Prevalence of cranberry fruit rots in commercial production beds in Oregon and Washington

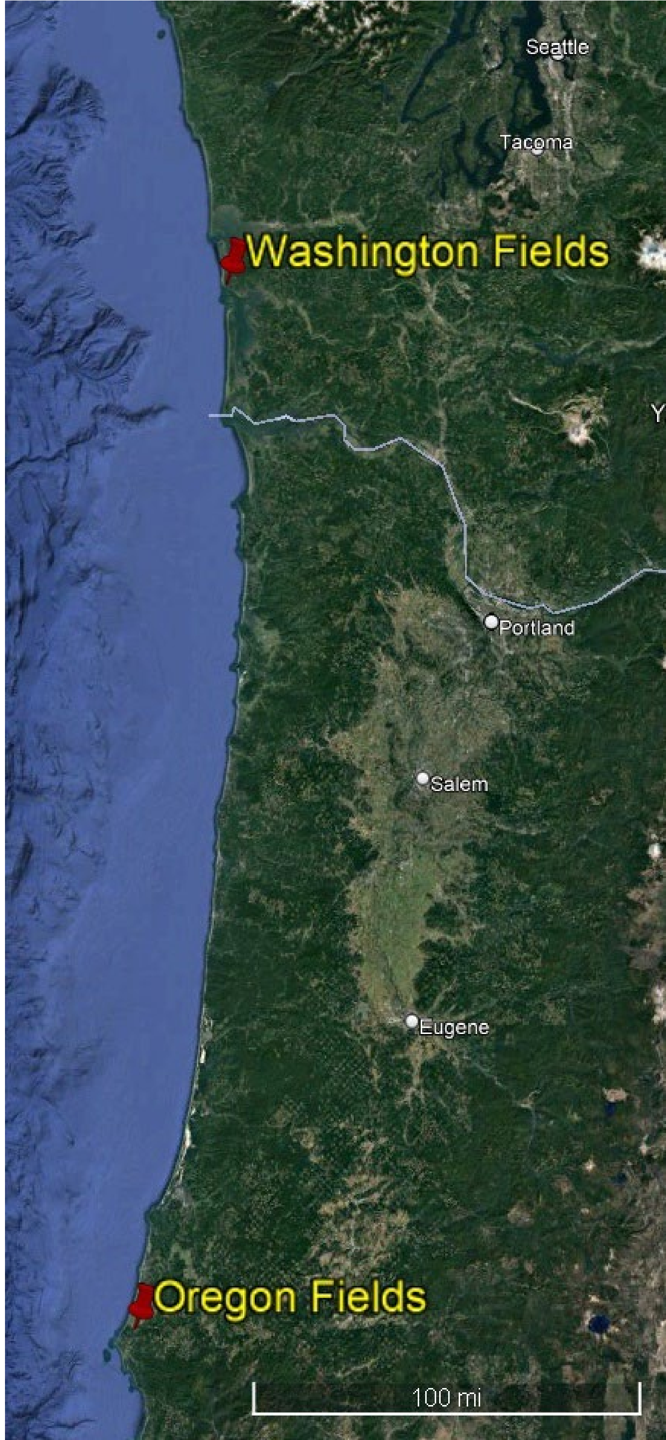
Virginia Stockwell[1], Cassie Bouska[2], Don Valentine[1]

[1]USDA Agricultural Research Service, Horticultural Crops Disease and Pest Management Research Unit, Corvallis, Oregon

[2]Oregon State University, Dept. of Horticulture and OSU Extension Service, Coos and Curry Counties, Myrtle Point, Oregon

Overview of Project

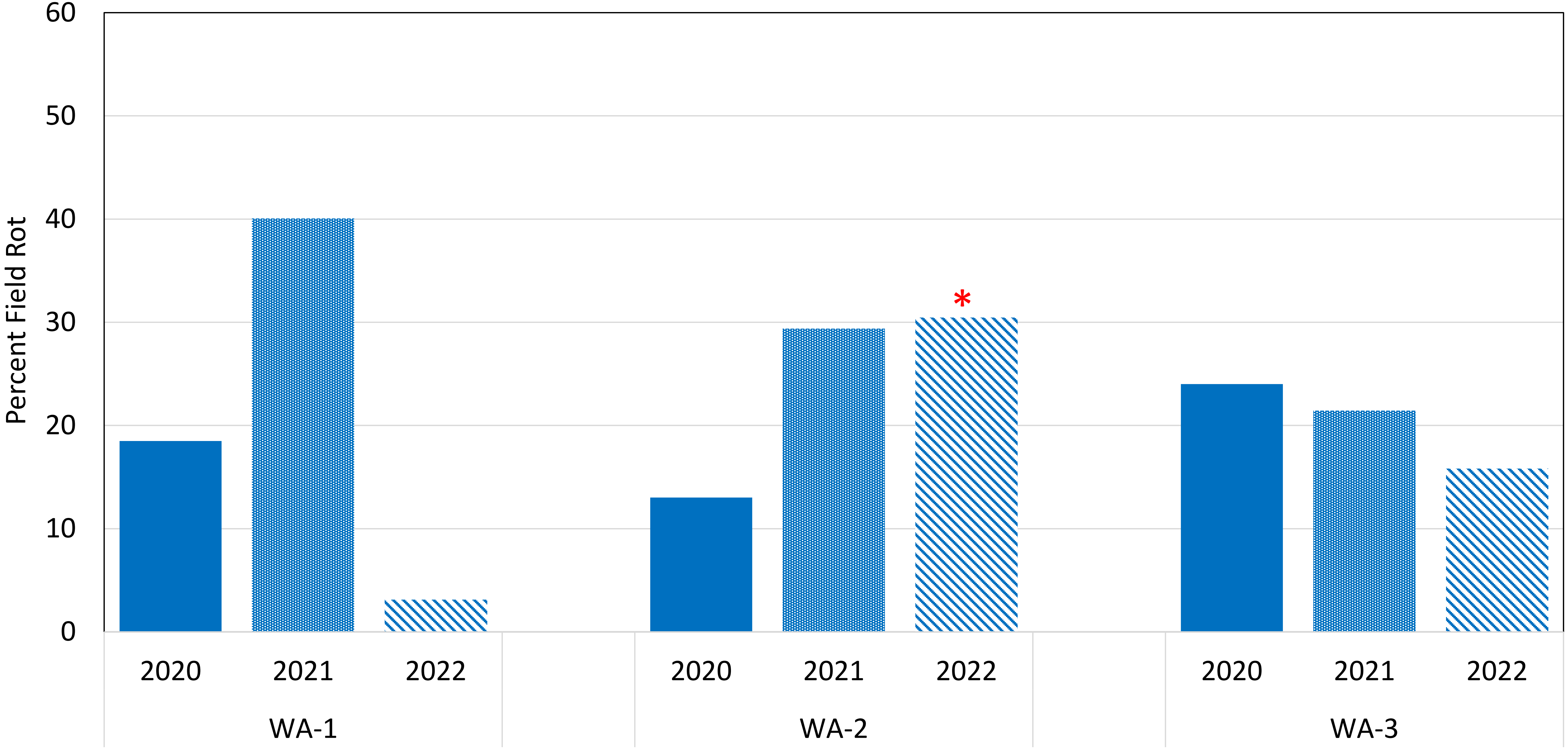
- Sampling of 7 Cranberry farms across Oregon & Washington from 2020-2022
- Estimated fruit rot incidence
- Pathogen Identification
- Fungicide resistance testing
- 3-year grant funded by Northwest Center for Small Fruit Research and base funds from USDA Project 2072-22000-045-00D



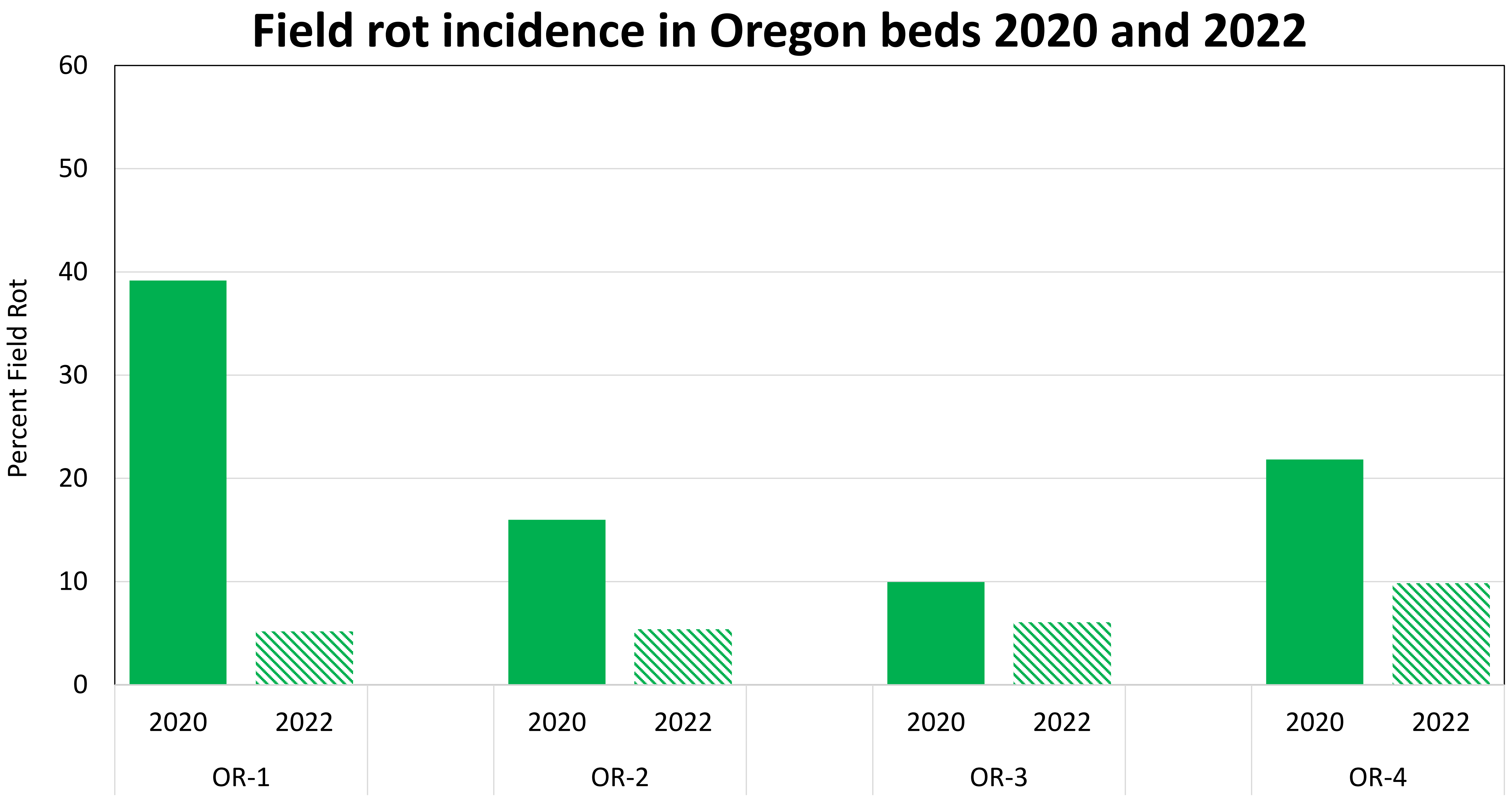
Field sampling

Berry Sorting

Field rot incidence in Washington beds 2020-2022



* Sampling occurred after dry-harvest, mainly around sprinkler heads


Field rot incidence in Oregon beds 2020 and 2022
Percent Field Rot
60
50
40
30
20
10
0
2020
2022
OR-1
2020
2022
OR-2
2020
2022
OR-3
2020
2022
OR-4

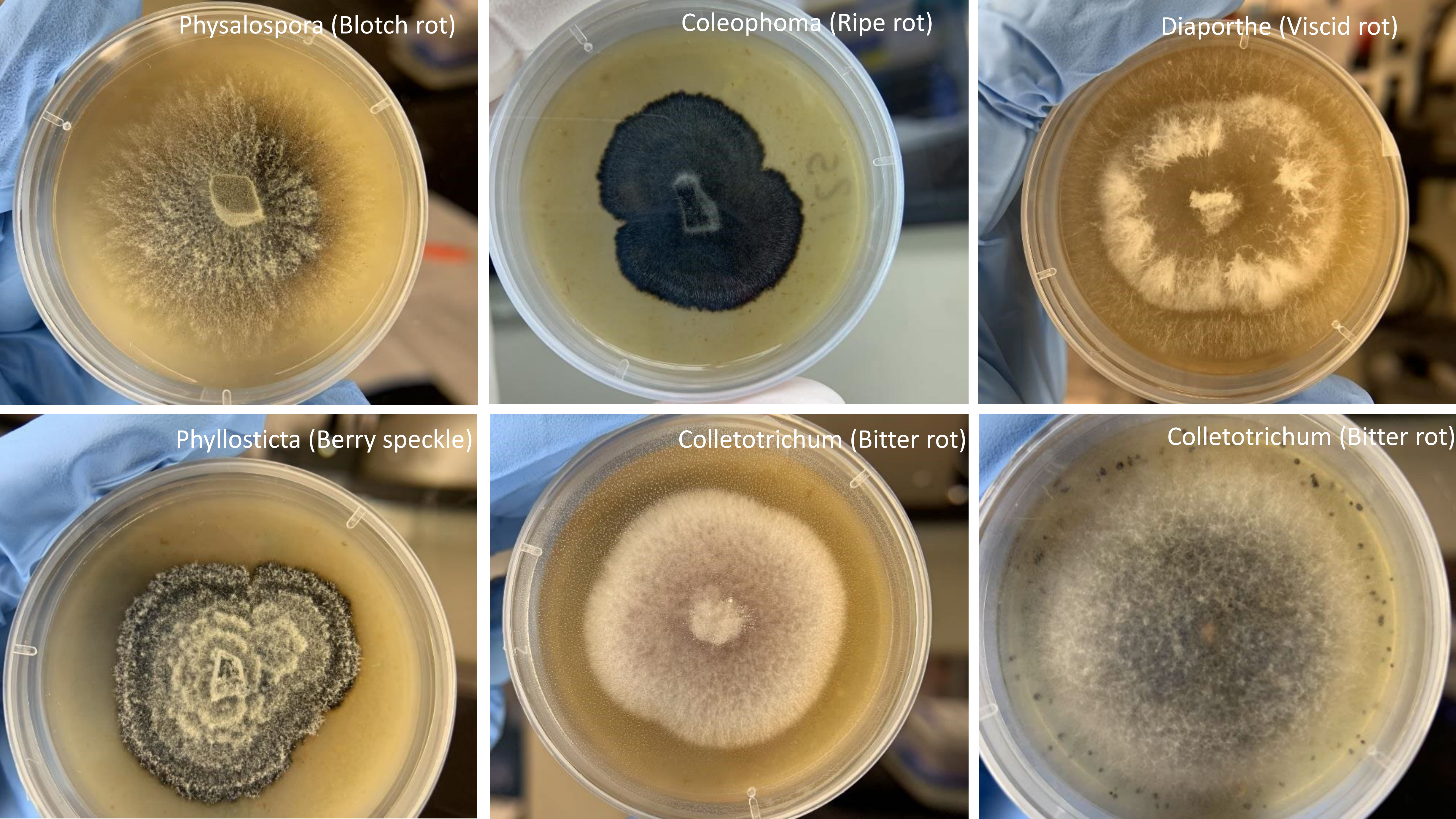
Culturing and Identifying Fungal Rots

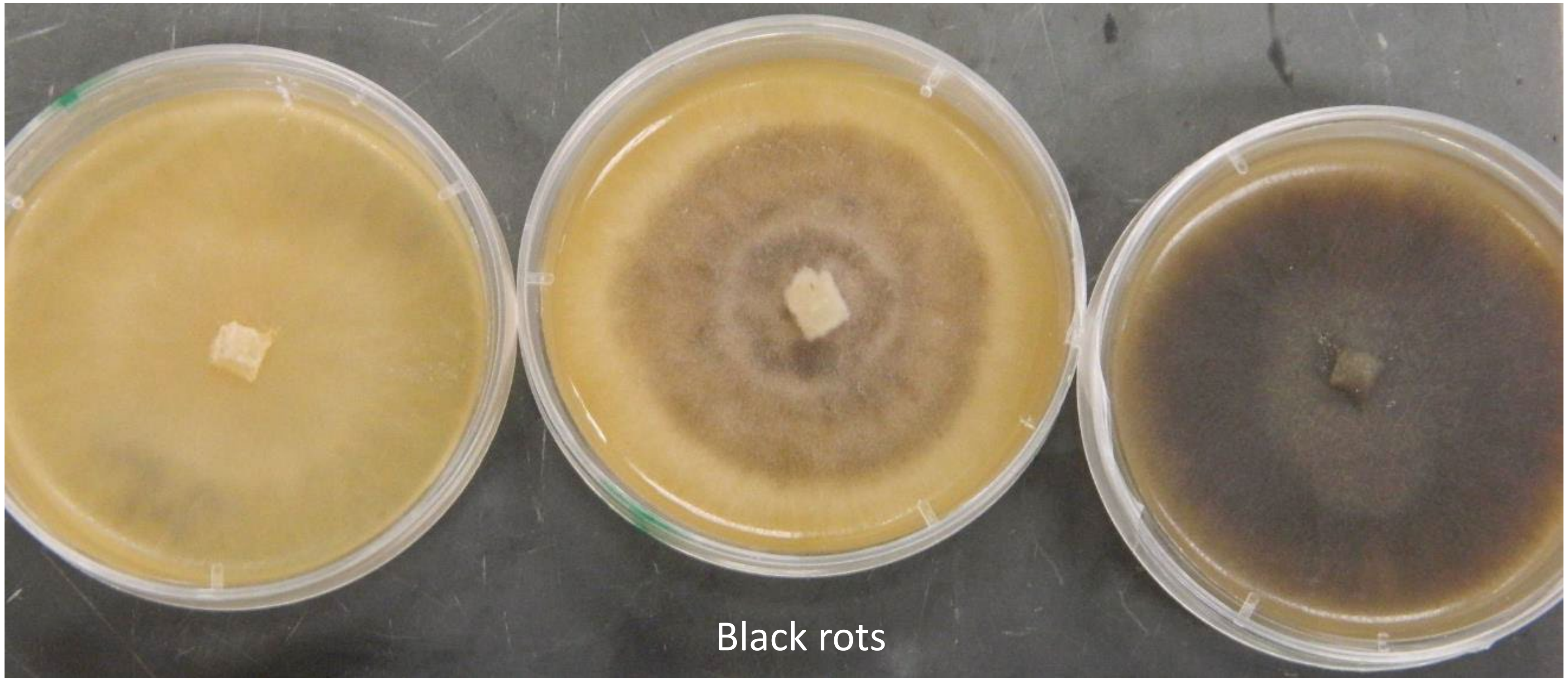
- Why plate rots?
  - Accurate ID
  - Fungicide tests

- Surface disinfest
  - 10 min 10% bleach
  - 1 min 70% Ethanol
  - 1 min DI Water
- Pinch of rot onto V8 plate
  - Multiple rounds of isolation
  - Some berries have more than one pathogen

Fruits Rots and Associated Pathogens
from WA & OR cranberry beds 2020-2022

Cranberry fruit rot disease	Fungal Pathogen
Berry speckle	Phyllosticta elongata
Bitter rot	Colletotrichum fructivorum
	Colletotrichum fiorinae
Black rot	Allantophomopsis cytisporea
	Allantophomopsis lycopodina
	Strasseria geniculata
Blotch rot	Physalospora vaccinii
End rot	Godronia cassandrae
Ripe rot	Coleophoma empetri
Viscid rot	Phomopsis vaccinii
Yellow rot	Botrytis sp.


Physalospora (Blotch rot)
Coleophoma (Ripe rot)
Diaporthe (Viscid rot)
Phyllosticta (Berry speckle)
Colletotrichum (Bitter rot)
Colletotrichum (Bitter rot)

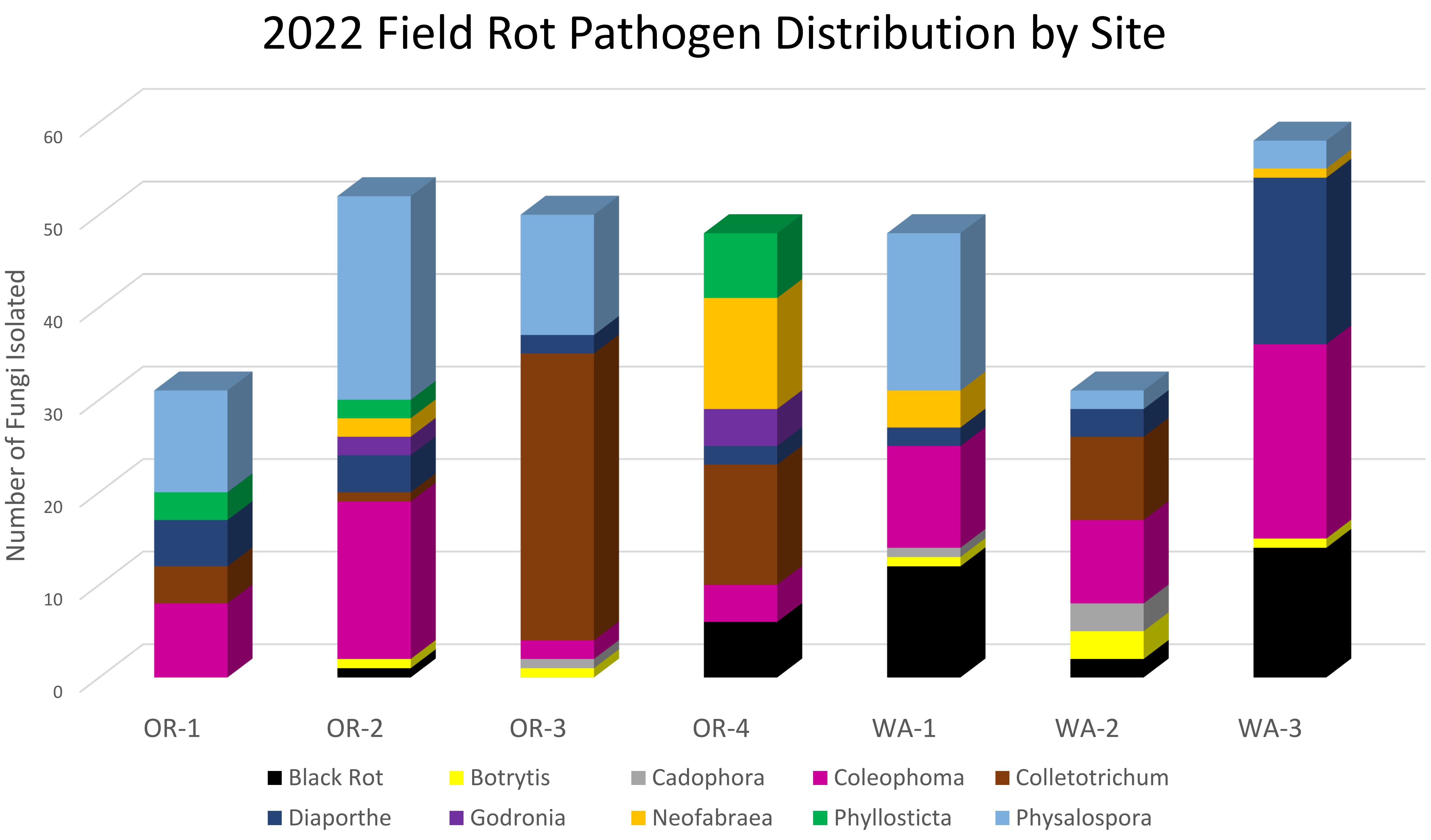


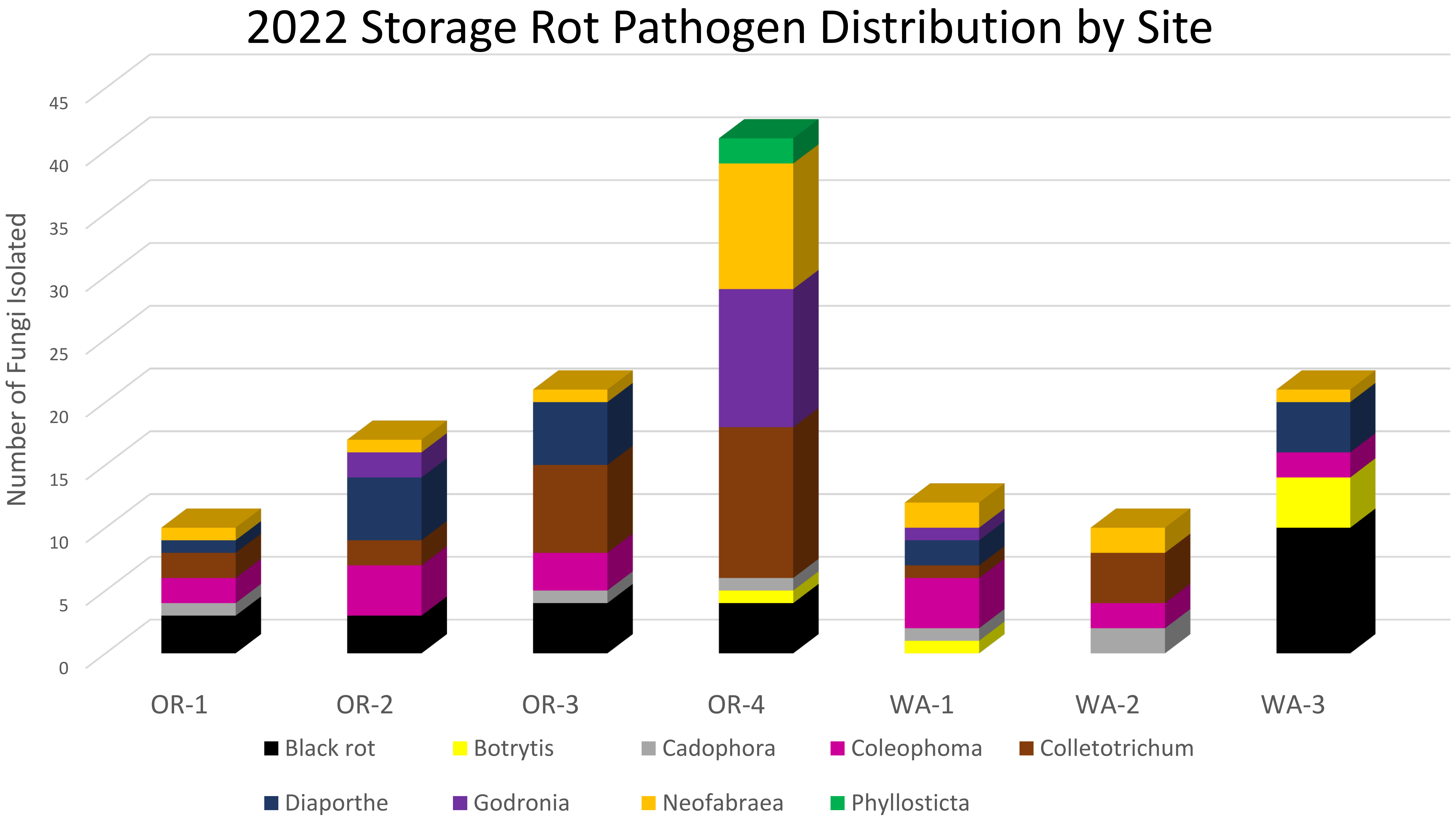
Black rots

Botrytis (Yellow rot)

Godronia (End rot)

Neofabraea actinidiae


2022 Field Rot Pathogen Distribution by Site
Number of Fungi Isolated
0
10
20
30
40
50
60
OR-1
OR-2
OR-3
OR-4
WA-1
WA-2
WA-3
Black Rot
Botrytis
Cadophora
Coleophoma
Colletotrichum
Diaporthe
Godronia
Neofabraea
Phyllosticta
Physalospora


2022 Storage Rot Pathogen Distribution by Site
Number of Fungi Isolated
0
5
10
15
20
25
30
35
40
45
OR-1
OR-2
OR-3
OR-4
WA-1
WA-2
WA-3
Black rot
Botrytis
Cadophora
Coleophoma
Colletotrichum
Diaporthe
Godronia
Neofabraea
Phyllosticta

Tools for Cranberry Fruit Rot Management

- Cultural practices
  - Upkeep of beds, removal of detritus
  - Moisture/Nutrient levels
  - Shading?
- Fungicides
  - Multi-site (Chlorothalonil, Mancozeb, copper)
  - Site-specific (FRAC 3s, FRAC 11)

Multi-site Fungicides

(Chlorothalonil, Mancozeb, copper)

- Multiple avenues for effective action (not just hitting one target)
- Much lower chance of resistance developing to multi-site fungicides
- “Beyond protecting and prolonging the lifespan of highly effective medium to high resistance risk fungicides, multisite fungicides provide added levels and spectrum of disease control. With this they can also support the single sites to be even more efficient”-FRAC (Fungicide Resistance Action Committee)

- More likely to affect non-target organisms

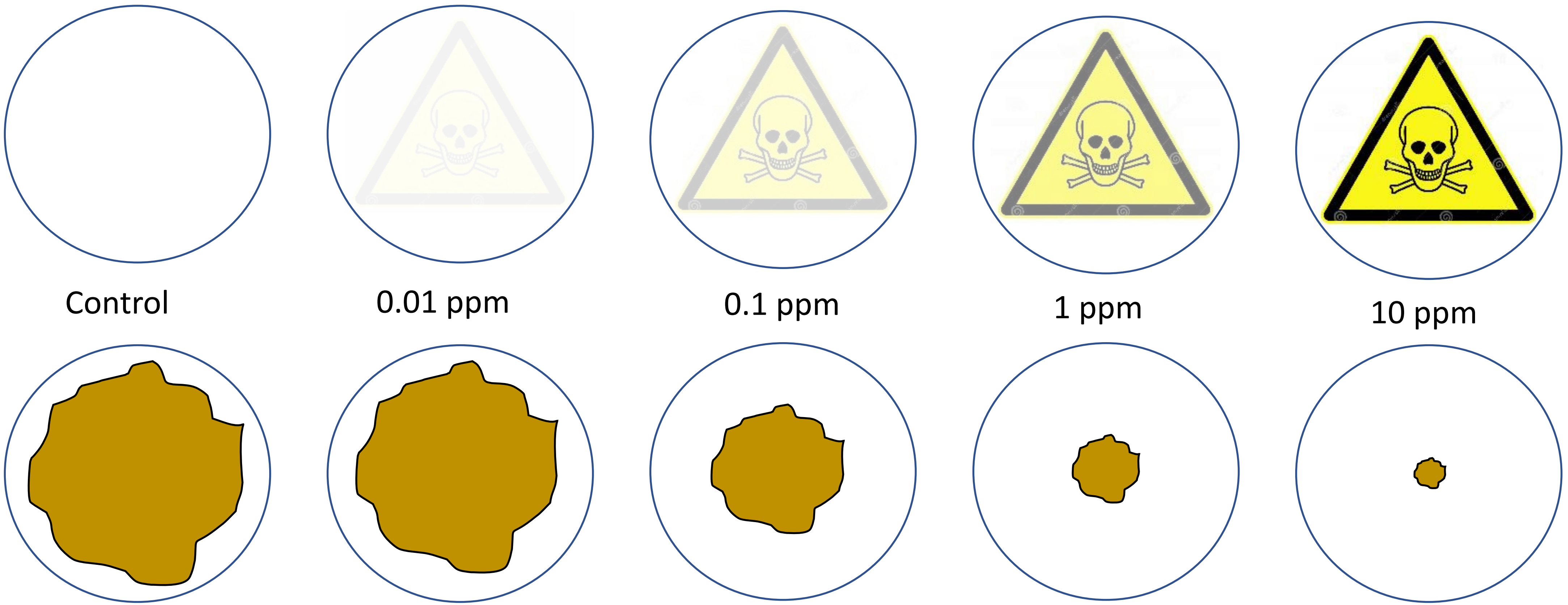
Site-specific Fungicides

- Associated with lower impact on environment and non-target organisms, but likelihood of developing resistance is higher than in multi-site fungicides

- FRAC 3-Fenbuconazole, Difenoconazole, Prothioconazole
  - Demethylation Inhibitors (DMIs)-targets cell membrane production
  - “Generally wise to accept that cross resistance is present between DMI fungicides active against the same fungus”-FRAC

FRAC 11-Azoxystrobin
  - Quinone Outside Inhibitor (QoI)- targets “respiration” of fungi
  - Several mutations known to confer resistance
  - Cross-resistance between all FRAC 11s (switching to another FRAC 11 won’t avoid resistance)

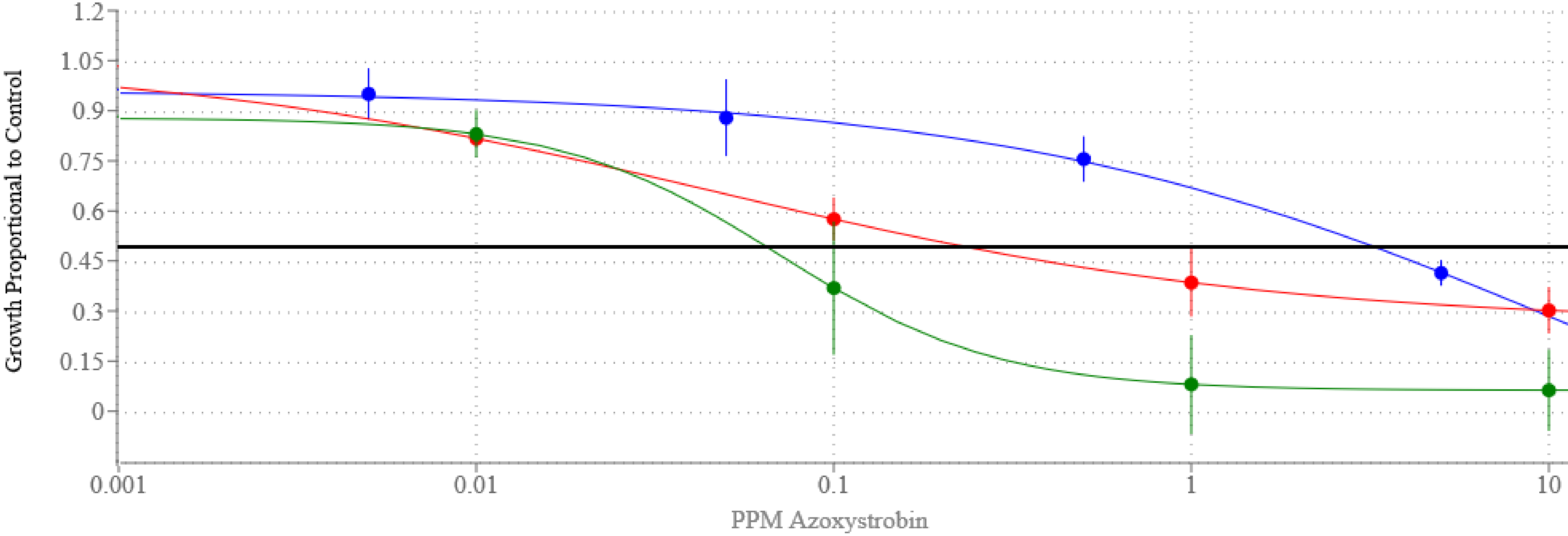
Fungicide Assays



AAT Bioquest, Inc. (2023, March 20). *Quest Graph™ EC50 Calculator*. AAT Bioquest. https://www.aatbio.com/tools/ec50-calculator.

Azoxystrobin (FRAC11) vs. 3 Fruit Rots

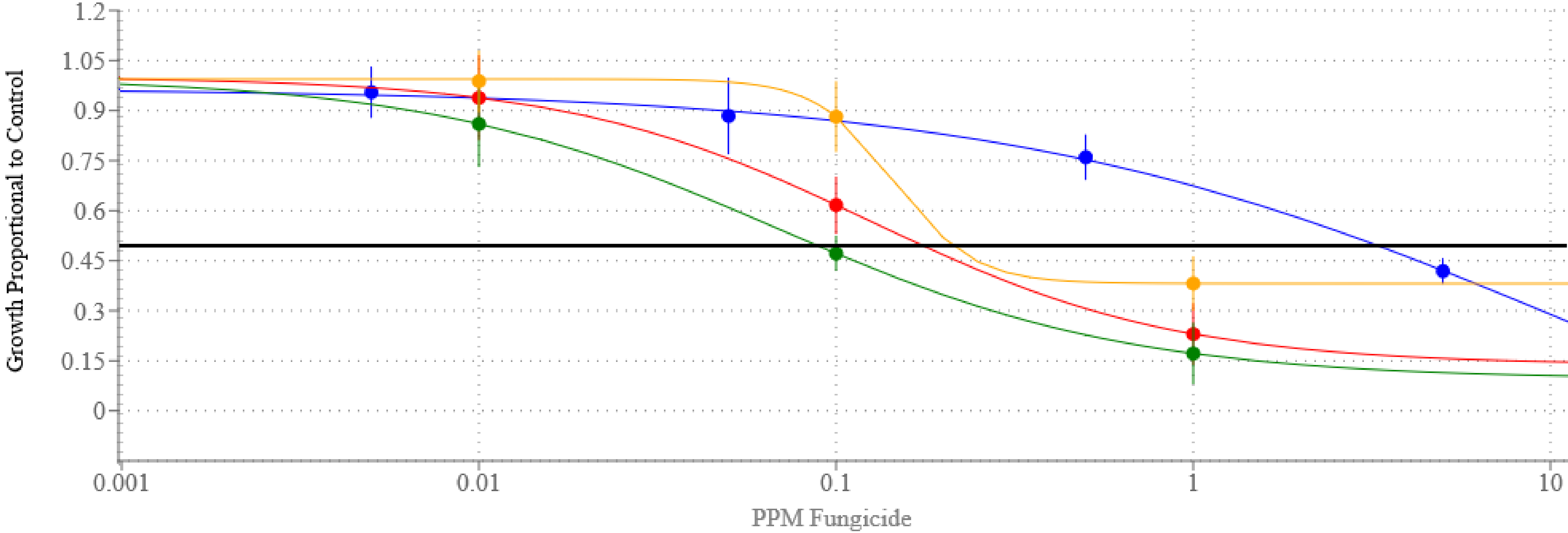
EC_{50} (ppm)
0.06------ Diaporthe (viscid rot/upright dieback)
0.23------ Colletotrichum (bitter rot)
3.19------ Coleophoma (ripe rot)



AAT Bioquest, Inc. (2023, March 20). *Quest Graph™ EC50 Calculator*. AAT Bioquest. https://www.aatbio.com/tools/ec50-calculator.

Coleophoma vs. FRAC 3 & 11

EC_{50} (ppm)
0.09------ Difenoconazole
0.17------ Fenbuconazole
0.21------ Prothioconazole
3.19------ Azoxystrobin



Fungicide sensitive species with high rot incidence?

- So far, Godronia, Diaporthe, Phyllosticta & Physalospora- consistently shown high sensitivity to all 4 site-specific fungicides tested

- Diaporthe- Upright dieback/Viscid rot. Persistence in woody tissue?
- Inoculum from outside beds? Alternate hosts?
- Could be factor of timing the fungicide application

To Date

- No evidence of resistance developing among strains tested
  - Low application frequency of single-site fungicides (1-2 times per year)
- Some fungi are naturally tolerant to certain classes of site-specific fungicides
  - Need to know what management tools work for which rot types
- Emergence of potential pathogens if some multi-site fungicides are phased out?
- Continued testing on more isolates
  - Determine baseline sensitivity or natural tolerance
  - Keeping an eye out for resistance development

Acknowledgements

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Questions?