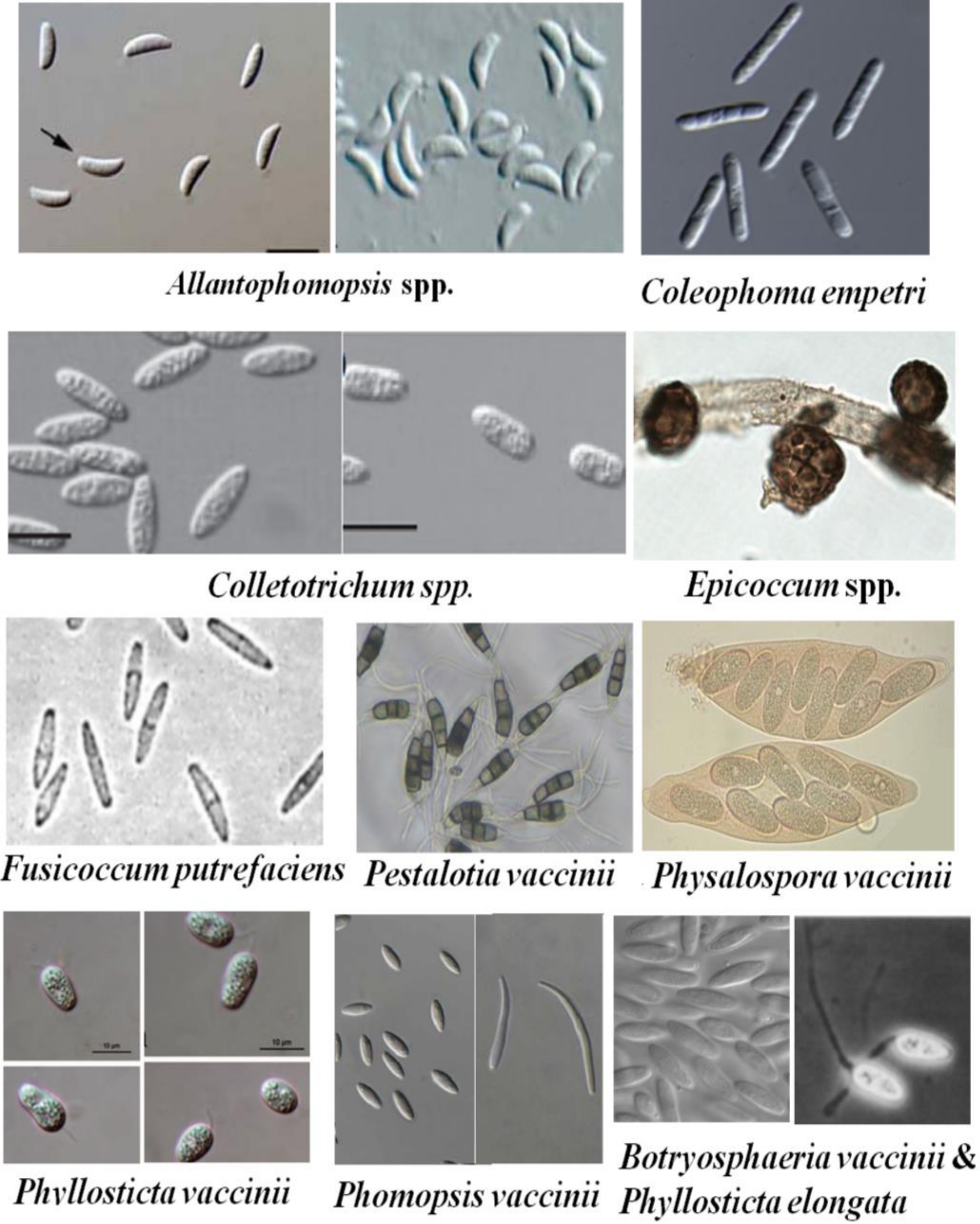
2023 Update Mtg Jan 25: Data Driven Cranberry Fruit Rot Management

DATA-DRIVEN CRANBERRY FRUIT ROT MANAGEMENT

Leela S. Uppala

UMass Cranberry Station

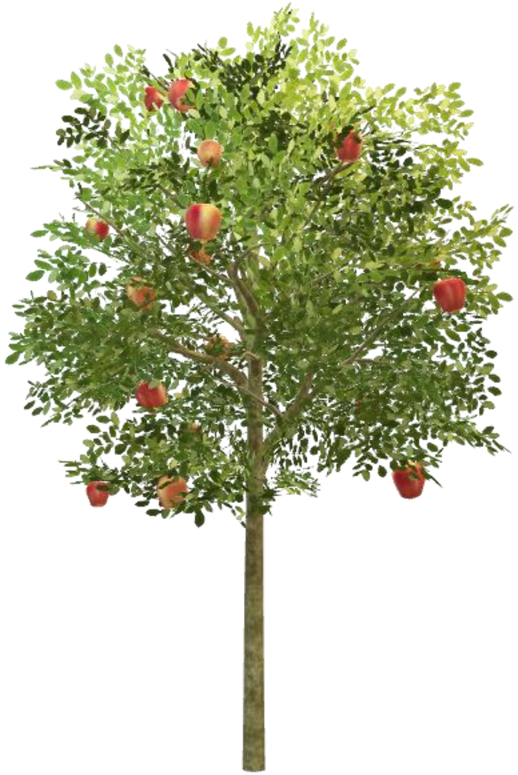
25th January 2023



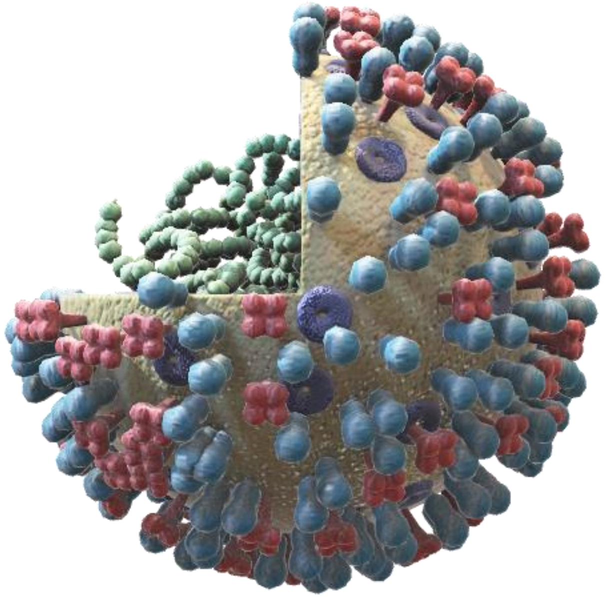
FRUIT ROT

- Cranberry fruit rot (CFR) is the most prevalent disease problem that cranberry growers face from season to season. If left uncontrolled, fruit rot could cause 100% yield losses.
- Over a dozen fungi are known to be associated with CFR disease complex.
- Fungal infection occurs during bloom and fruit rot symptoms appear as the fruit develops.

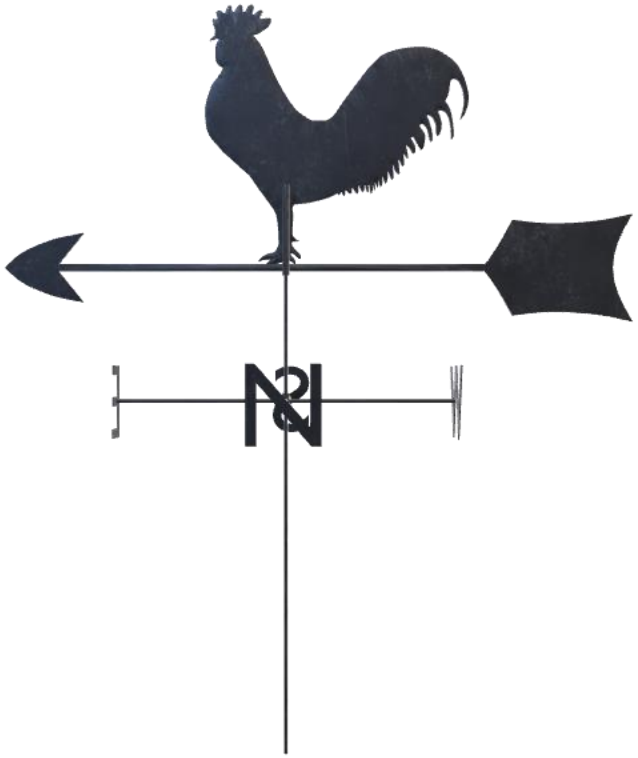
REQUIREMENTS FOR ANY PLANT DISEASE TO HAPPEN



Susceptible plant

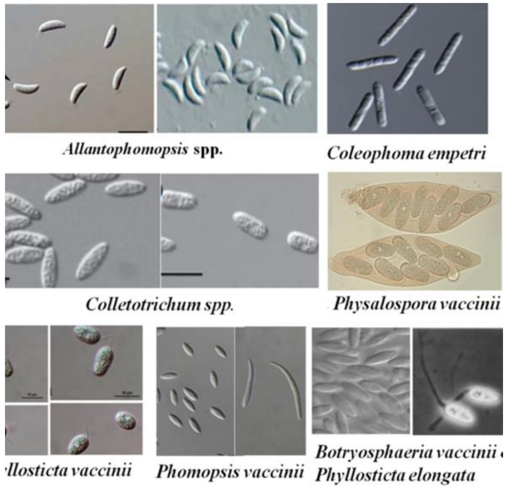


Virulent Pathogen



Favorable Environment

WITH REFERENCE TO CRANBERRY FRUIT ROT



- Do we have all three in MA? In every single year?
    - Why rot levels differ among the cropping seasons?
    - Among the bogs?
    - Even with same number of fungicide applications?
    - How other cultural practices are impacting the CFR occurrence?
- Can we quantify these differences and derive data-driven forecast and management strategies?

WHAT RESEARCH IS BEING CONDUCTED BY UMASS-CRANBERRY STATION'S PATHOLOGY TEAM?

- UNDERSTANDING THE CFR CAUSAL AGENTS/PATHOGENS

Characterization of CFR Fungi

- It is important to understand current status of prevalent CFR fungi in MA in order to develop best management practices.
- How do these pathogen populations differ among Organic, Conventional and Wild cranberry bogs?

CHARACTERIZATION OF CFR FUNGI

- Employing molecular tools, in collaboration Dr. Richard Belanger's group from the University Laval, Quebec we characterized CFR fungi from rotten fruits sampled across the southeastern MA during 2021 growing season.

A Molecular Assay Allows the Simultaneous Detection of 12 Fungi Causing Fruit Rot in Cranberry

Matteo Conti[1], Benjamin Cinget[1], Julien Vivancos[2], Peter Oudemans[3], Richard R. Bélanger[1,†]

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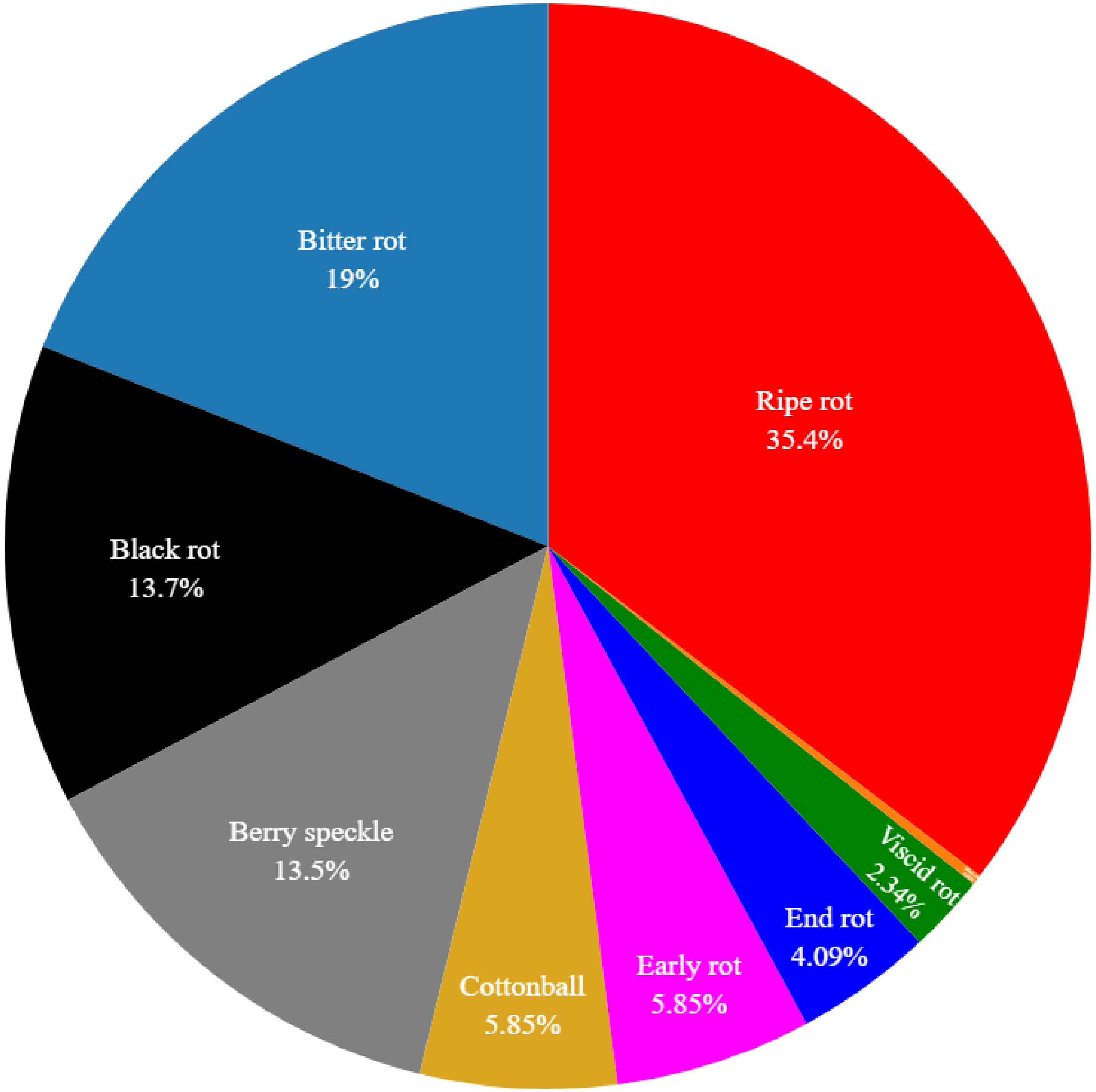
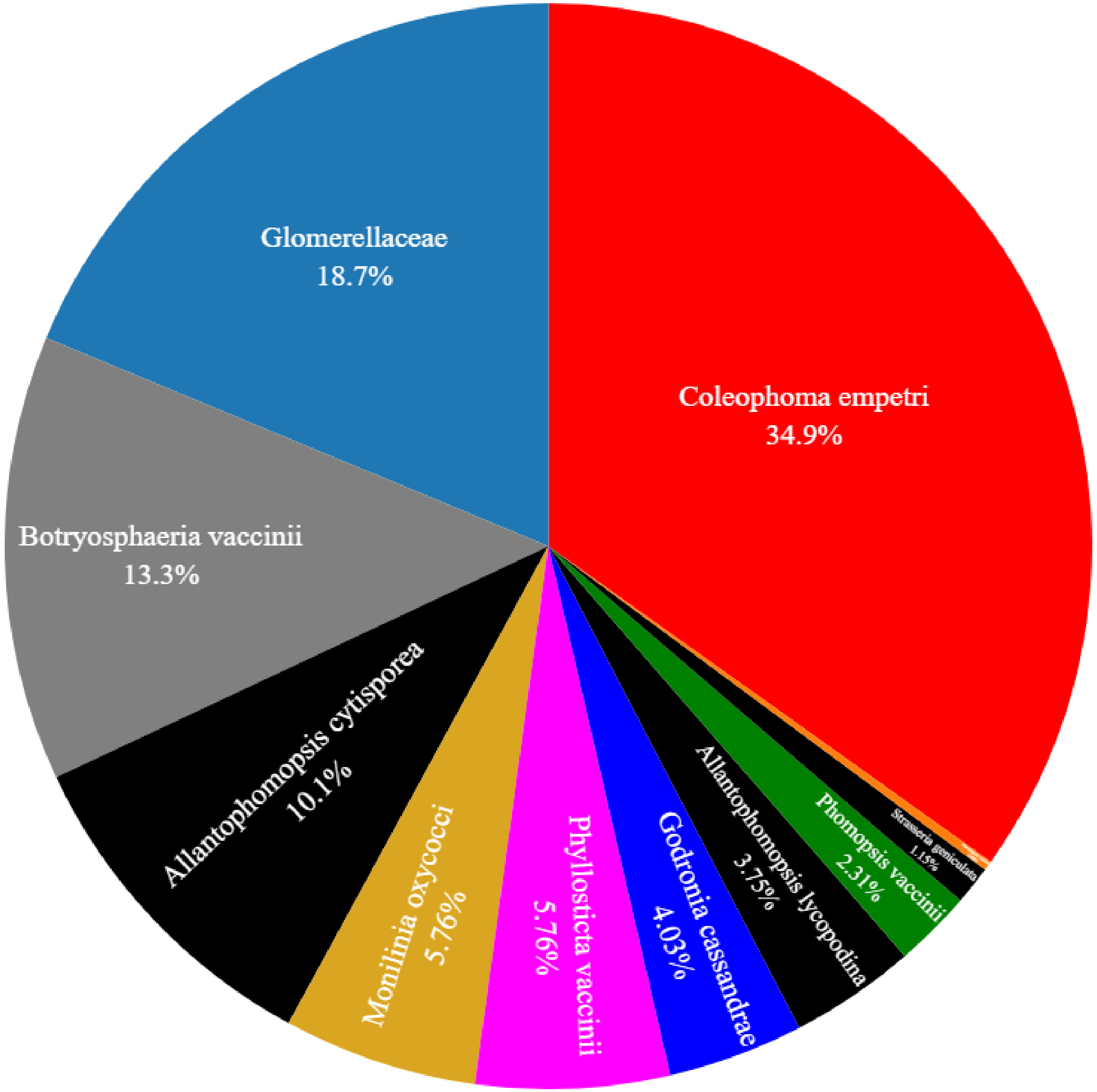
[2] Laboratoire d'expertise et de Diagnostic en Phytoprotection, Quebec City, Québec, Canada
[3] Philip E. Marucci Center for Blueberry and Cranberry Research and Extension, The State University of New Jersey, Chatsworth, NJ, U.S.A.



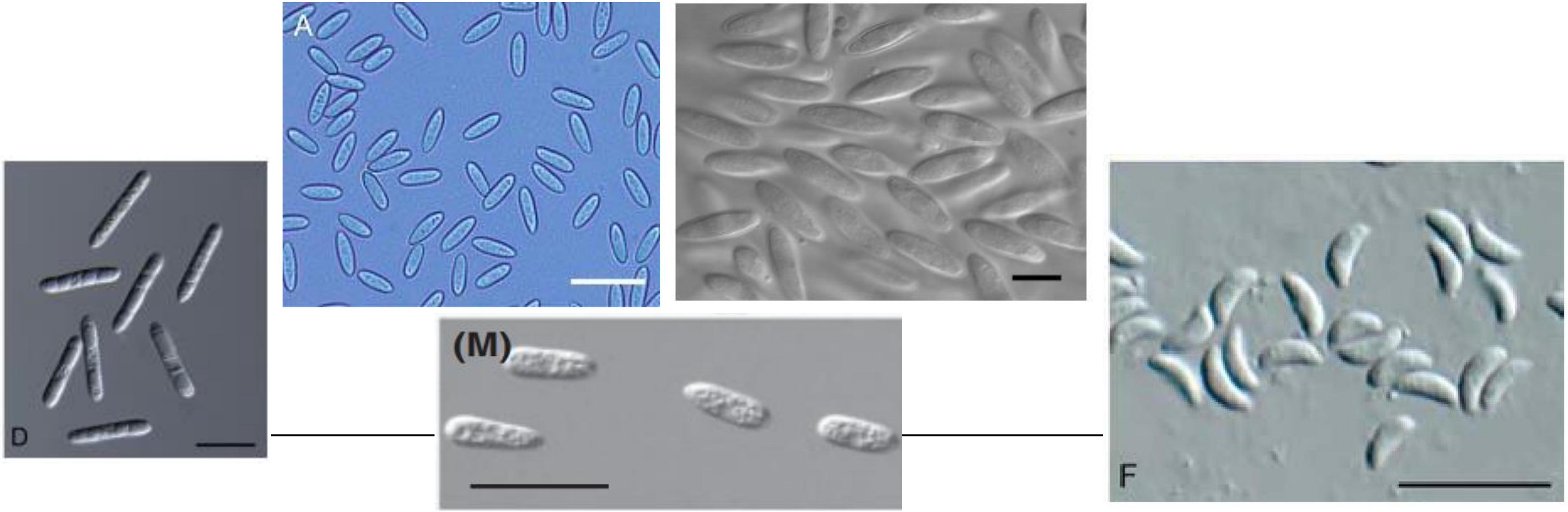
Relative abundance- DISEASE diversity



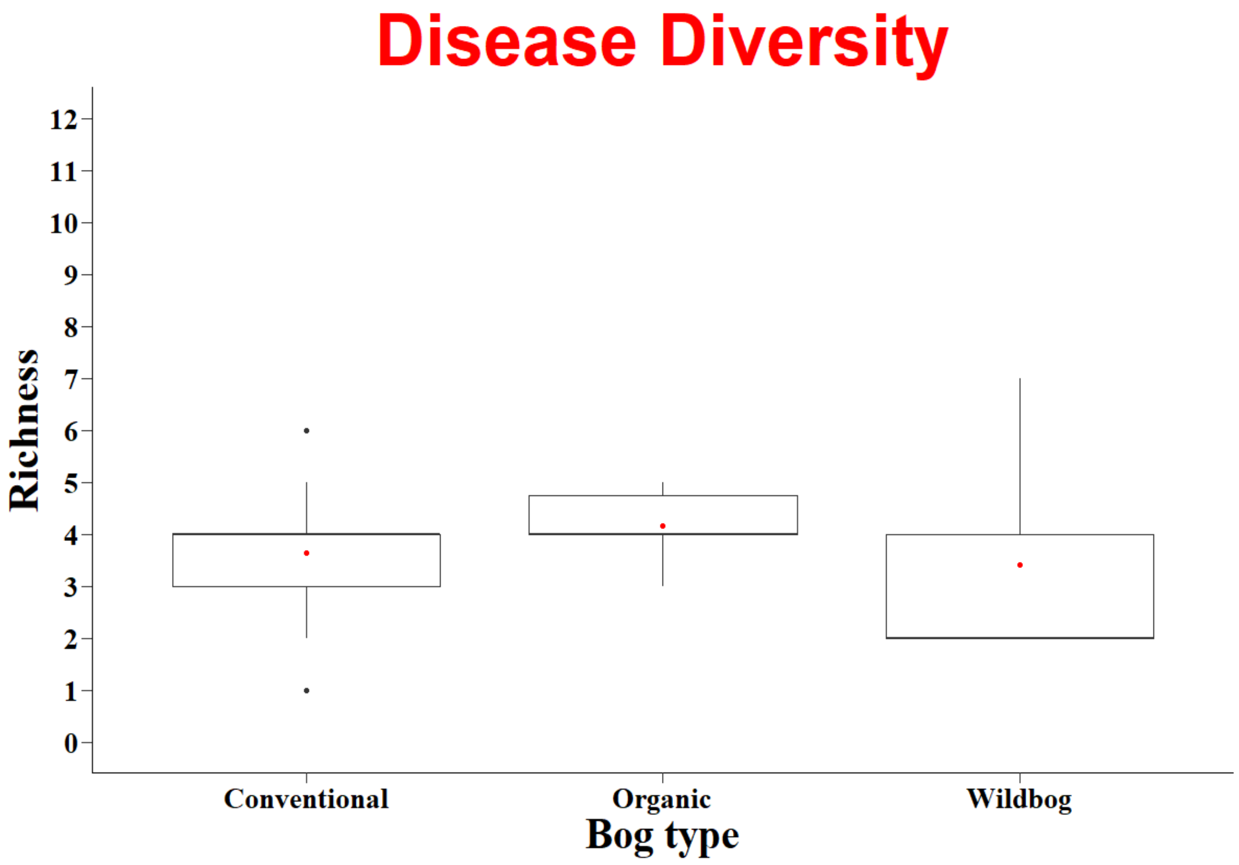
Relative abundance - SPECIES diversity

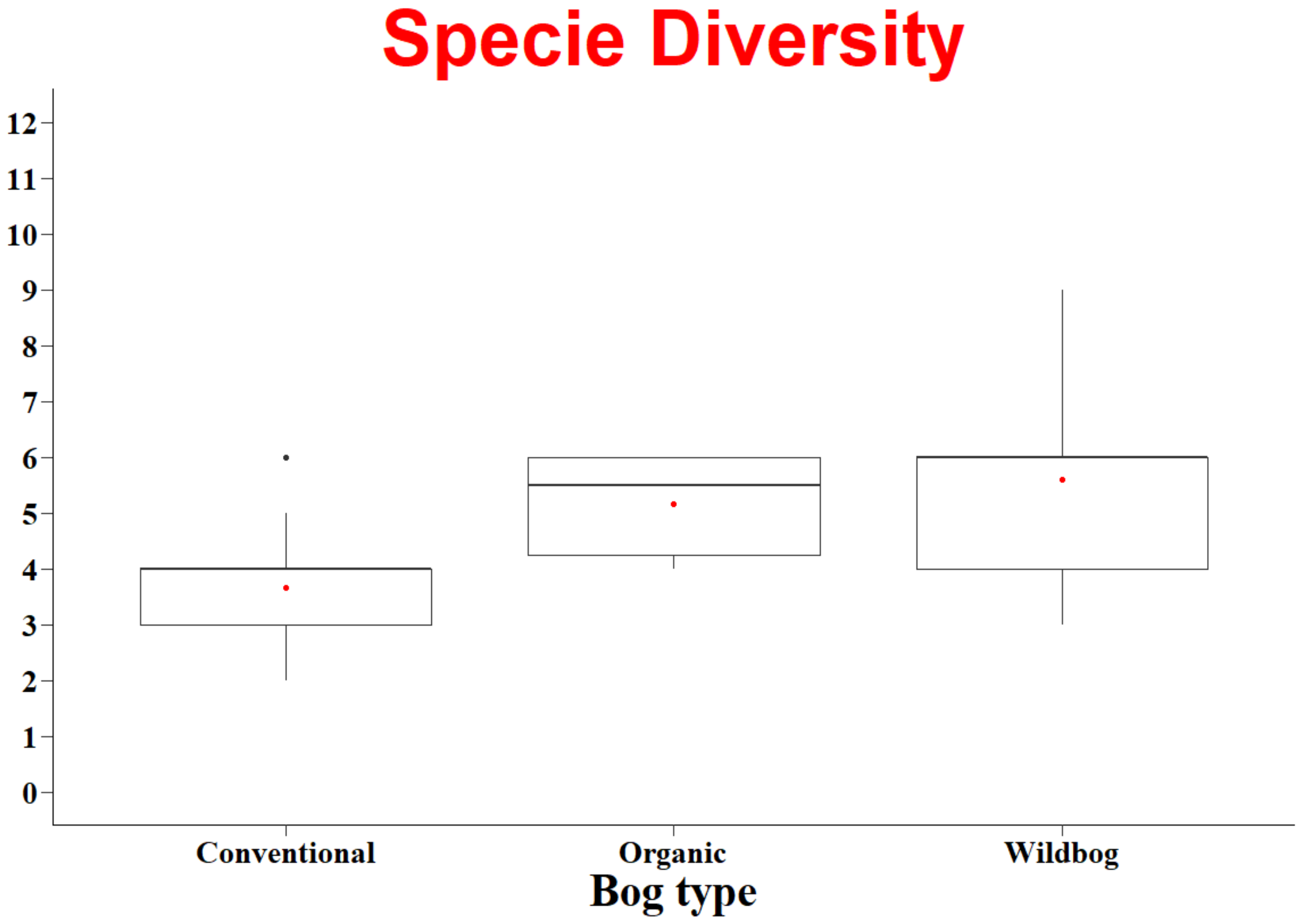
SUMMARY

- Ripe rot caused by *Coleophoma empetri* was the most abundant pathogen detected across the locations with high relative abundance (35%) found in 42 of 46 sampled fields.
- This is followed by bitter rot (*Colletotrichum* spp. Glomerellaceae), black rot (*Allantophomopsis cytisporea*) and berry speckle (*Botryosphaeria vaccinii*).



Relative Abundance Among Conventional, Organic and Wild Bogs





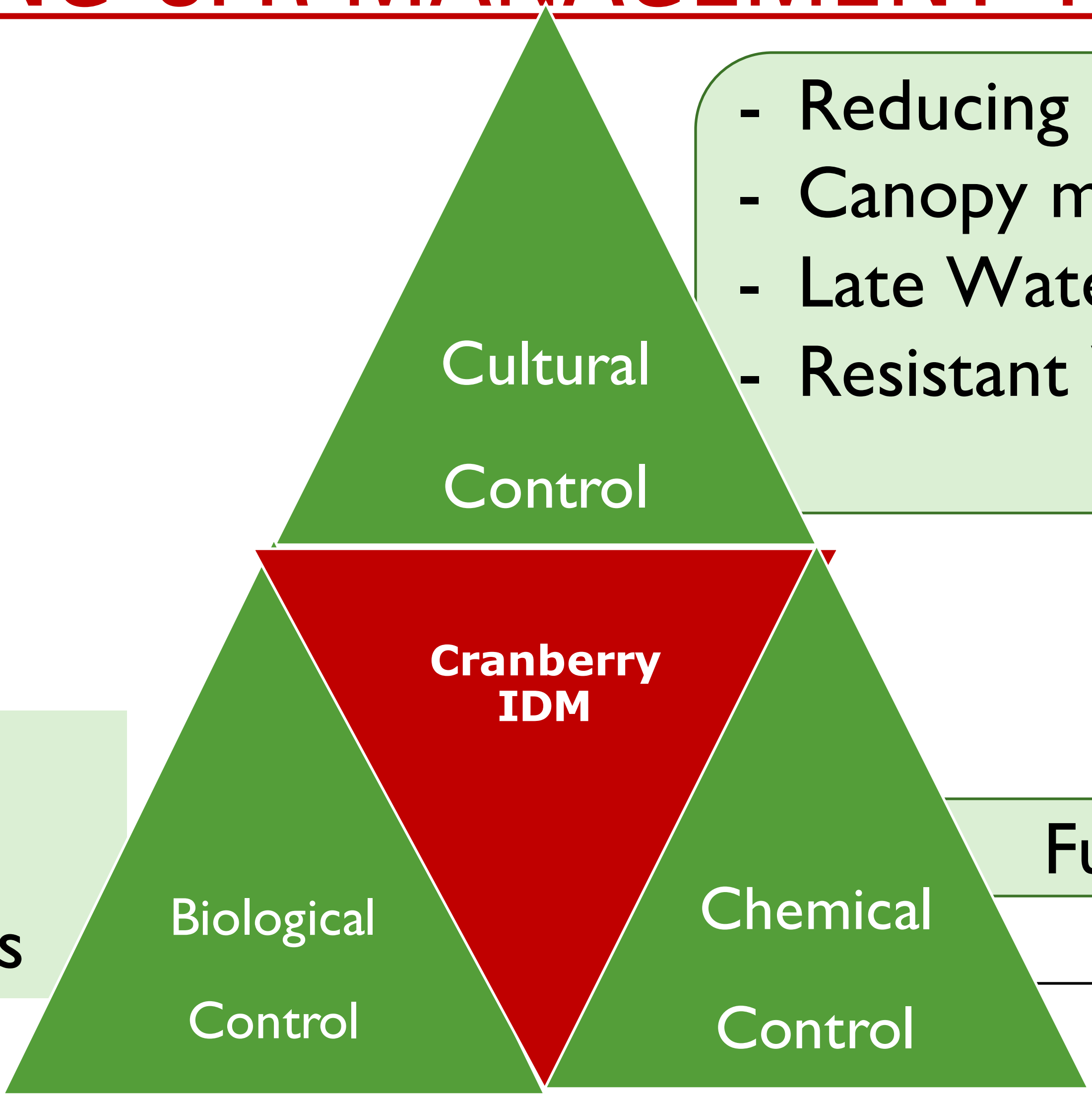
SUMMARY

- The number of fungal species detected were far greater from the wild bogs than conventional bogs.
- These results suggest that fungicides applied in conventional production significantly impact the fungal species observed in fields.
- However, despite the abundance of bitter rot across the fields sampled, none of the wild bogs showed *Colletotrichum* spp.

Future Outlook

- Multi-year study of CFR pathogens for better understanding of the year-to-year variations (if any) and identifying factors associated with changes.

EXPANDING CFR MANAGEMENT TOOL KIT



- Reducing inoculum levels
- Canopy management
- Late Water
- Resistant Varieties

Using beneficial microbes & OMRI approved products

Fungicides

FUNGICIDES

- Fungicides are pesticides that kill or prevent the growth of fungi and their spores.

FUNGICIDES USE IN CFR MANAGEMENT

- Initial fungicides use in cranberries for CFR dates back to 1880s.
- Started with Professor Taylor recommending "Lime to neutralize the poisonous acids of the NJ bogs and sweeten them to control rot" in late 1880s.
- Shear et al (1905) Liquid Bordeaux Mixture (a combination of copper sulfate, lime, and water).
- In the last 50 years --- Broad-spectrum, multi-site mode of action fungicides like Mancozebs and Chlorothalonils- most widely used.
- For the past 2 decades- Introductions of single-site mode of action fungicides.

Cranberry Fungicides Resistance Risk

Azoxystrobin

Group 11

Abound

Group 3

Indar

Proline

Fenbuconazole

Prothioconazole

Azoxystrobin &
Difenconazole

Group 3 & 11

Quadris Topp

Group M5

Group M3

Group M1

Group 19

Cholorothalonils

Mancozebs

Coppers

Polyoxin- D-Zinc Salt

Why expand fungicide toolbox now?

❖New challenge of losing the effective multi-site mode of action fungicides (chlorothalonils and mancozebs) to stringent Maximum Residue Limits (MRLs) by export markets owing to perceived negative impacts on pollinators (honeybees and bumble bees), human and environmental health.

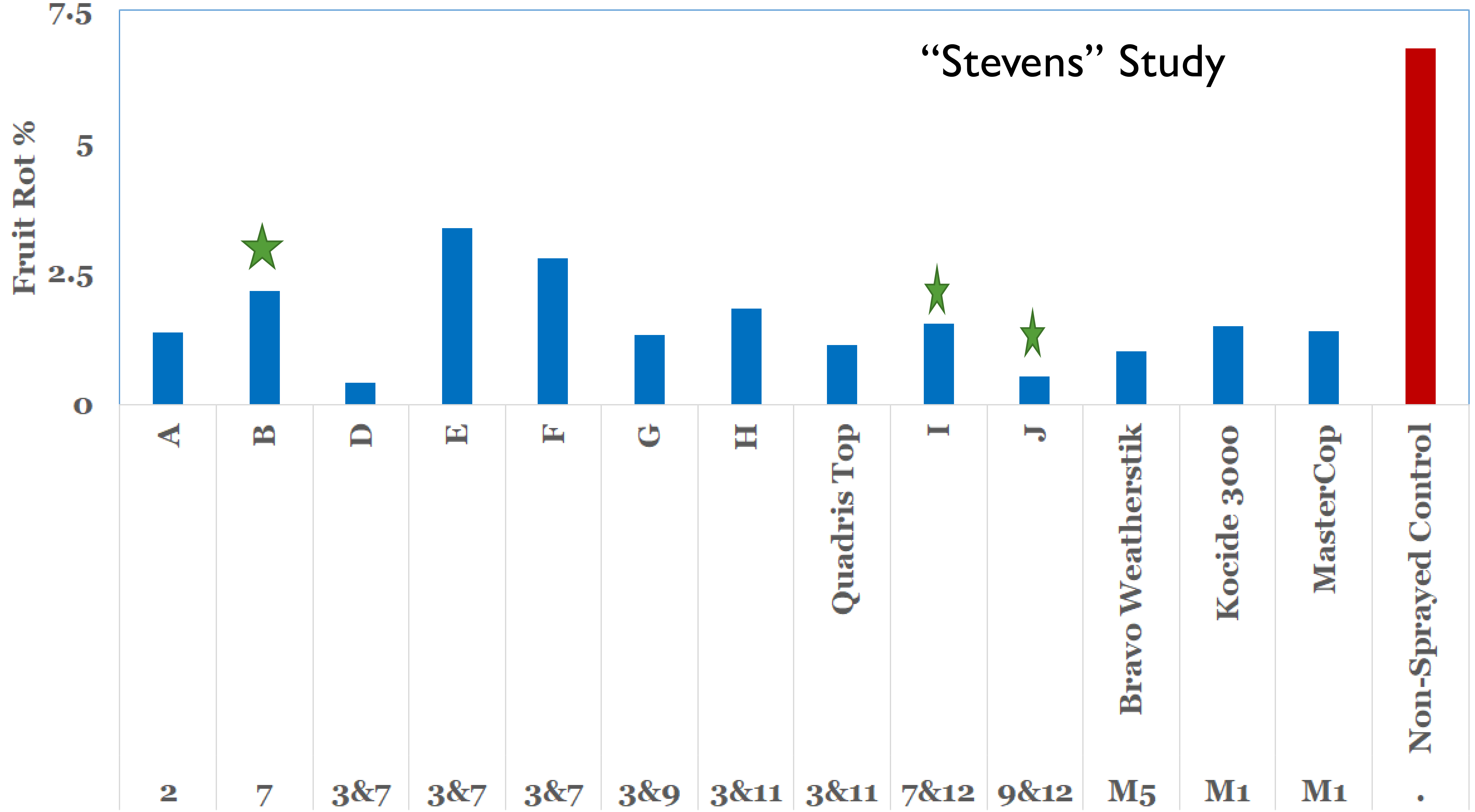
❖The void created by these revisions is being filled by the only two other classes of effective single-site mode of action fungicides from FRAC (Fungicide Resistance Action Committee) Group 3 and Group 11.

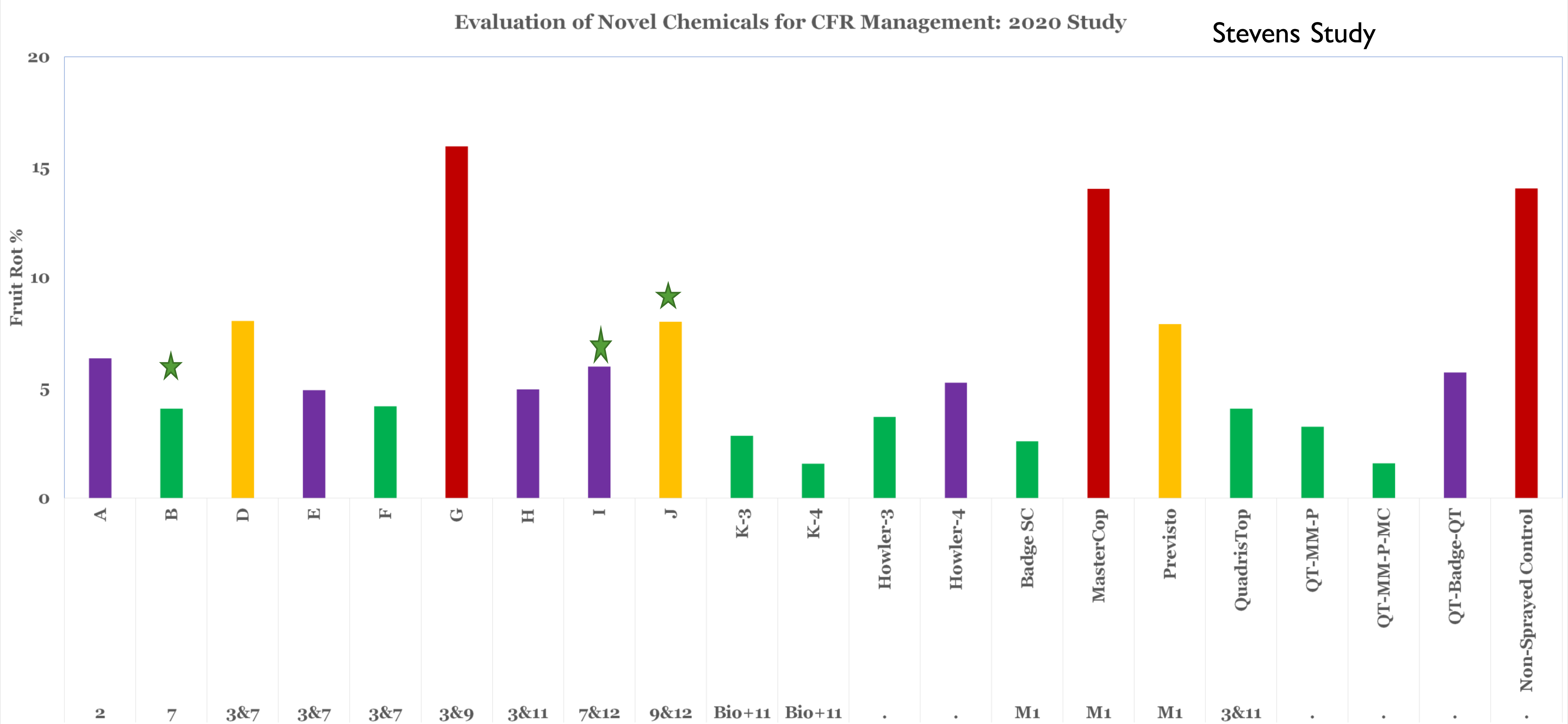
❖These newer fungicides pose a much higher risk of selecting for fungicide resistance than the multi-site mode of action fungicides.

❖For the long-term sustainability of cranberry industry, it is critical to reduce overreliance and preserve their durability (by adopting resistant management tools) and diversify fruit rot management tool kit with novel fungicides.

Focus on the efficacy of 3 Novel compounds that are in line for Registration

Evaluation of Novel Chemicals for CFR Management: 2019 Study




Evaluation of Novel Chemicals for CFR Management: 2020 Study
Stevens Study
Fruit Rot %
20
15
10
5
0
A
B
D
E
F
G
H
I
J
K-3
K-4
Howler-3
Howler-4
Badge SC
MasterCop
Previsto
QuadrisTop
QT-MM-P
QT-MM-P-MC
QT-Badge-QT
Non-Sprayed Control
2
7
3&7
3&7
3&7
3&9
3&11
7&12
9&12
Bio+11
Bio+11
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M1
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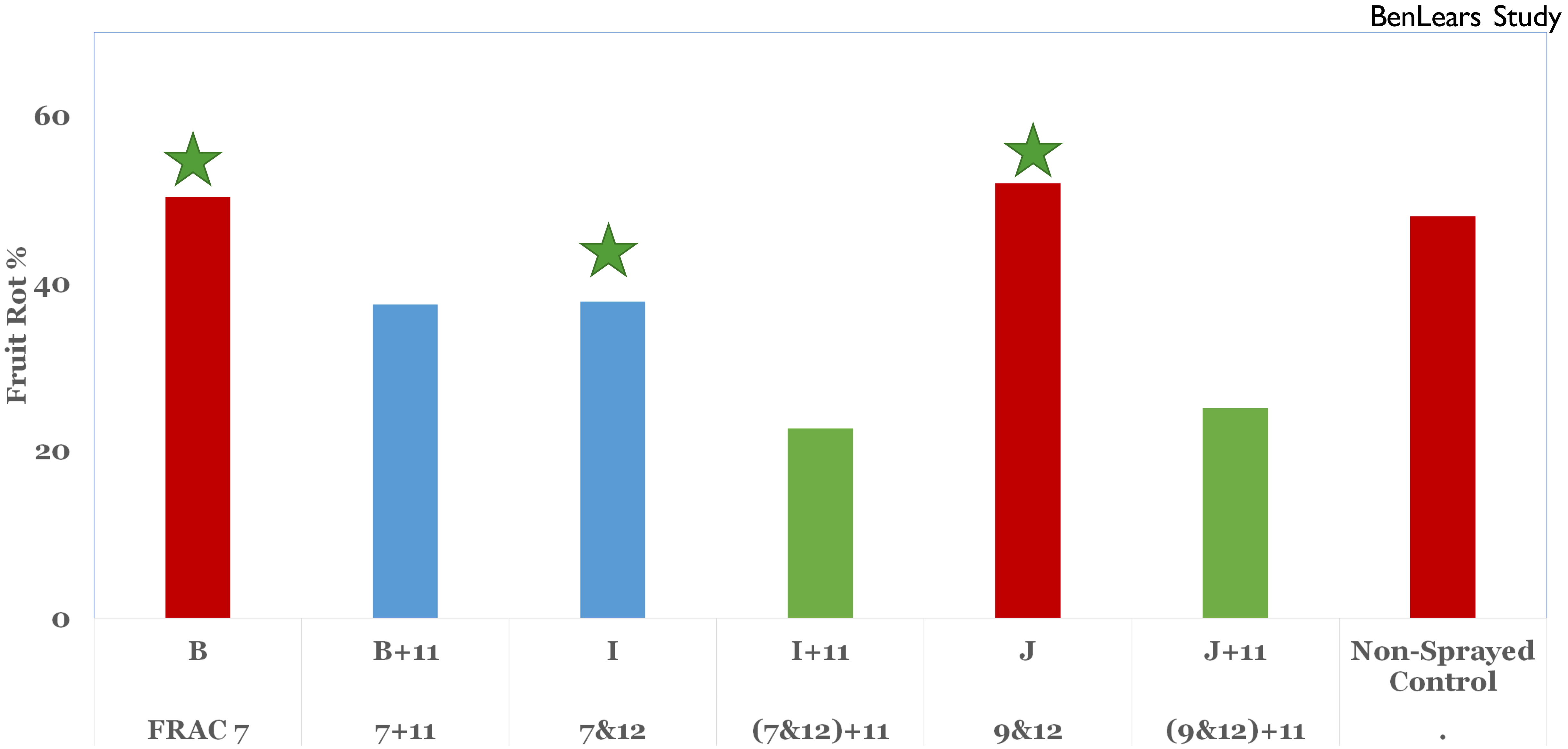
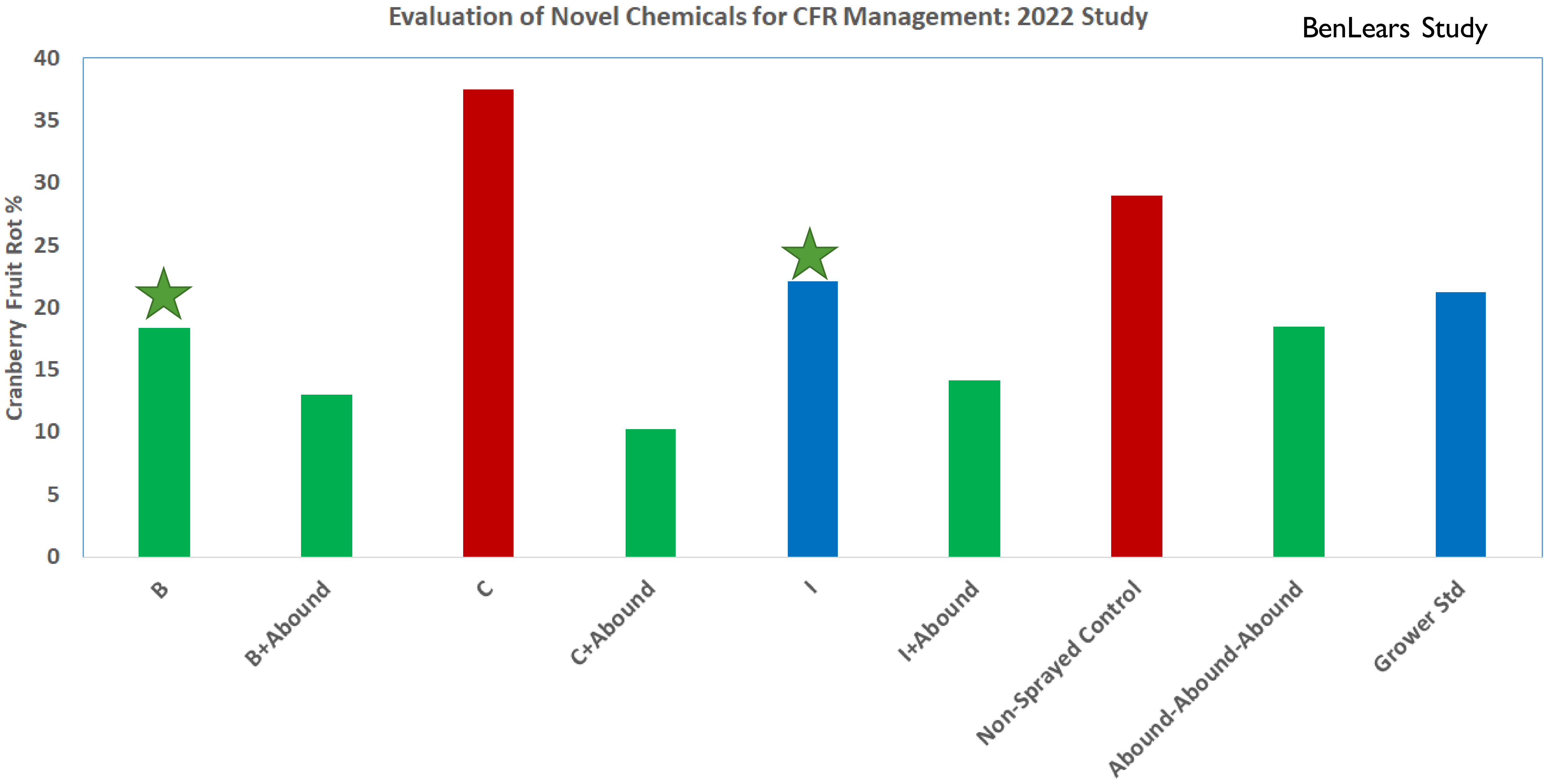
Evaluation of Novel Chemicals for CFR Management: 2021 Study



Focus on the efficacy of 3 Novel compounds that are in line for Registration


Evaluation of Novel Chemicals for CFR Management: 2022 Study
BenLears Study
Cranberry Fruit Rot %
40
35
30
25
20
15
10
5
0
B
B+Abound
C
C+Abound
I
I+Abound
Non-Sprayed Control
Abound-Abound-Abound
Grower Std

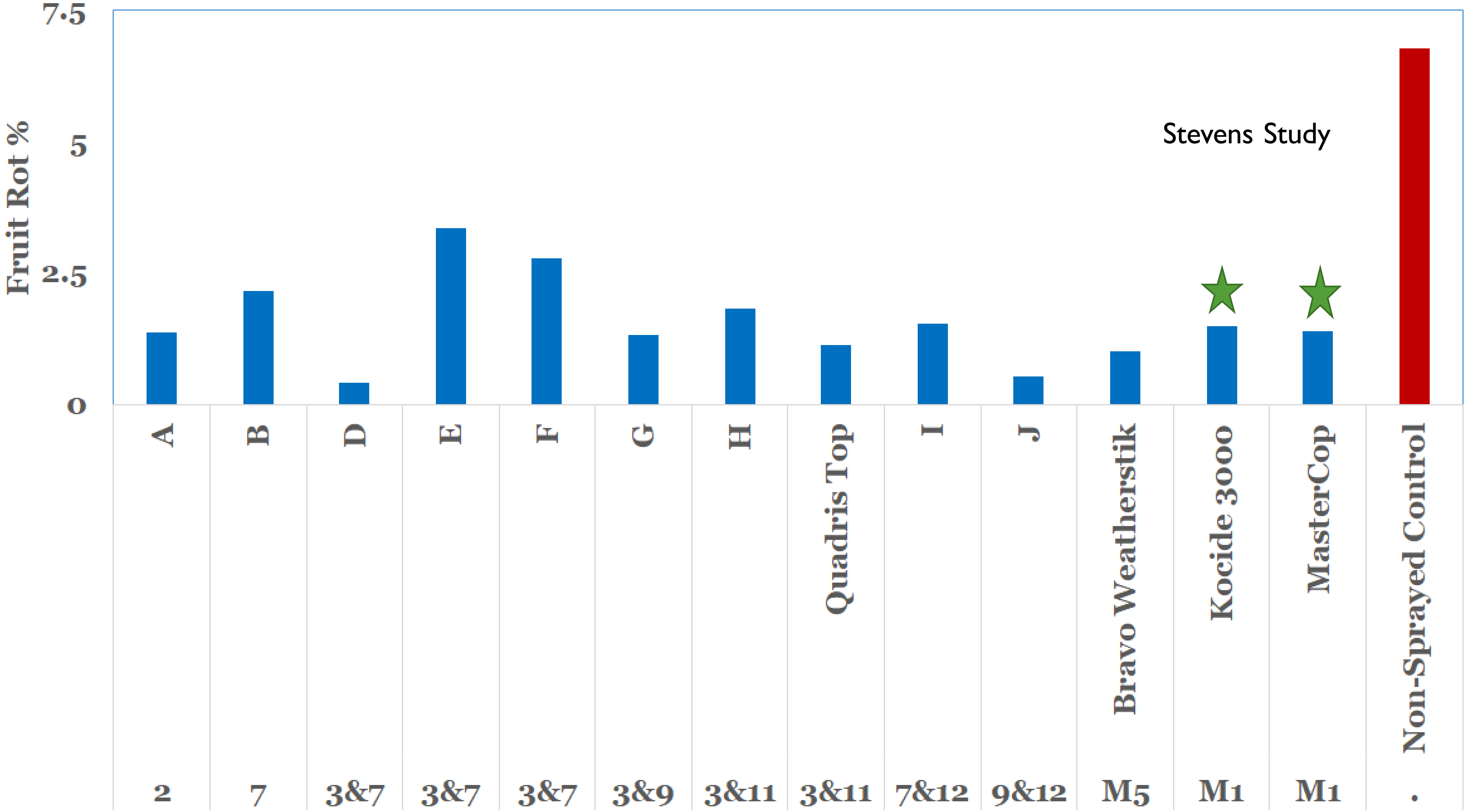
Conclusion

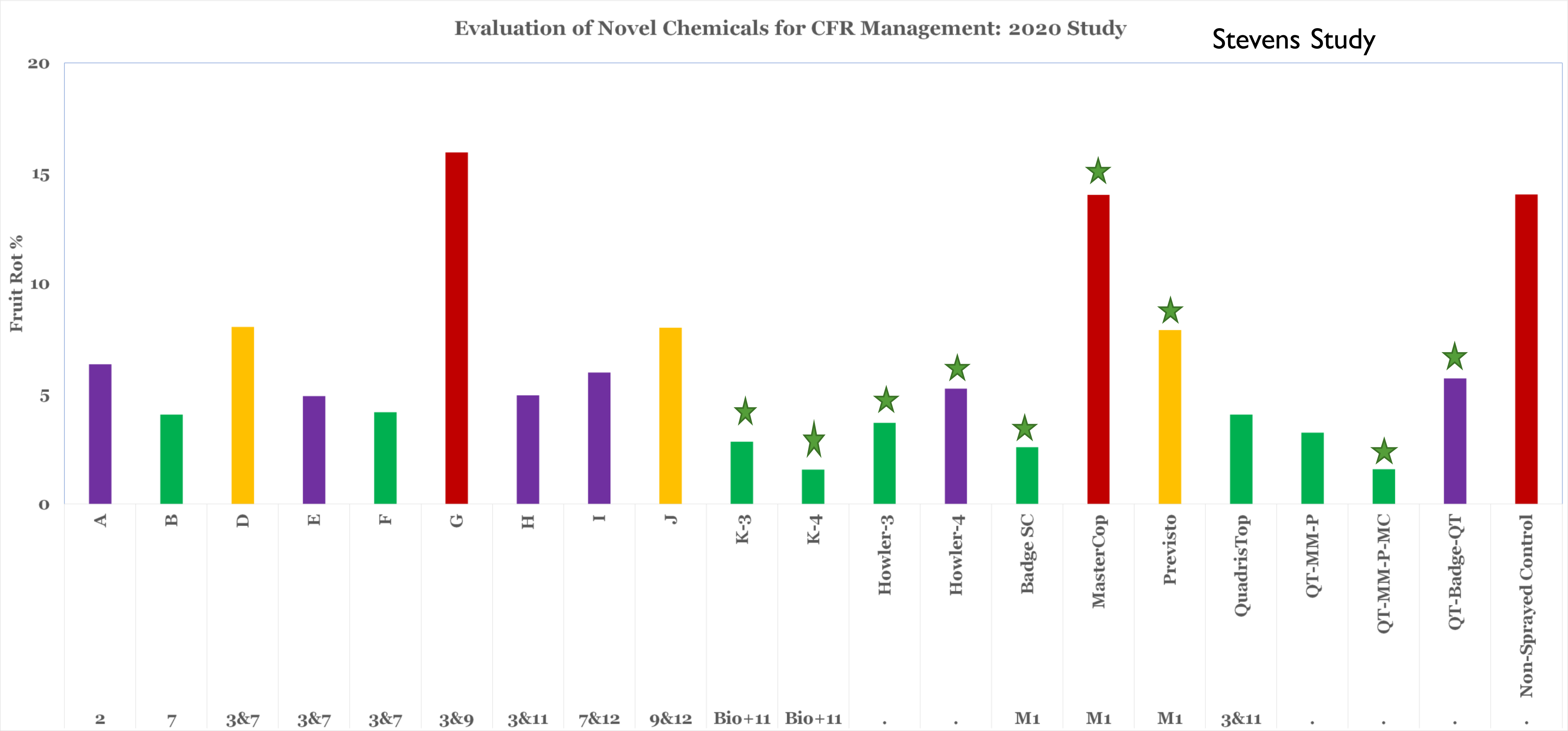
- Although there are year-to-year variations in efficacy, these three products would be a great addition to the shrinking fruit rot toolkit.

Focus on the efficacy of Coppers and Biologicals for CFR Management

- Data on their efficacy in managing CFR is lacking.
- Evaluated several products SOLO and as part of fungicide regimes with a goal to develop an integrated fruit rot management program.

Evaluation of Novel Chemicals for CFR Management: 2019 Study




Evaluation of Novel Chemicals for CFR Management: 2020 Study
Stevens Study
Fruit Rot %
20
15
10
5
0
A
B
D
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J
K-3
K-4
Howler-3
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Badge SC
MasterCop
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QuadrisTop
QT-MM-P
QT-MM-P-MC
QT-Badge-QT
Non-Sprayed Control
2
7
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7&12
9&12
Bio+11
Bio+11
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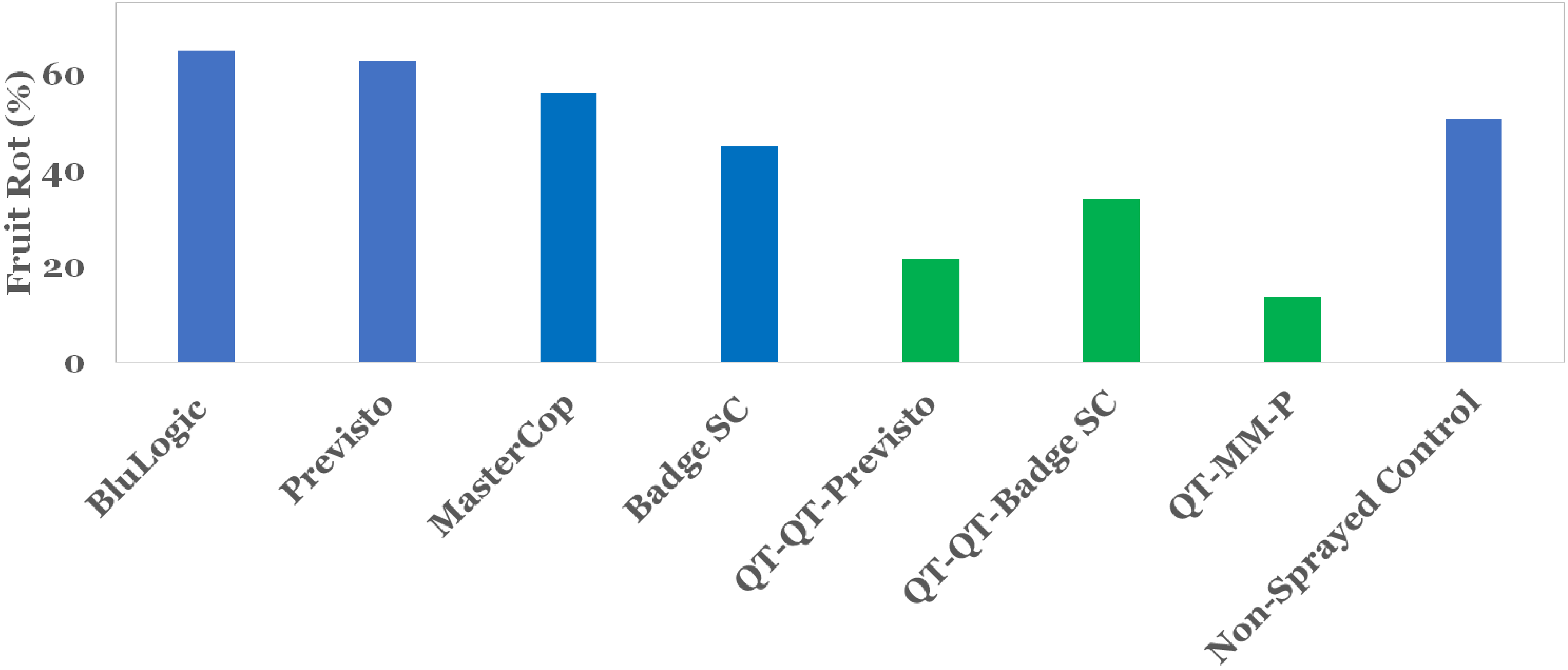
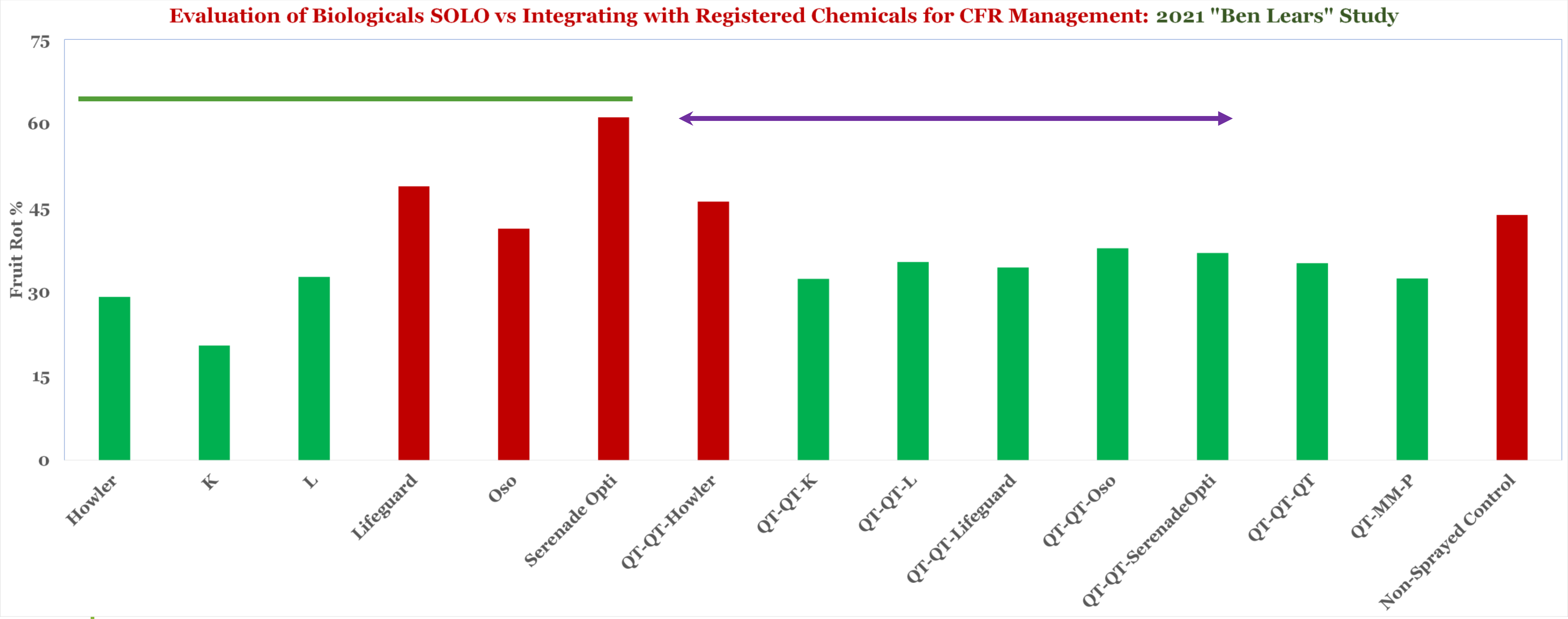
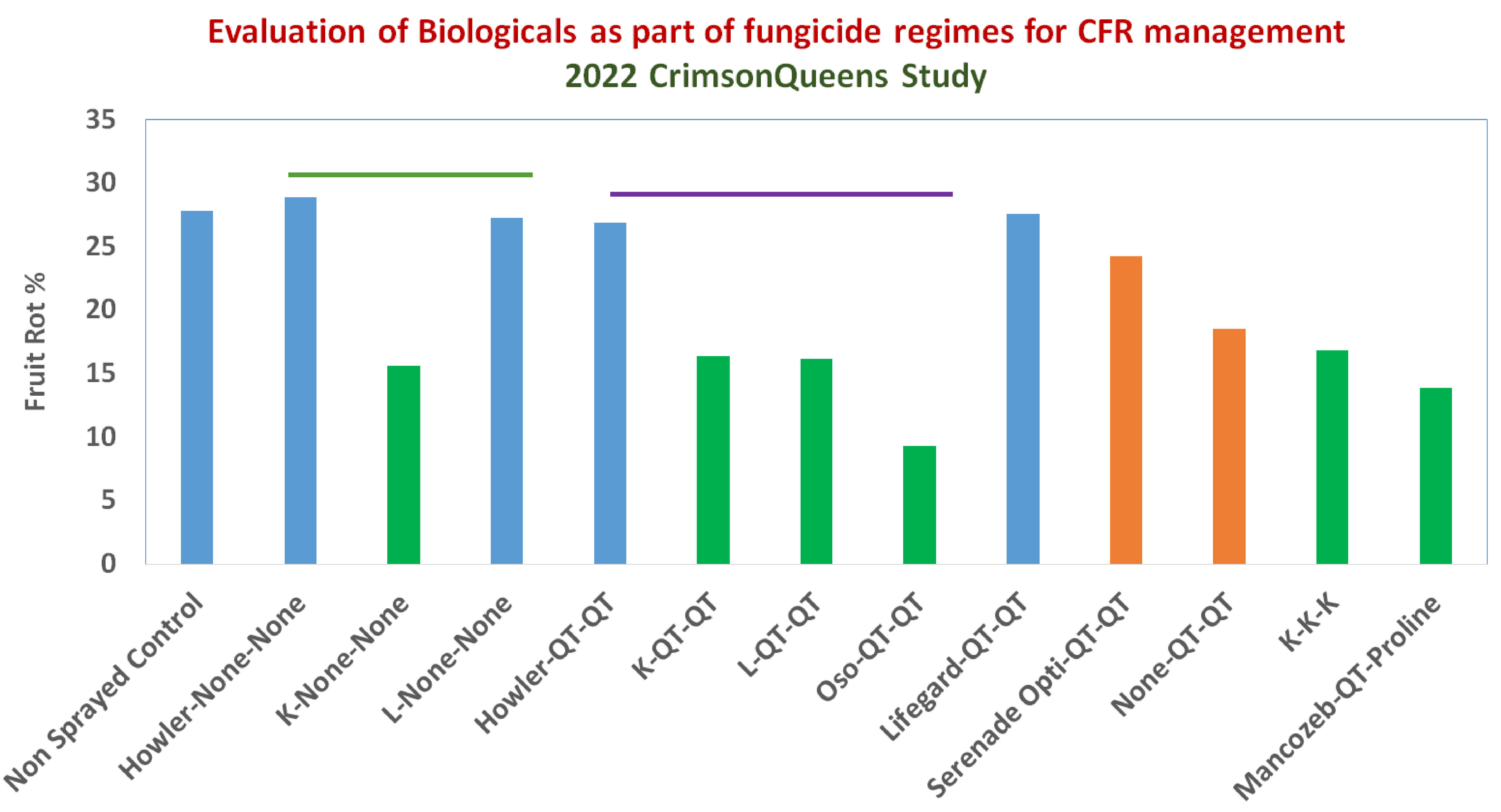
Evaluation of Copper Products for CFR Management: 2021 Early Blacks Study




Evaluation of Biologicals SOLO vs Integrating with Registered Chemicals for CFR Management: 2021 "Ben Lears" Study
Fruit Rot %
75
60
45
30
15
0
Howler
K
L
Lifeguard
Oso
Serenade Opti
QT-QT-Howler
QT-QT-K
QT-QT-L
QT-QT-Lifeguard
QT-QT-Oso
QT-QT-SerenadeOpti
QT-QT-QT
QT-MM-P
Non-Sprayed Control



Evaluation of Biologicals as part of fungicide regimes for CFR management
2022 CrimsonQueens Study
Fruit Rot %
0
5
10
15
20
25
30
35
Non Sprayed Control
Howler-None-None
K-None-None
L-None-None
Howler-QT-QT
K-QT-QT
L-QT-QT
Oso-QT-QT
Lifegard-QT-QT
Serenade Opti-QT-QT
None-QT-QT
K-K-K
Mancozeb-QT-Proline

Conclusions

- Coppers worked efficiently in reducing fruit rot as part of fungicide regimes not SOLO.
- Product ‘K’ with *Pseudomonas chlororaphis* + Abound® (Group 11) consistently resulted in significantly lower fruit rot SOLO and as part of fungicide regimes, while registered biologicals Howler®, Lifeguard®, Oso™ and Serenade® Opti were more efficient as part of fungicide regimes not SOLO.

Phytophthora and *Pythium* Studies

- We plan to survey for *Phytophthora* and *Pythium spp. in MA.*
- If you suspect these in any of your bogs or you would like us to sample your bogs for these pathogens in spring, please contact me at 508-970-7644.

Identifying Critical Criteria to Develop a Decision-Making Model for implementation of Late Water Floods in Cranberry Production

Late Water

- Being underutilized but has potential to improve fruit quality with reduced inputs.
- Known to be highly effective for scale management.
- Under current situations, there is a need for reconsidering all available tools towards sustainable CFR management.
- Mid April to Mid May. Once in three years.
- Bloom will be compressed into a shorter time period.
- Reduced recommended rates and less number of fungicide applications are recommended during the late water year and the following year.

Late Water Decision Making Tool

- **Hypotheses:** Critical criteria that impact the outcomes of the LW floods can be identified, quantitated, and evaluated. A LW-DMM (late water decision-making model) can be developed to increase grower confidence and the adoption of this cultural practice for sustainable cranberry production.
- **Research questions:**

1. Which physiological, environmental, and climatic factors are associated with LW success? Which are most influential?
2. How do LW and unflooded farms differ in yield, fruit rot, and quality?
3. How to build a LW-DMM that maximizes grower confidence, adoption, and reliability?

Vision for Late Water DMM

Decision tool conceptual model

Tool Inputs
(Historical and field data collected during the grant period)

→

Tool Algorithms
- Regression equations
- Machine Learning tools

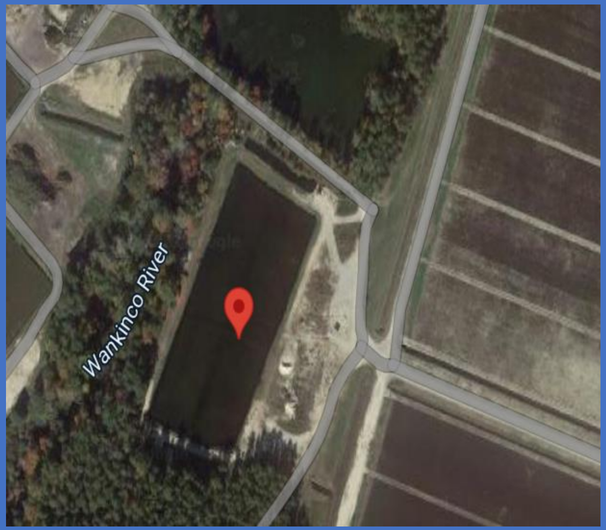
→

Tool Output(s)
Likelihood of success

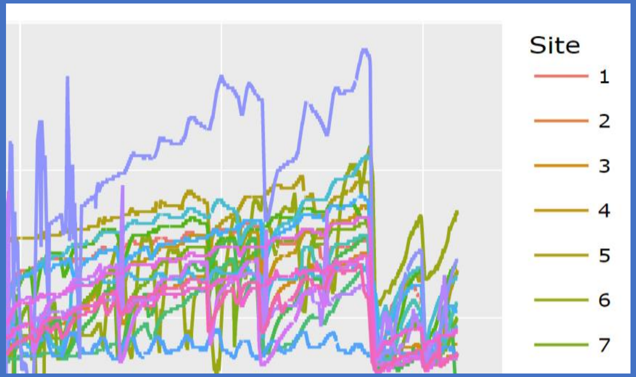
Vision for Late Water DMM

LW-DMM Dashboard Potential Layout

Grower Bog Map
(Mapbox or leaflet)



Bog Data Plots
(Dropdown menu to
choose variables)



Model Output

127.0.0.1:64273/?view=rmarkdown

Open in Browser

Publish

Late Water Dashboard - Prototype Layout V 1.0

Select Bog Site ID

2021-CON-4

Select Bog Location:

- [ ] Carver
- [ ] Freetown
- [ ] Halifax
- [ ] Hanson
- [ ] Lakeville
- [ ] Middleboro
- [ ] Plymouth
- [ ] Taunton
- [x] Wareham

Last Year's Yield

0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Last Year's Yield (barrel/acre):

0

Last Year's Rot %

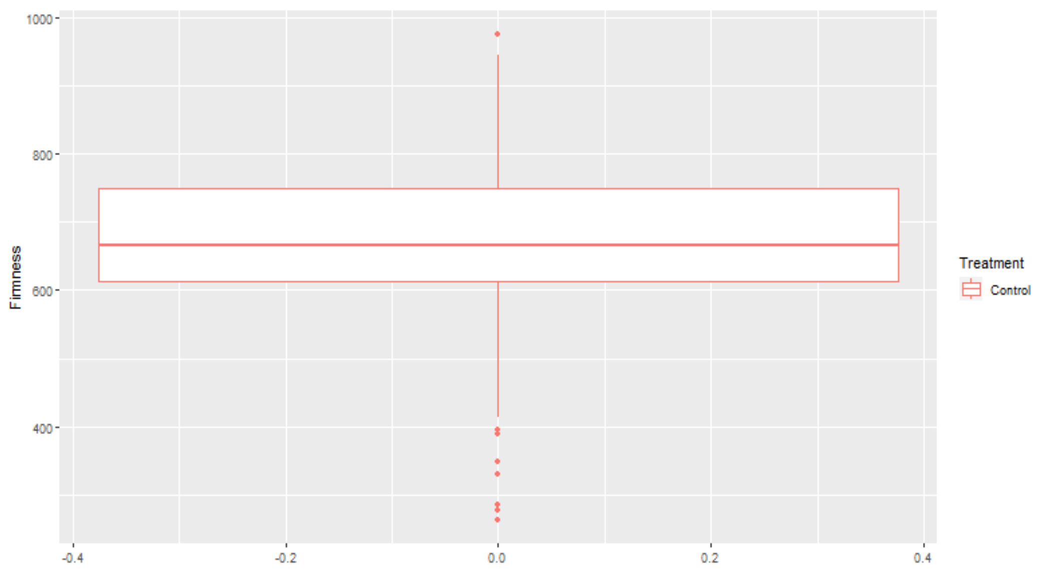
0 100

0 10 20 30 40 50 60 70 80 90 100

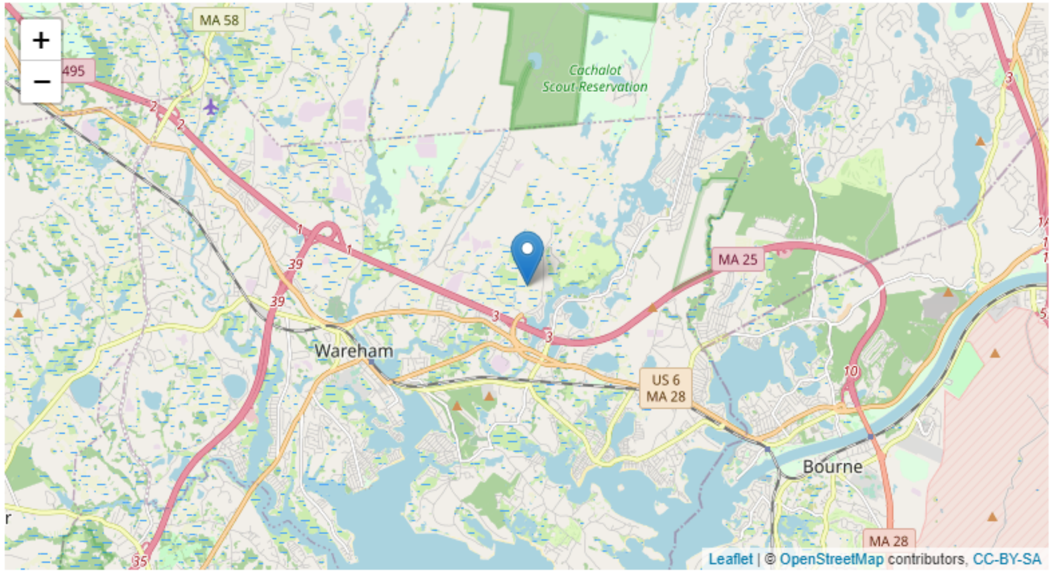
Management after the LW flood is withdrawn

- **Irrigation:** No need to irrigate (unless protecting for frost) for at least 2 weeks after the LW. Following this period, schedule irrigation based on soil moisture status determined by sensors or tensiometers.
- **Frost protection:**
  1-2 weeks flood : Protect the bogs for 27˚F
  > 2 weeks flood : Protect the bogs for 30˚F
- **Fertilizer use:**
  < 3 weeks flood : standard fertilizer regime
  > 3 weeks flood : Reduce N dose (30-40%) to avoid overgrowth
- **Fruit rot Fungicide use:**
  Use reduced recommended rate and less number of applications during the late water year and the following year.
  If one application to be made- apply at 50% bloom.
  If two applications are to be made- at 10% bloom and two weeks later.
- **Herbicide usage:**
  Casoron® (lower labelled rate @ <40 lbs/acre) and QuinStar may be applied once flood is withdrawn for dodder management.
  Quinstar® could also offer management of yellow loosestrife (YLS) and other broadleaf grasses. Up to two applications of QuinStar can be applied at 30 days interval @ 8.4 oz/acre.
  No other preemergence herbicides are recommended after LW.
  POST herbicides can be applied when weeds have emerged, according to the label.

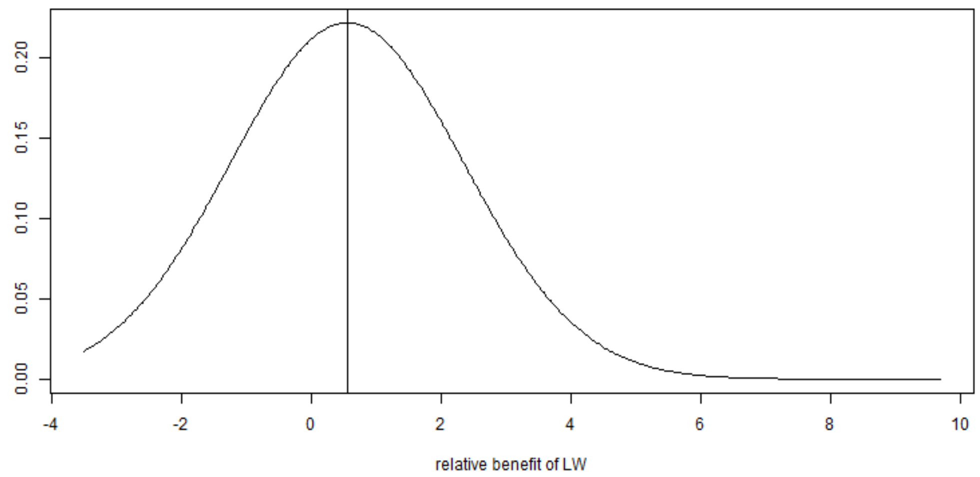
Fruit Firmness



Bog Map



LW Predicted Outcome



Improving Cranberry Fruit Quality by Understanding the Microclimate of the Bog

Cape Cod Cranberry Growers' Association

HORTAU

USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service

24 SE Massachusetts cranberry bogs

3-year project

Goals

Identify variables associated with fruit rot incidence and fruit quality

Determine the relative importance of microclimatic factors and their interrelationships

Develop easy-to-adopt, eco-friendly, crop management guidelines

Candidate Factors

Abiotic, (micro) climate, management-level, and plant-level

Sincere Thanks

MA Cranberry Growers

Dr. Salisu Sulley

Krystal Demoranville

Dr. Michael Nelson

Ms. Dawn Gates-Allen

Dr. Jyostna Devi Mura

Dr. Richard Belanger

Hortau Inc. and Cody Jones