

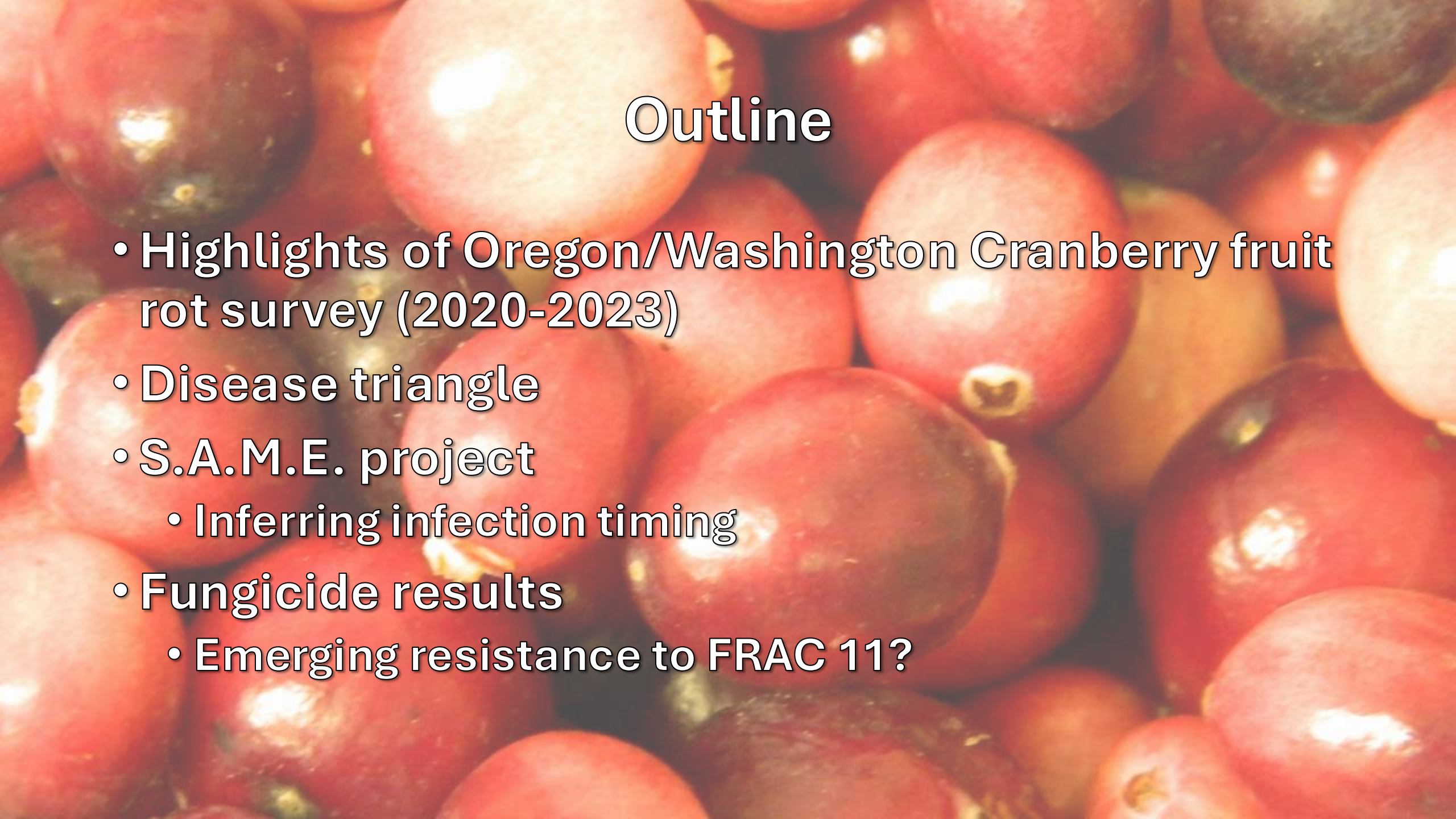
Cranberry Fruit Rot Infection Timing and Fungicide Efficacy

Don Valentine- OSU/USDA Corvallis, OR



Oregon State
University



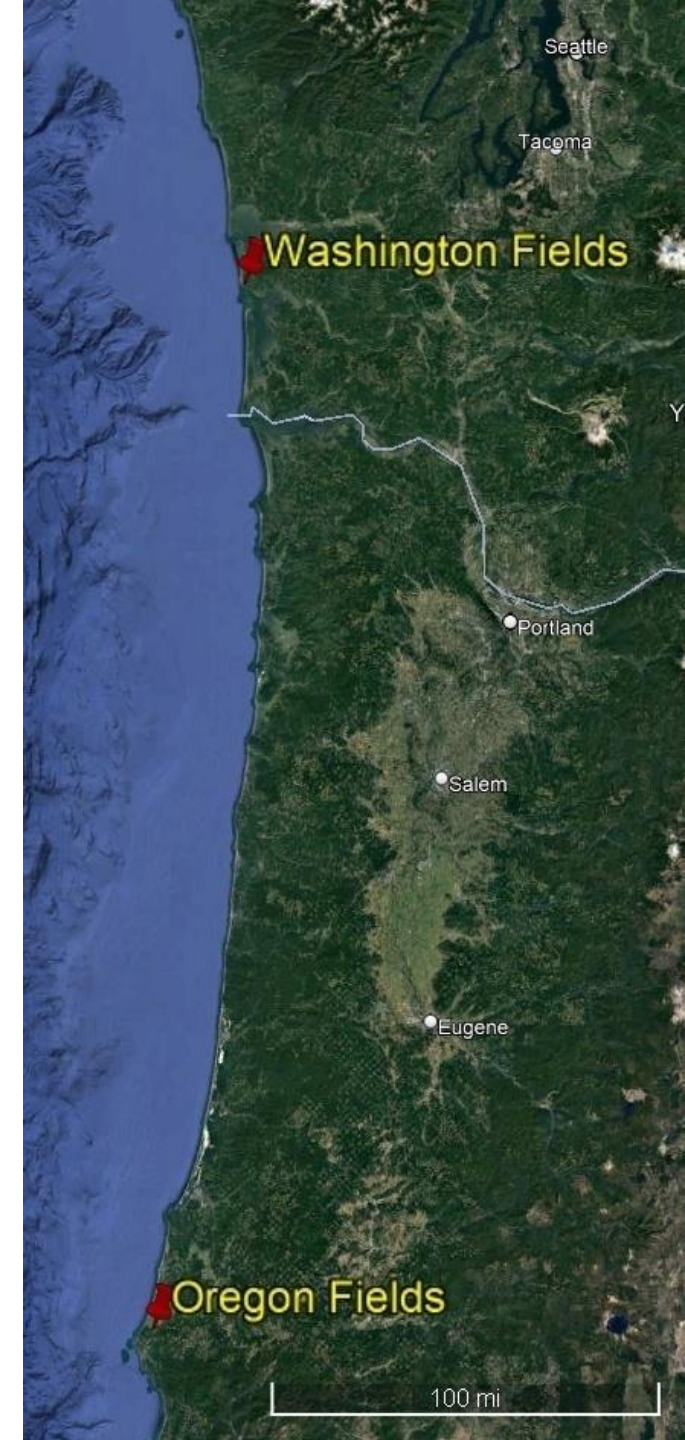
The background of the slide is a close-up photograph of numerous red cranberries. The berries are vibrant red with some natural white variegation and are covered in a fine layer of white wax. They are clustered together, filling the entire frame.

Outline

- Highlights of Oregon/Washington Cranberry fruit rot survey (2020-2023)
- Disease triangle
- S.A.M.E. project
 - Inferring infection timing
- Fungicide results
 - Emerging resistance to FRAC 11?

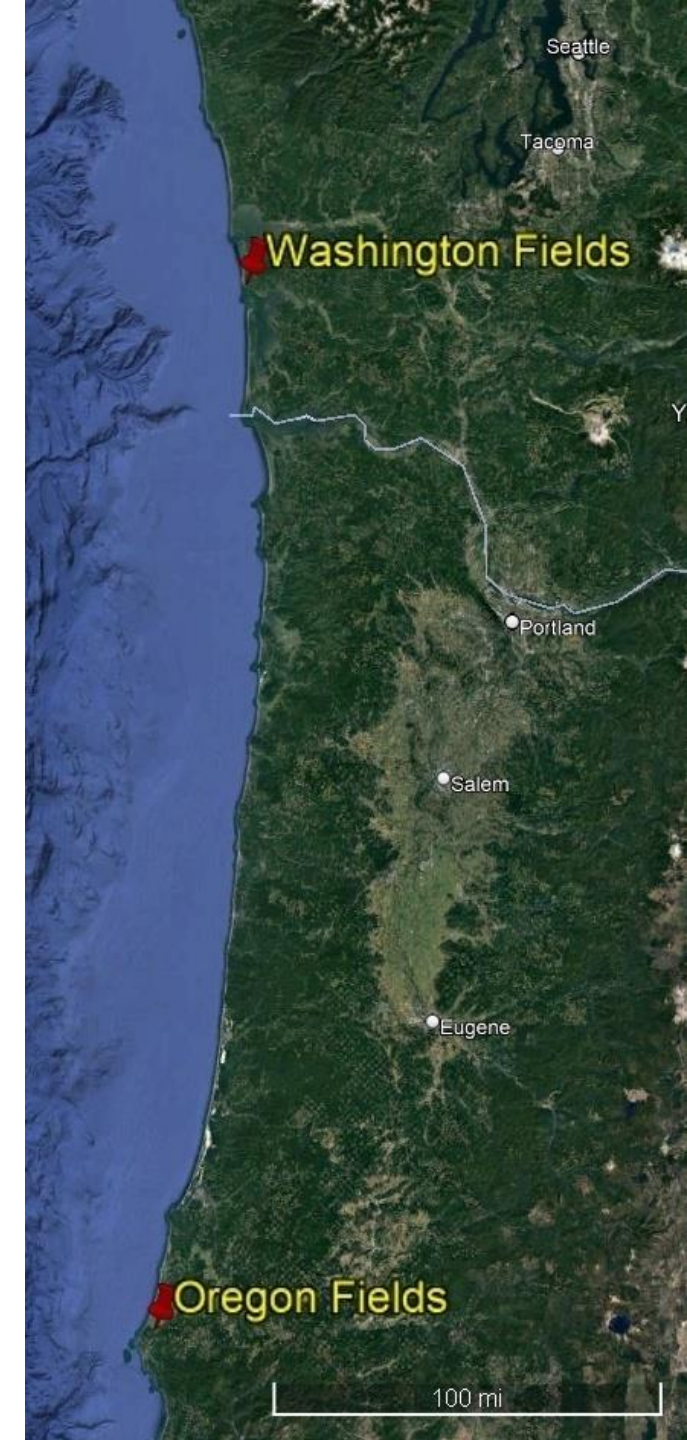
Cranberry fruit rot (**CFR**) survey 2020-2023

- Sampling edges of 7 cranberry farms around Bandon, OR & Grayland, WA from 2020-2023
- Estimated fruit rot incidence
- Pathogen Identification
- Fungicide resistance testing
- 3-year grant funded by Northwest Center for Small Fruit Research and base funds from USDA Project 2072-22000-045-00D



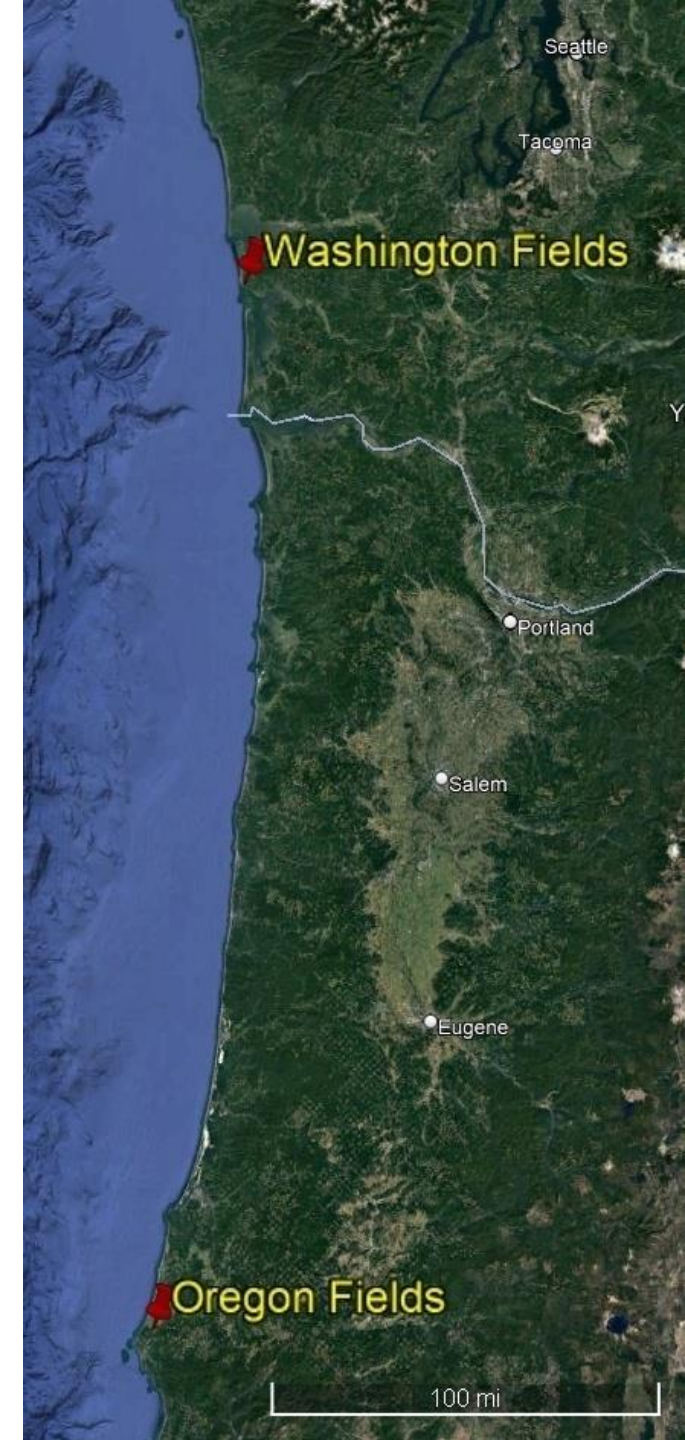
Cranberry fruit rot (**CFR**) survey 2020-2023 findings

Common Name	Latin Name
Bitter rot	<i>Colletotrichum acutatum</i> complex
	<i>Colletotrichum gloeosporioides</i> complex
Black rot	<i>Allantophomopsis cytispora</i>
	<i>Allantophomopsis lycopodina</i>
	<i>Strasseria geniculata</i>
Blotch rot	<i>Physalospora vaccinii</i>
Cottonball	<i>Monilinia oxycocci</i>
Early rot	<i>Phyllosticta vaccinii</i>
End rot	<i>Godronia cassandrae</i>
Ripe rot	<i>Coleophoma cylindrospora</i>
Speckle berry	<i>Phyllosticta elongata</i>
Viscid rot/Upright dieback	<i>Diaporthe vaccinii</i>
Yellow rot	<i>Botrytis</i> spp.



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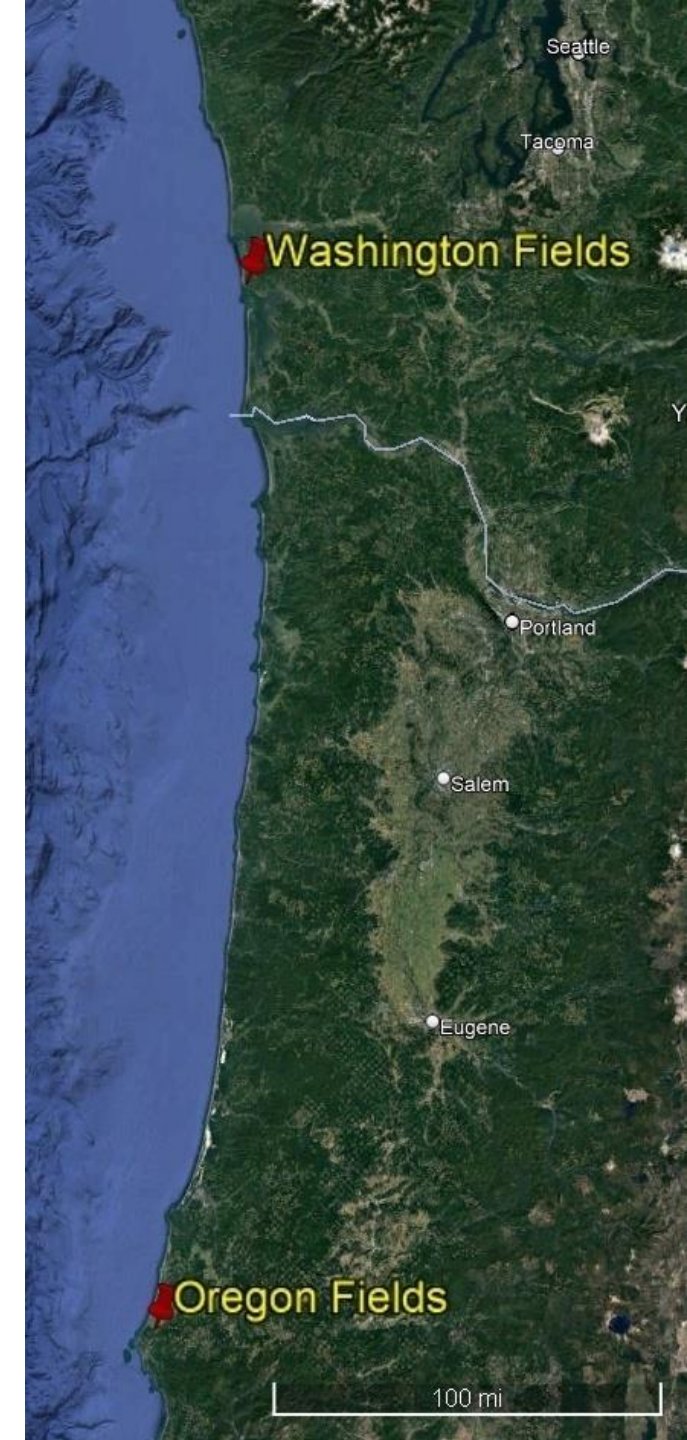
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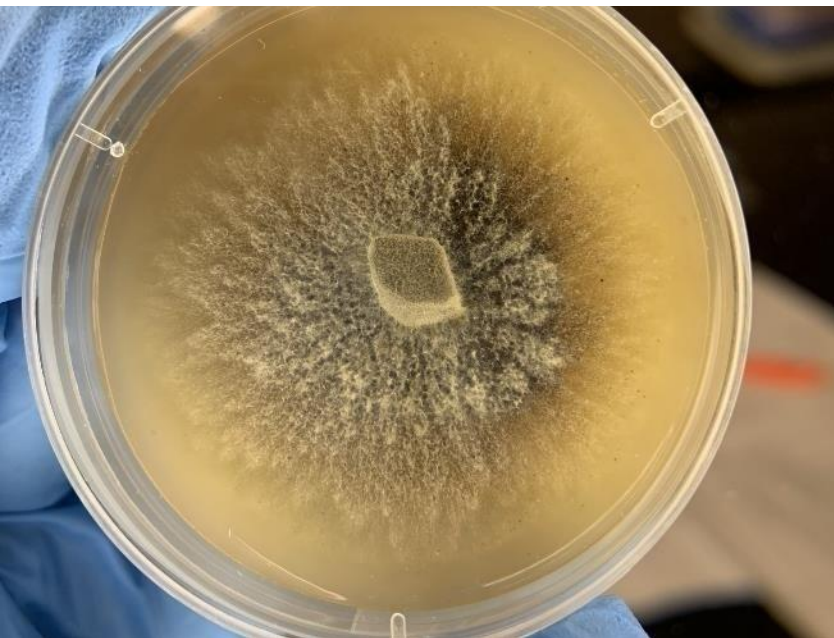


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Physalospora (Blotch rot)



Coleophoma (Ripe rot)



Diaporthe (Viscid rot)

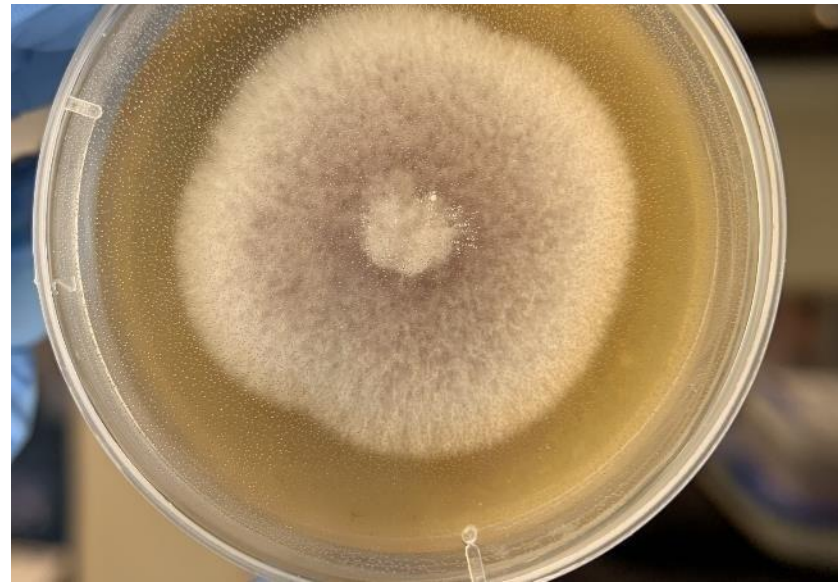


Phyllosticta (Berry speckle)



Colletotrichum (Bitter rots)

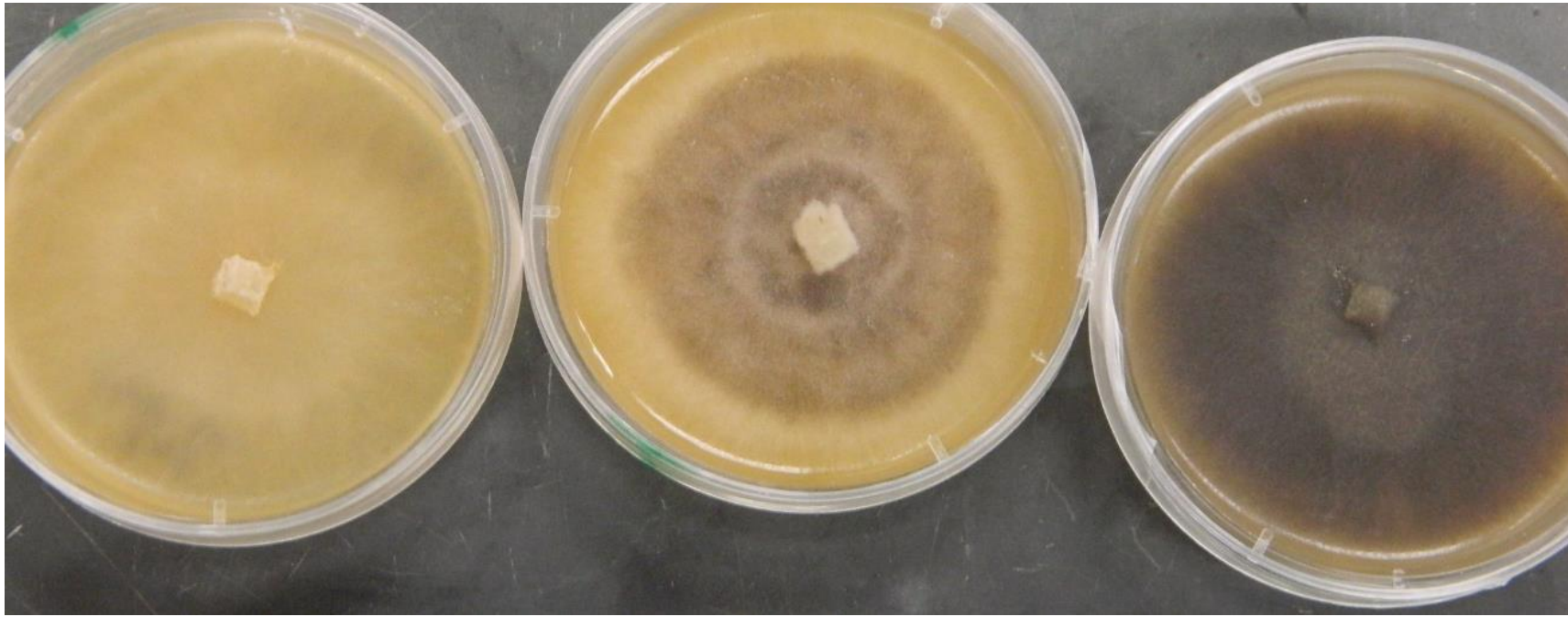
acutatum species



gloeosporioides species



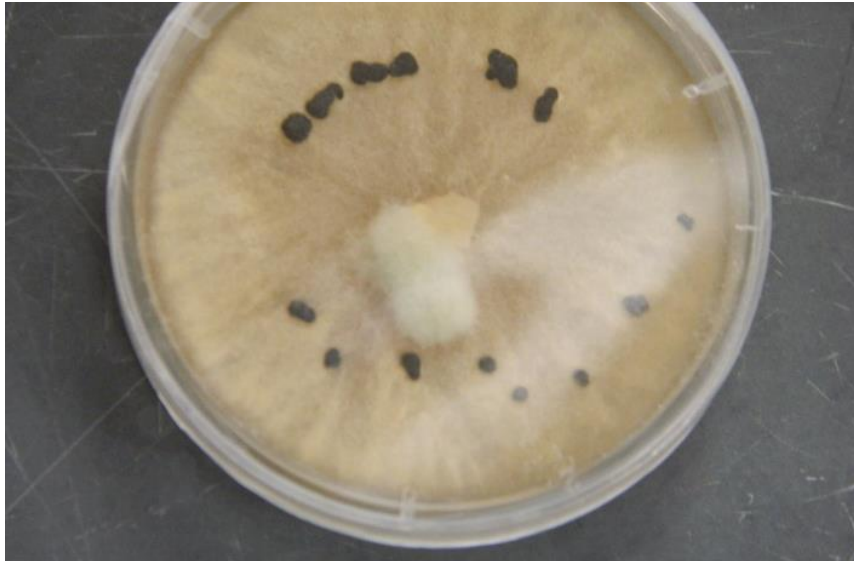
Black rots



Neofabraea actinidia



Botrytis (Yellow rot)

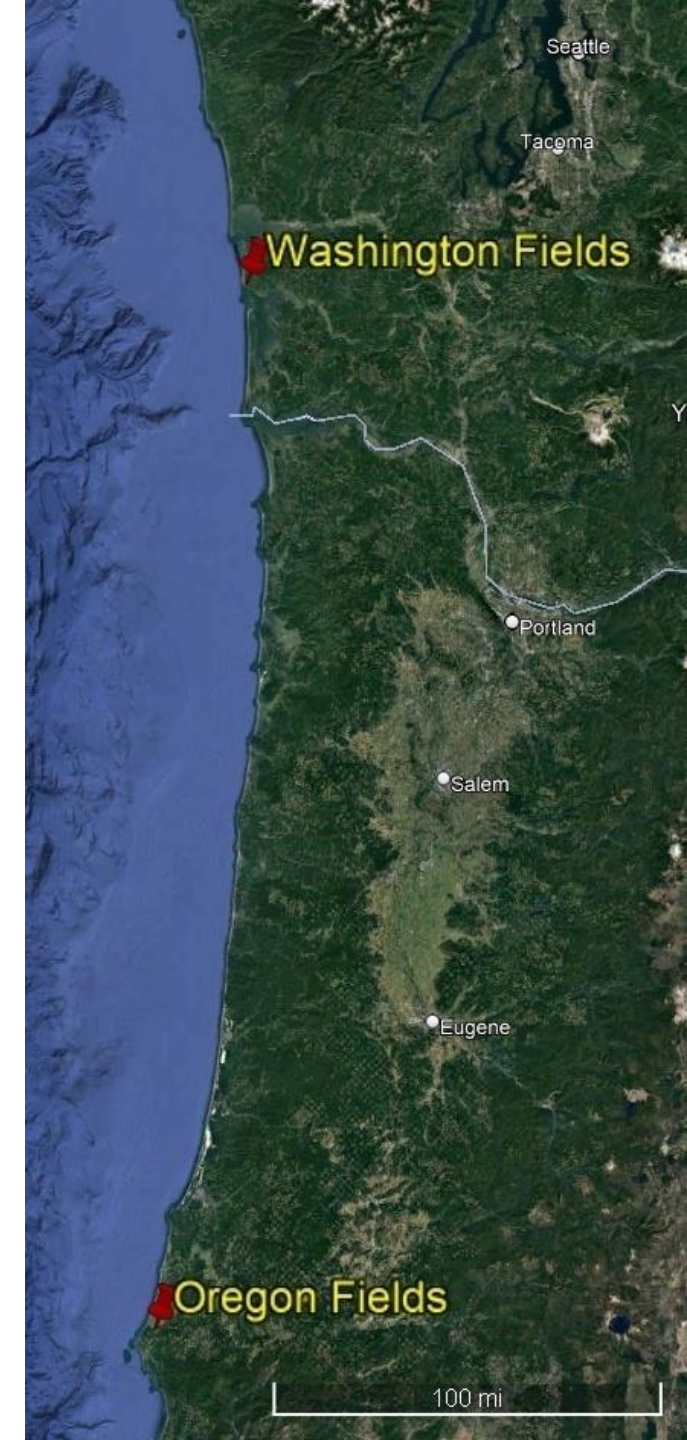


Godronia (End rot)



Cranberry fruit rot (CFR) survey 2020-2023 findings

- Nearly every type of fruit rot found in each field
- Generally low rot (~5-10%).
 - Higher incidences b/c weather and spray programs?
- Newly identified CFR-
Neofabraea actinidiae.
- Pathogen sensitivities to available single-site fungicides varied between CFR groups



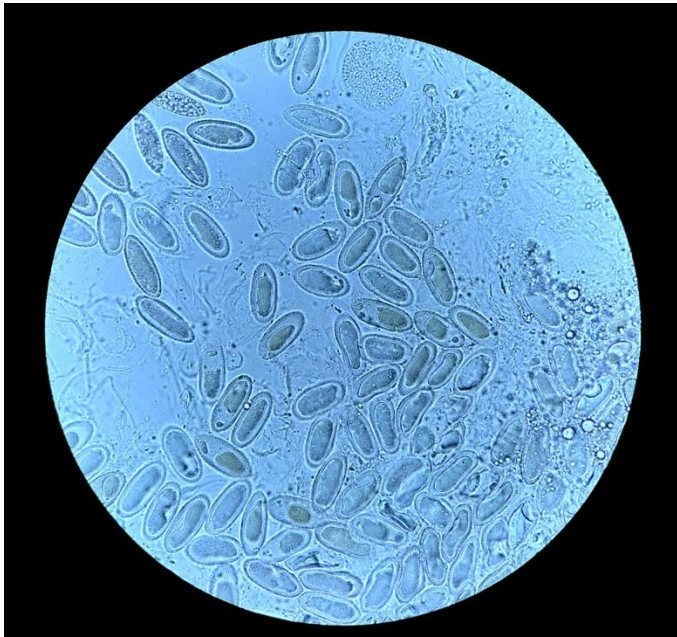
Cranberry Fruit Rot Management- The Disease Triangle

Host



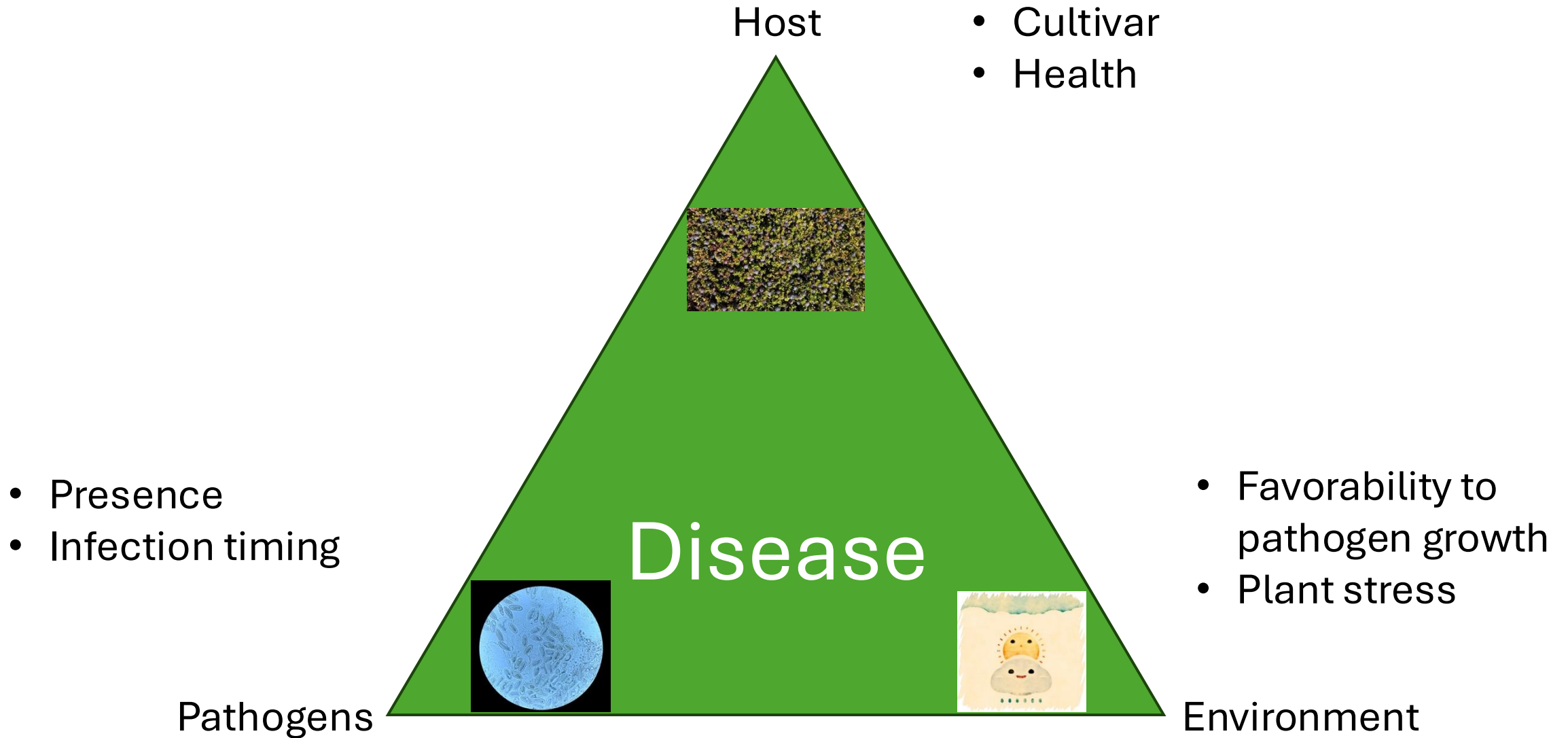
Disease

Pathogens



Environment

Cranberry Fruit Rot Management- The Disease Triangle



Things we can manage

Host

- Choosing rot-resistant cultivars
- Maintaining plant health (not over-fertilizing)

Environment

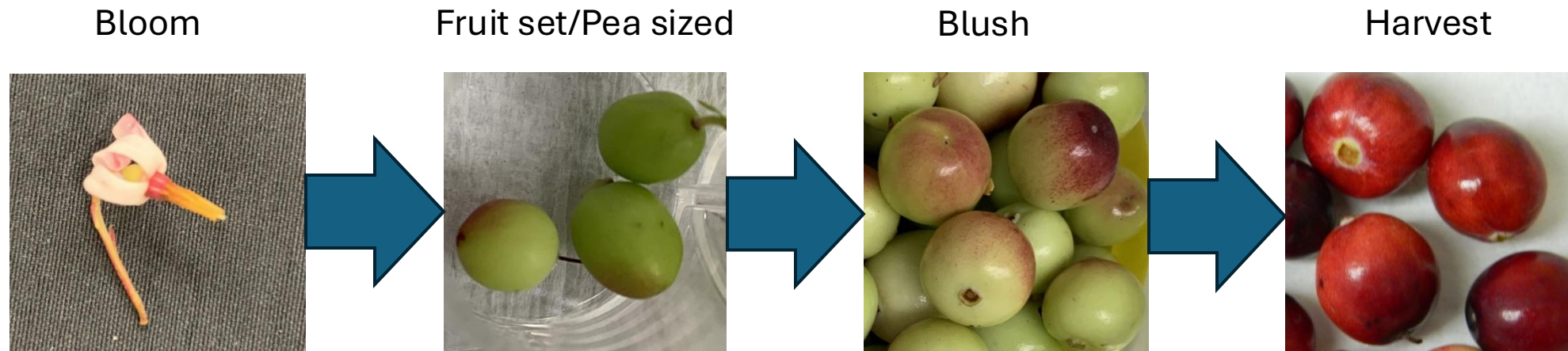
- Keeping vines cool on hot days
- Not overwater (fungi generally grow best in wet, warmer conditions).

Pathogen

- Reducing sources of inoculum (bed upkeep, removal of detritus, outside sources?)
- Fungicide application

Systems Approach to Manage the Expression of cranberry fruit rot (S.A.M.E.) 2023-present

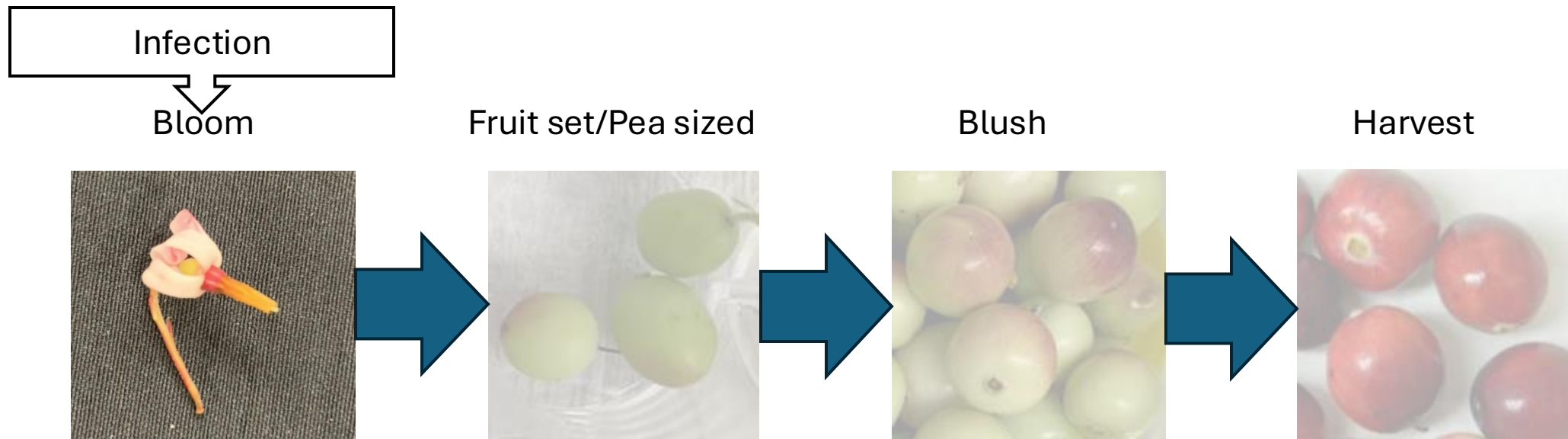
- Multi-State, multi-year research project (Wisconsin, Massachusetts, New Jersey, **Oregon** and Washington)
- Aspects of the disease triangle:
 - Presence of pathogens at different points in the season: timing of infection
 - Stevens and Mullica Queen varieties
 - Environmental variables
 - Fungicide sensitivity



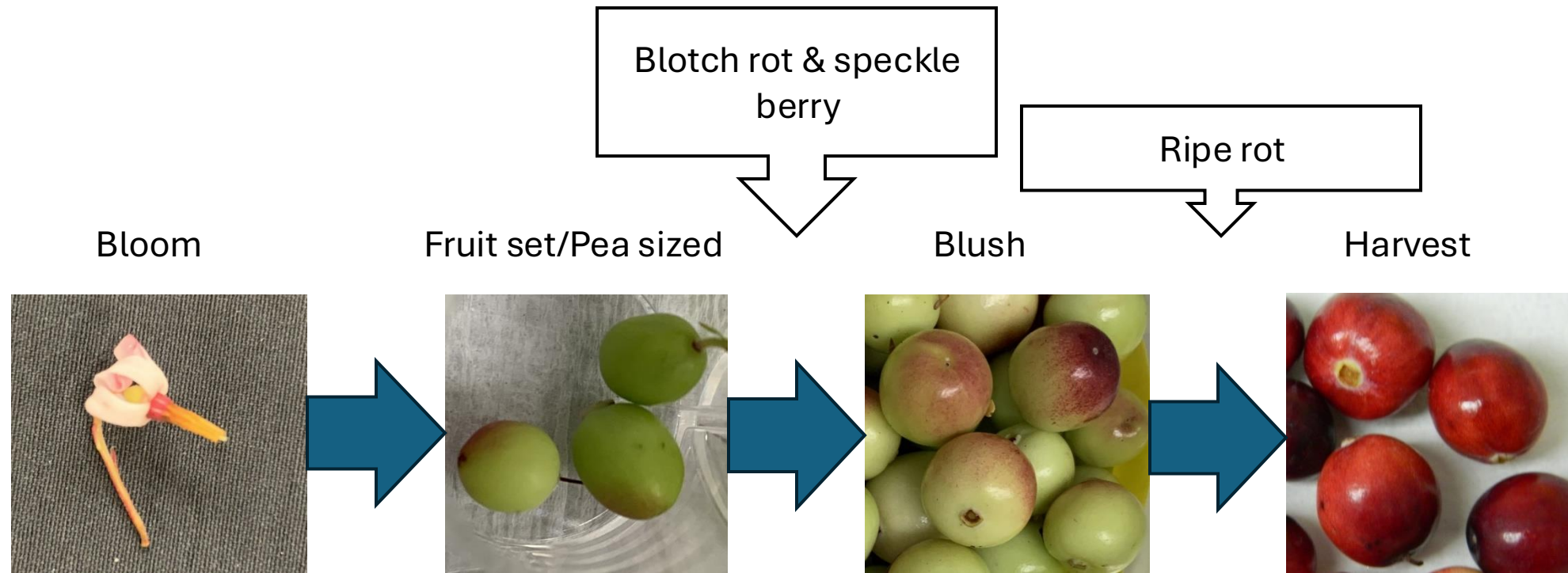
- Signup for the Newsletter! <https://sameproject.wisc.edu/>

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Yellow rot	<i>Botrytis</i> sp.

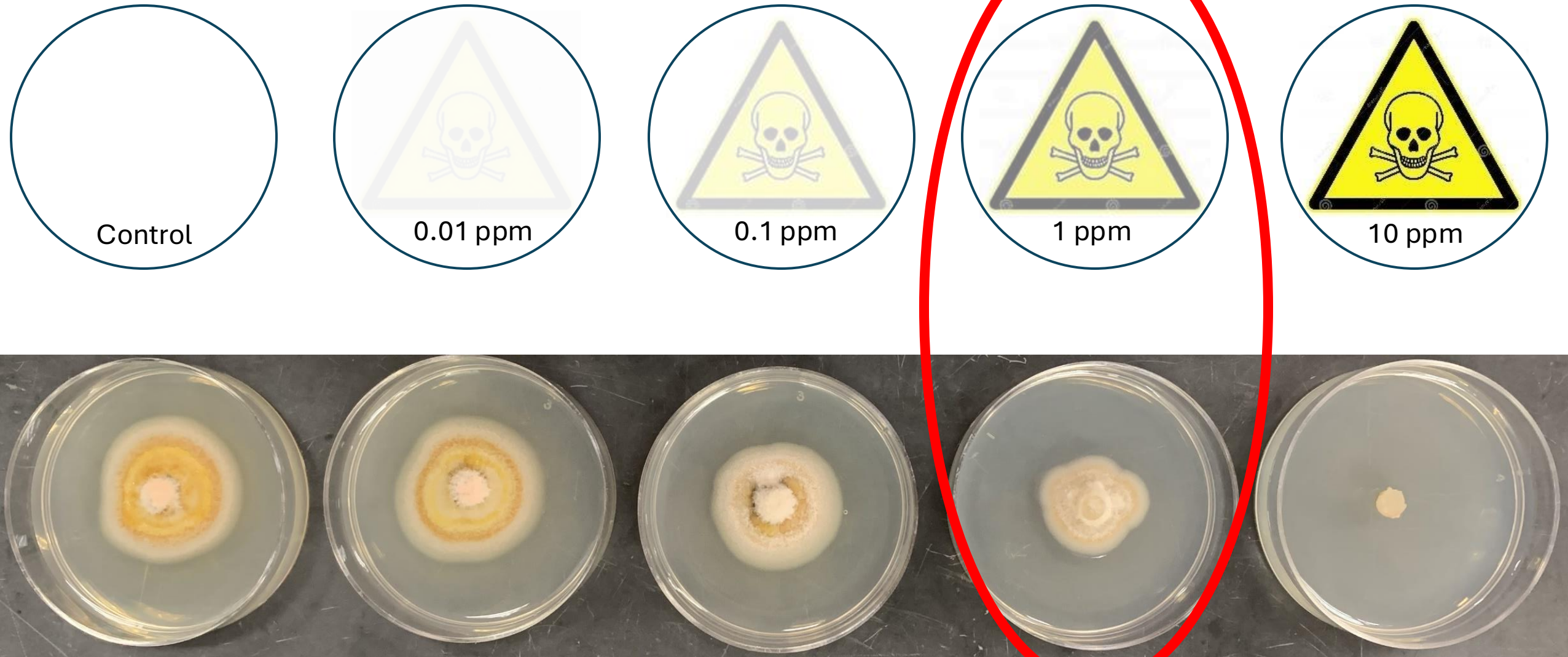
1 st Stage Present	Common Name	Latin Name
Bloom	Bitter rot	<i>Colletotrichum acutatum</i> complex
Bloom	Black rot	<i>Allantophomopsis cytispora</i>
		<i>Allantophomopsis lycopodina</i>
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Bloom	Viscid rot/Upright dieback	<i>Diaporthe vaccinii</i>
Bloom	Yellow rot	<i>Botrytis</i> spp.



1 st Stage Present	Common Name	Latin Name
Blush	Blotch rot	<i>Physalospora vaccinii</i>
Blush	Speckle berry	<i>Phyllosticta elongata</i>
Harvest	Ripe rot	<i>Coleophoma cylindrospora</i>



Fungicide Assays



		FRAC 3		FRAC 11
Pathogen Common Name	Scientific name	Fenbuconazole (eg Indar)	Prothioconazole (eg Proline)	Azoxystrobin (eg Abound)
Black rot	Black Rots	Sensitive	Sensitive	Mixed
Ripe rot	<i>Coleophoma</i> sp.	Sensitive	Sensitive	Tolerant
Bitter rot	<i>Colletotrichum</i> sp.	Mixed	Mixed	Mixed
Viscid rot/Upright dieback	<i>Diaporthe</i> sp.	Sensitive	Sensitive	Mixed
End rot	<i>Godronia cassandrae</i>	Mixed	Mixed	Sensitive
Bulls-eye rot?	<i>Neofabraea actinidiae</i>	Sensitive	Mixed	Tolerant
Berry speckle	<i>Phyllosticta elongata</i>	Sensitive	Sensitive	Sensitive
Blotch rot	<i>Physalospora vaccinii</i>	Mixed	Sensitive	Sensitive

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Blotch rot	<i>Physalospora vaccinii</i> (dark strain)	Sensitive	Sensitive	Sensitive
	<i>Physalospora vaccinii</i> (light strain)	Tolerant	Sensitive	Sensitive

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Emerging Resistance to Azoxystrobin (FRAC11)

- Annual screening of CFRs for sensitivity to fungicides
- 22% of *Colletotrichum rhombiforme* from a Washington field showed very high resistance to Azoxystrobin.
- Azoxystrobin, a single-site fungicide, targets a single gene in fungi
 - Sequenced gene to look for mutations



Cytochrome b gene

F129L mutation

Segment of gene

Colletotrichum fioriniae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTGGGGTT
Colletotrichum fioriniae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTGGGGTT
Colletotrichum fioriniae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTGGGGTT
Colletotrichum fioriniae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTGGGGTT
Colletotrichum schimae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCCCTGGGGTT
Colletotrichum schimae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCCCTGGGGTT
Colletotrichum schimae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCCCTGGGGTT
Colletotrichum schimae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCCCTGGGGTT
Colletotrichum schimae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCCCTGGGGTT
Colletotrichum godetiae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Colletotrichum godetiae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Colletotrichum godetiae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Colletotrichum godetiae isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Colletotrichum rhombiforme isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Colletotrichum rhombiforme isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Resistant Colletotrichum rhombiforme isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Resistant Colletotrichum rhombiforme isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
Colletotrichum rhombiforme isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT
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Colletotrichum rhombiforme isolate	TGCTATAAATACCTTG TAGCTATGATGGGTATAGGTTTCTTAGGGTT

Resistant
mutants

“The label is the law”

Crop	Target Diseases	Use Rate (Fl. Oz.) Product/Ac. (Lb. a.i./Ac.)	Application Instructions
Berries, Low Growing Subgroup 13-07H (except Strawberry) Cranberry Additional Low Growing Berries: Bearberry; Bilberry; Blueberry, lowbush; Cloudberry; Lingonberry; Muntries; and Partridgeberry including all cultivars and/or hybrids of these	Cottonball <i>(Monilinia oxycocci)</i> Fruit Rots <i>(Physalospora vaccinii)</i> <i>(Glomerella cingulata)</i> <i>(Coleophoma empetri)</i> Lophodermium Twig Blight <i>(Lophodermium spp.)</i>	6.0 to 15.3 (0.10 to 0.25)	Begin applications at 5 to 10% bloom for fruit rot, cottonball, and twig blight. Continue applications on a 7- to 14-day schedule if conditions are favorable for disease development. Applications may be made by ground, chemigation or air. DO NOT apply more than two sequential applications of this product or other Group 11 fungicides before alternation with a fungicide that is not in Group 11.
	Fairy Ring (suppression) <i>(Psilocybe spp.)</i>	15.3 (0.25)	Make the first application at bud break. Measure the ring diameter and add 10 feet to that diameter. Apply This product at a rate equivalent to 15.5 fl. ozs./Ac. in 30 to 100 gallons of water to the affected area. Irrigation (1 to 2 hrs.) following application is advisable to ensure penetration to the base of the plant. If necessary make another application 2 to 4 weeks later. For ground application ensure adequate water volume for thorough canopy penetration.
Specific Use Restrictions: - Maximum Single Application Rate: DO NOT exceed the maximum rate listed in the table. - Minimum Application Interval: 7 days - Maximum Annual Rate: DO NOT apply more than 92.3 fl. ozs. (1.5 lbs. a.i.) of this product per acre per year. DO NOT make more than 6 applications of this product per acre per year at the high rate of 15.3 fl. ozs./Ac. (0.25 lb. a.i./Ac.) or 15 applications per year at the low rate of 6.0 fl. ozs./Ac. (0.10 lb. a.i./Ac.). DO NOT treat Cranberry fields used for aquaculture of fish and crustacea. DO NOT apply when weather conditions favor drift from treated areas to non-target aquatic habitat. Use care in making applications near non-target aquatic habitats. DO NOT apply to flooded crop. DO NOT allow release of irrigation or flood water to non-target aquatic habitat for at least 14 days after the last application. - Pre-Harvest Interval (PHI): 3 days			

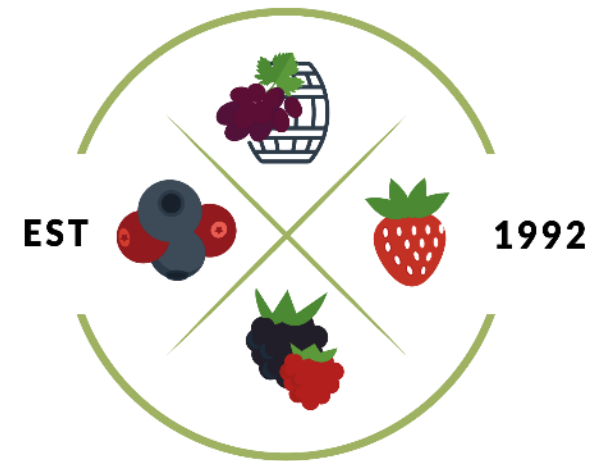
Recap

- Most CFRs seen in all 7 fields over the study
 - Managing a fruit rot “complex” not just a couple pathogens
- No magic bullet to fruit rot management
 - Variety of CFRs, variety of sensitivities
 - Baseline sensitivity or resistance to some fungicide classes
 - Rotation of single-site fungicides important to reducing resistance potential
- S.A.M.E. project leading to better management practices



Acknowledgements

- **S.A.M.E. project:** This work is supported by the USDA National Institute of Food and Agriculture Specialty Crop Research Initiative Award No. 2022-51181-38322
- **Oregon/Washington cranberry fruit rot survey:** Funding for the project was provided by a grant from the Northwest Center for Small Fruit Research and base funds from USDA Project 2072-22000-045-00D.
- Sincere thanks to the growers who allowed us to sample their cranberry beds and to Rod Keller, Gayle McGhee and Brenda Shaffer for excellent technical assistance!



Northwest Center
FOR SMALL FRUITS RESEARCH

Questions?

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