management relies heavily on proper storage and handling but varietal options show promise
- Additional isolates may improve screening for robust responses

MSU Potato & Sugar Beet Pathology

- Characterize potato viruses and strain prevalence
- Conduct annual field testing of products for control of early blight and brown spot, late blight, early die, Rhizoctonia stem canker, white mold, Fusarium and Pythium seed piece rots
- Monitor fungicide resistance in Cercospora and Alternaria populations impacting beets
- Integrated management approaches of foliar and postharvest diseases, predictive modeling and alternative approaches

Acknowledgements

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Internal - Plant, Soil and Microbial Sciences
- Dr. Linda Hanson and Tom Goodwill, USDA-ARS Sugarbeet
- Dr. David Douches, Potato Breeding
- Dr. Ray Hammerschmidt
- Chris Long, Potato Outreach
- Dr. Martin Chilvers

Internal - Other Departments
- Dr. Younsuk Dong, Biosystems & Agricultural Engineering

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- Elizabeth Dorman
- Stefanie Rhodes

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- Mathew Klein

<u>Michigan Potato Industry & Grower Cooperators</u>

Project GREEEN

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Questions?

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