Cornell AgriTech
New York State Agricultural Experiment Station

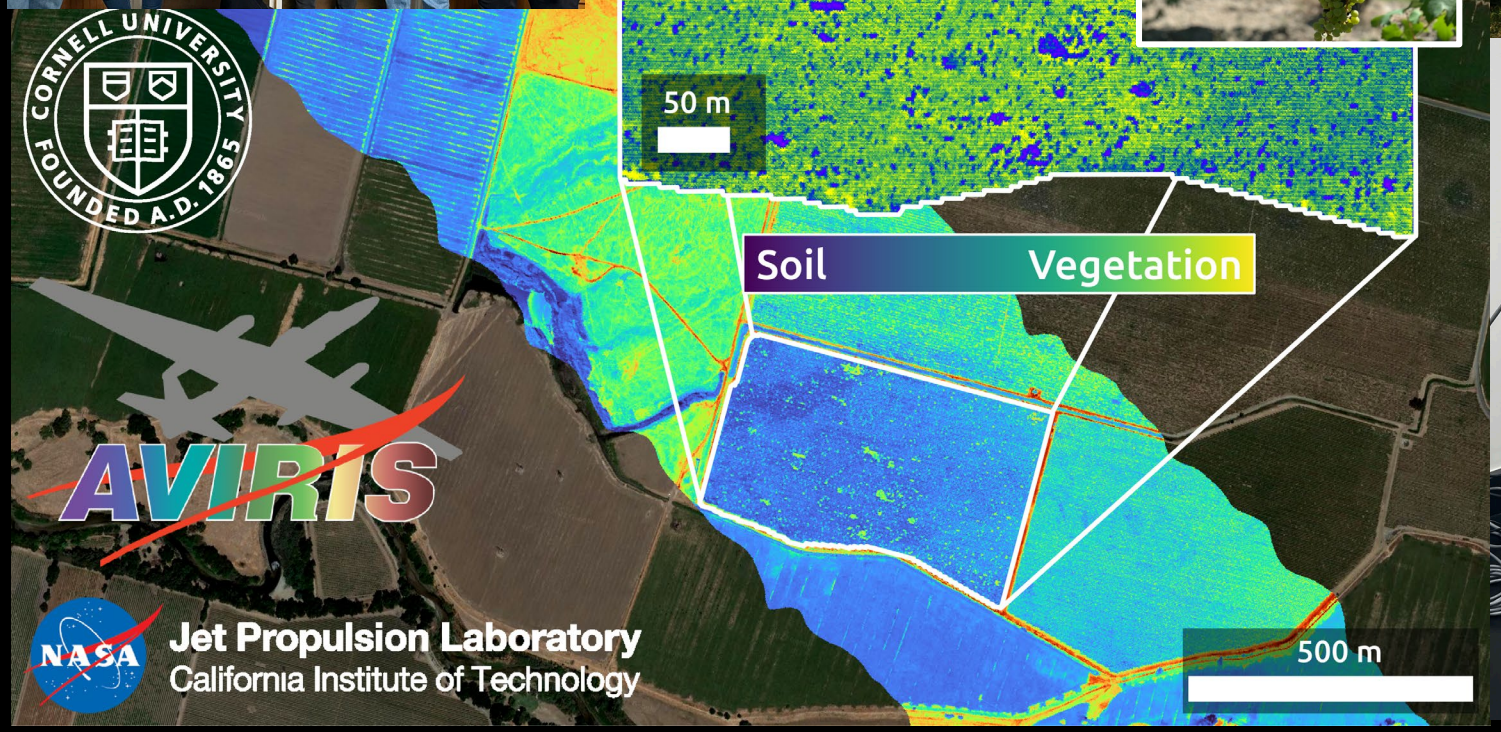
Biopesticides for Grape Disease Control

Dave Combs, Katie Gold, Wayne Wilcox
Cornell AgriTech
Geneva, NY

Cornell CALS
College of Agriculture and Life Sciences

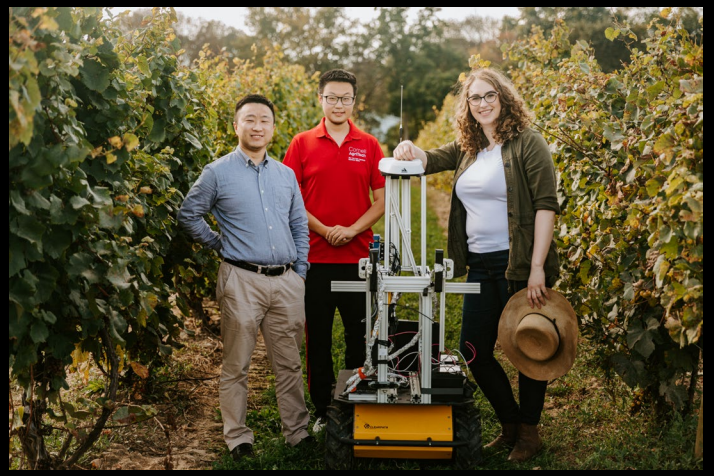
Grape Sensing, Pathology, and Extension at Cornell AgriTech

The Gold Lab



Katie Gold, katiegold@cornell.edu

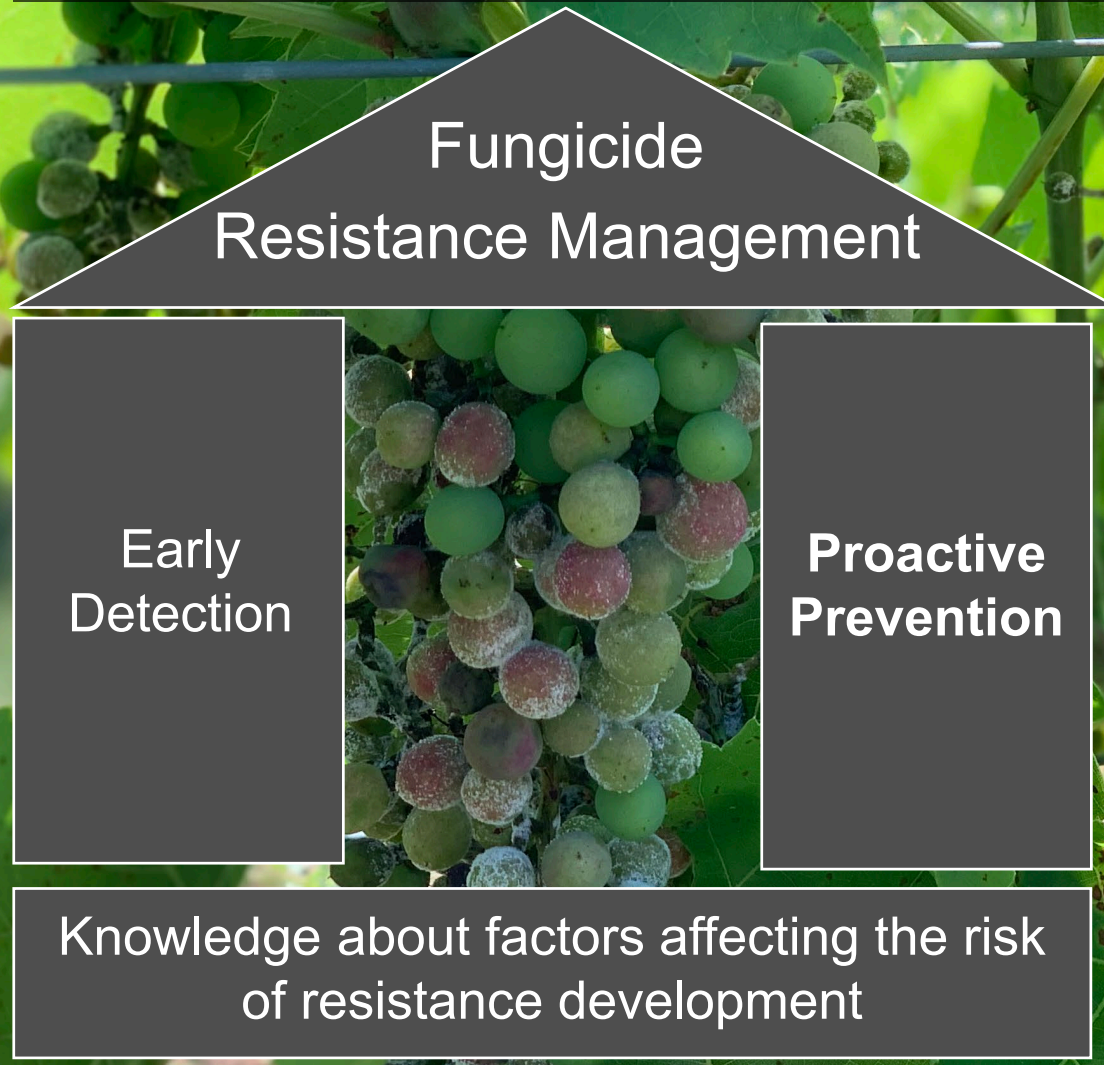
Cornell Pathology Vineyards in Geneva, NY



- 6 acres of fungicide efficacy trials for powdery mildew, downy mildew, black rot, botrytis, and phomopsis
- Applied disease management education
- FRAC40 resistance survey & management outreach
- Integrated sensor management

Cornell AgriTech
New York State Agricultural Experiment Station

Proactive protection is an important part of fungicide resistance management



1) What are biopesticides?
2) Use considerations
3) Historical performance

Adapted from Gambhir et al. 2021
Plant Health Progress

What is a biopesticide?

Pesticidal product derived from natural materials such as animals, plants, bacteria, and minerals

1) Biochemical
2) Microbial
3) Plant-incorporated protectant

Fastest growing market sector despite representing only 5% of the global market

Why so much interest?

- Less toxic than traditional chemistries
- Significantly less risk of off-target environmental effects
- Effective in small quantities, fast decomposition
- Logistics – short reentry interval, no pre-harvest interval restrictions
- No risk of pathogen resistance development

STARGUS® BIOFUNGICIDE

Romeo®

HOWLER™ fungicide

LIFEGARD® BIOLOGICAL PLANT ACTIVATOR

OSO FUNGICIDE

Biochemical pesticides

Naturally occurring substance that controls pests with “non-toxic” mechanisms

- Plants Extracts
  - Regalia, Thymegard, Timorex, Ecoswing
- Microbial Extracts
  - Oso, Romeo
- Oils and Mineral Compounds
  - Stylet Oil, Copper, Sulfur, Phos. Acid, Sil-Matrix

EcoSwing
BOTANICAL FUNGICIDE

Romeo®

OSO
FUNGICIDE

Microbial pesticides

Living microorganism

- Competition
  - Double Nickel, Stargus
- Parasitism/antibiosis
  - Howler
- Defense induction
  - Lifegard
- Plant growth promotion
  - Nutrol

Plant included protectants

- Uncommon in grape disease control
  - GMO
  - Example – Bt corn

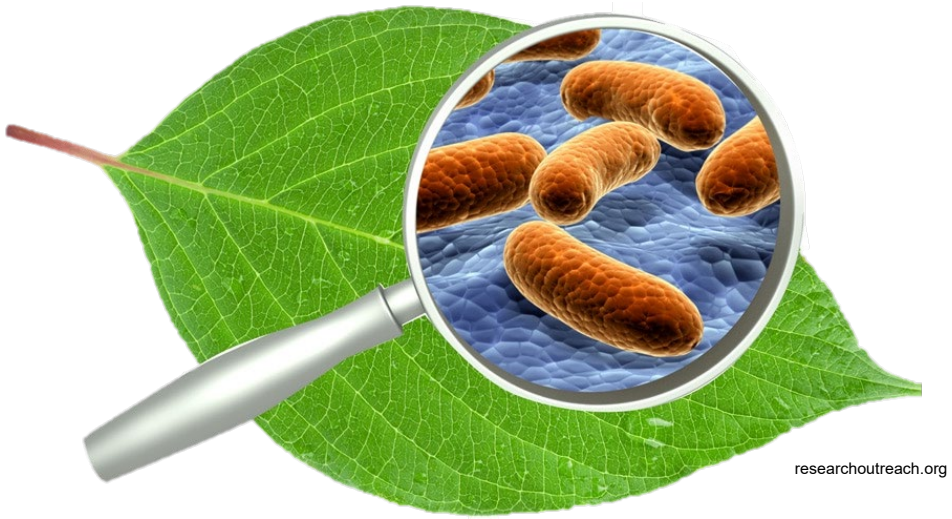
Remember…

Biopesticides work differently from traditional chemistries!

**Look out for biopesticides article in the next *Appellation Cornell*

Key differences between biopesticides and traditional chemistries

- Prophylactic applications- they are not rescue materials!
- Usually need more frequent applications
- Limitations:
  - May have shorter shelf life
  - Special storage conditions
  - Handling procedures
  - Smaller activity window



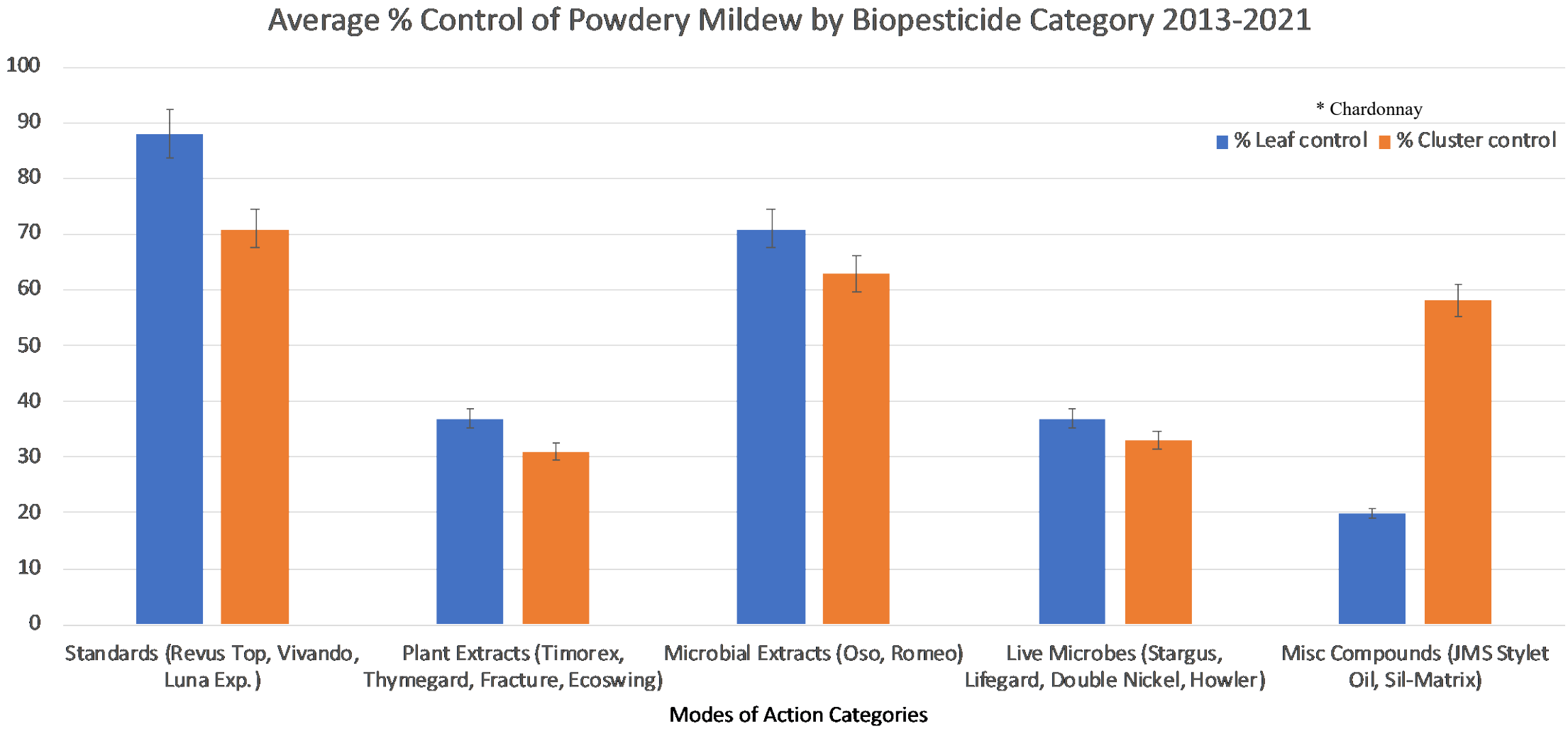
researchoutreach.org

The archives…

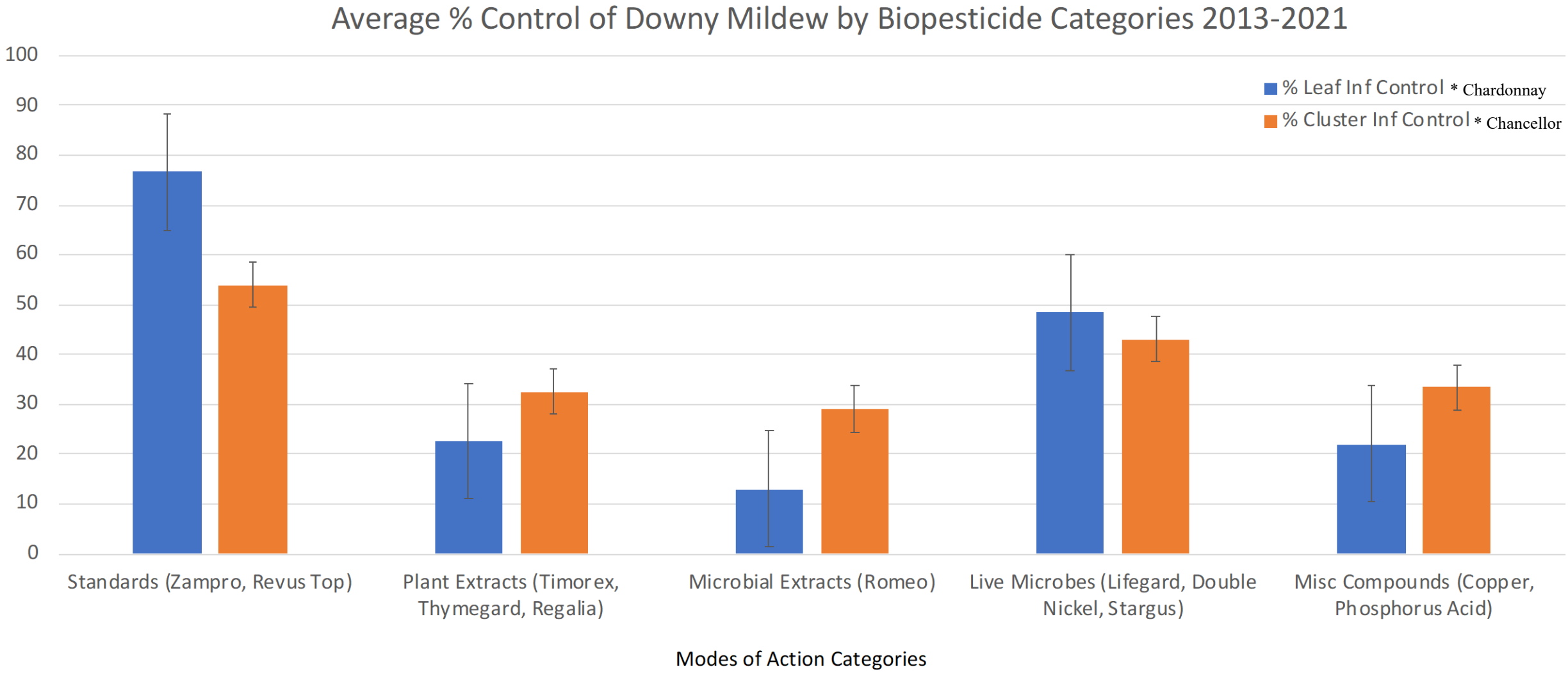
- Extensive data on:
  - Powdery mildew – 2013-2022
  - Downy mildew – 2013 -2022
- Moderate data on:
  - Black Rot - 2021-2022
  - Botrytis – 2013 – 2022 (fewer materials tested)
- Coming 2023
  - Phomopsis

Cornell Research Vineyard Sprayer

- Custom build for research applications
- 4 tanks, each has its own set of nozzles
- Sprays both sides of the vine simultaneously
- Covered to prevent drift

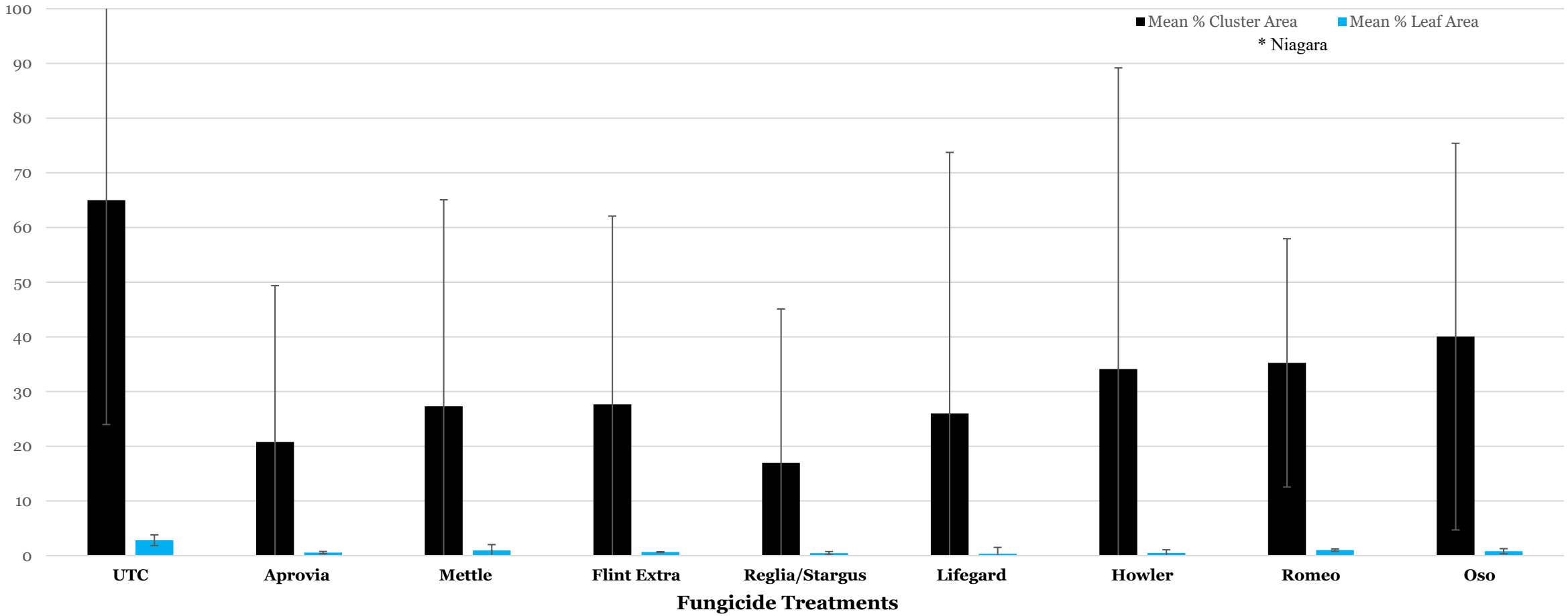


- Microbial extracts and miscellaneous compounds (cluster control only) tend to provide the best incidence control
- Live microbe bio-fungicides and plant extracts perform somewhat similar for both leaf and cluster control



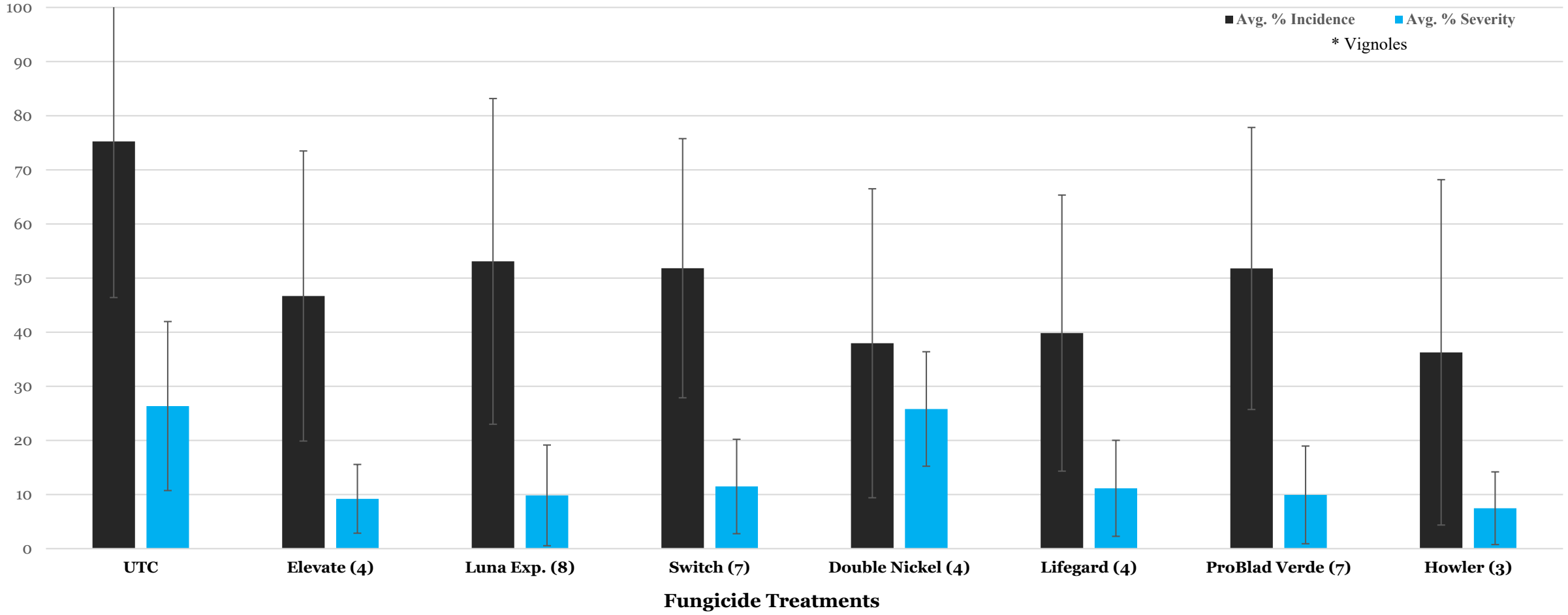
- Live microbes provide somewhat equivalent control
- Biopesticides tend to provide better cluster control than foliar control

Average % of Black Rot Damage 2021-2022



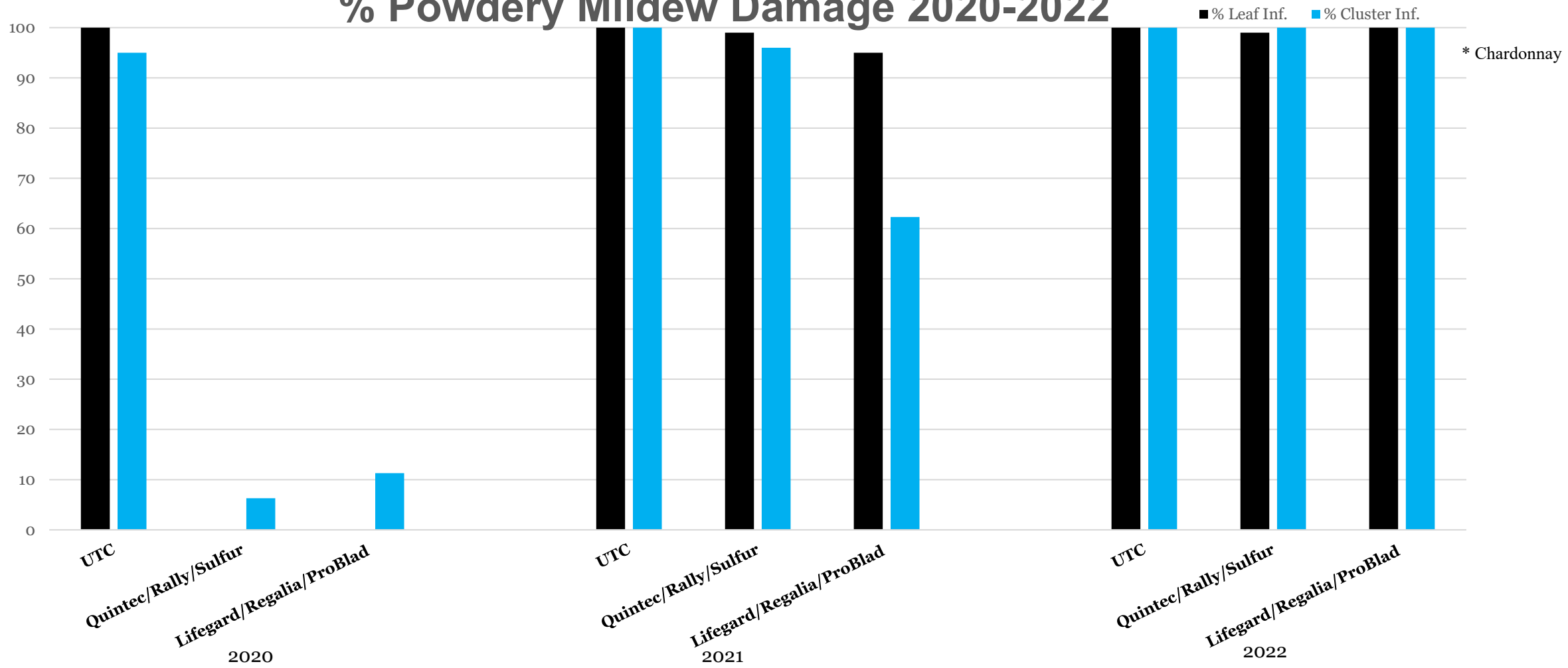
- Biofungicides controlled black rot, as well or better than conventional materials
- Cluster incidence higher than foliar
- Trial conducted on Niagara

Average % Botrytis Damage 2014-2022 (# years)



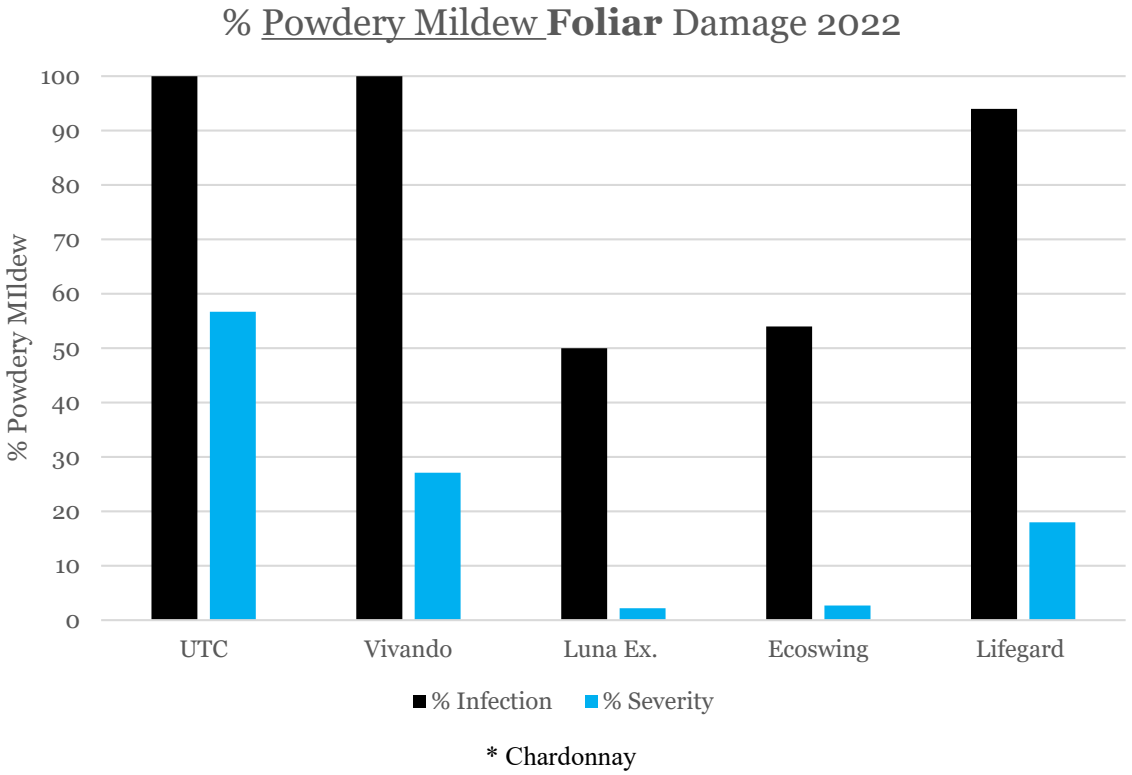
- Biofungicides controlled botrytis incidence comparably to conventional materials
- Only 1 trt comparable to UTC for severity
- Trial conducted on Vignoles

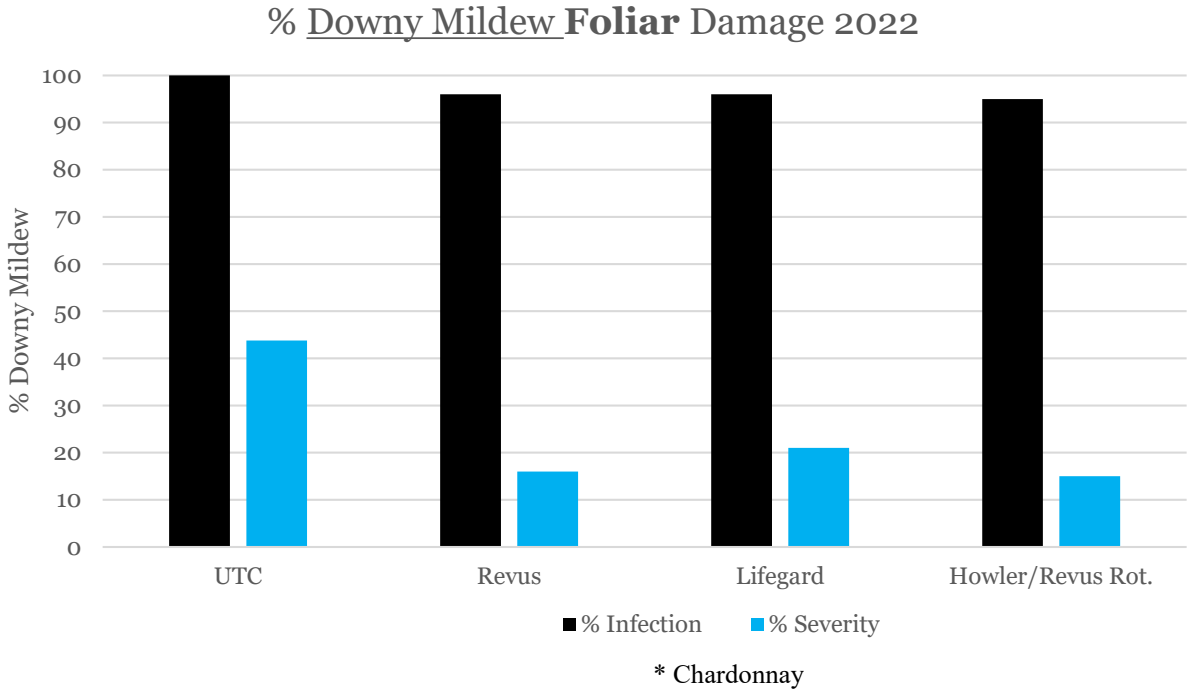
% Powdery Mildew Damage 2020-2022



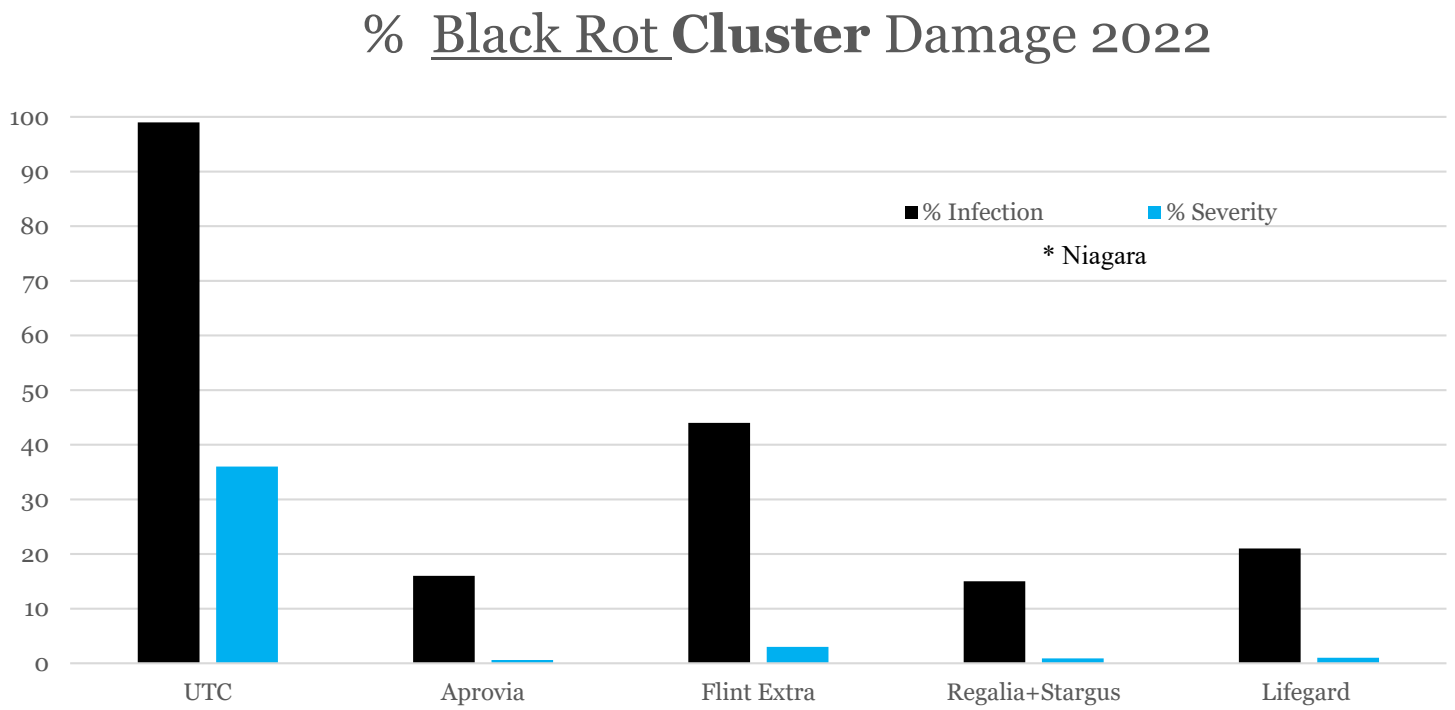
- 2020 – low pressure – comparison combo programs worked well
- 2021/22 – high pressure –all materials failed
- Know limitations and when to intervene
- Trial conducted on Chardonnay

Conventional vs. Biopesticides in 2022





Conventional vs. Biopesticides in 2022



The story so far

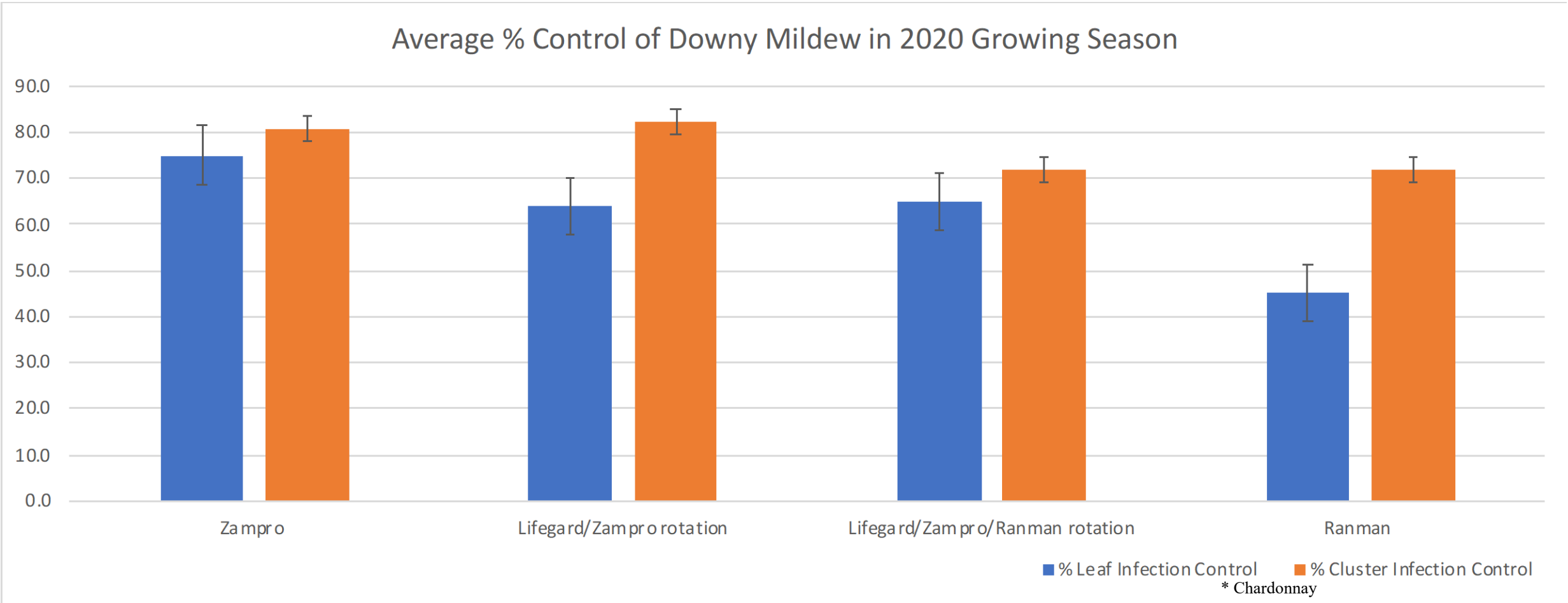
- Our data shows that biopesticides add the most value when used as rotational materials with conventional chemistries
- In certain cases we see comparable control to conventional when used correctly

- Can biopesticides be used alone? Yes, but…
  - Know limitations
  - Critical disease windows may require intervention
  - More frequent applications
  - Know what materials are effective on what pathogens
- Are they organically approved?
  - Most are, or are pending approval

Why use biopesticides?

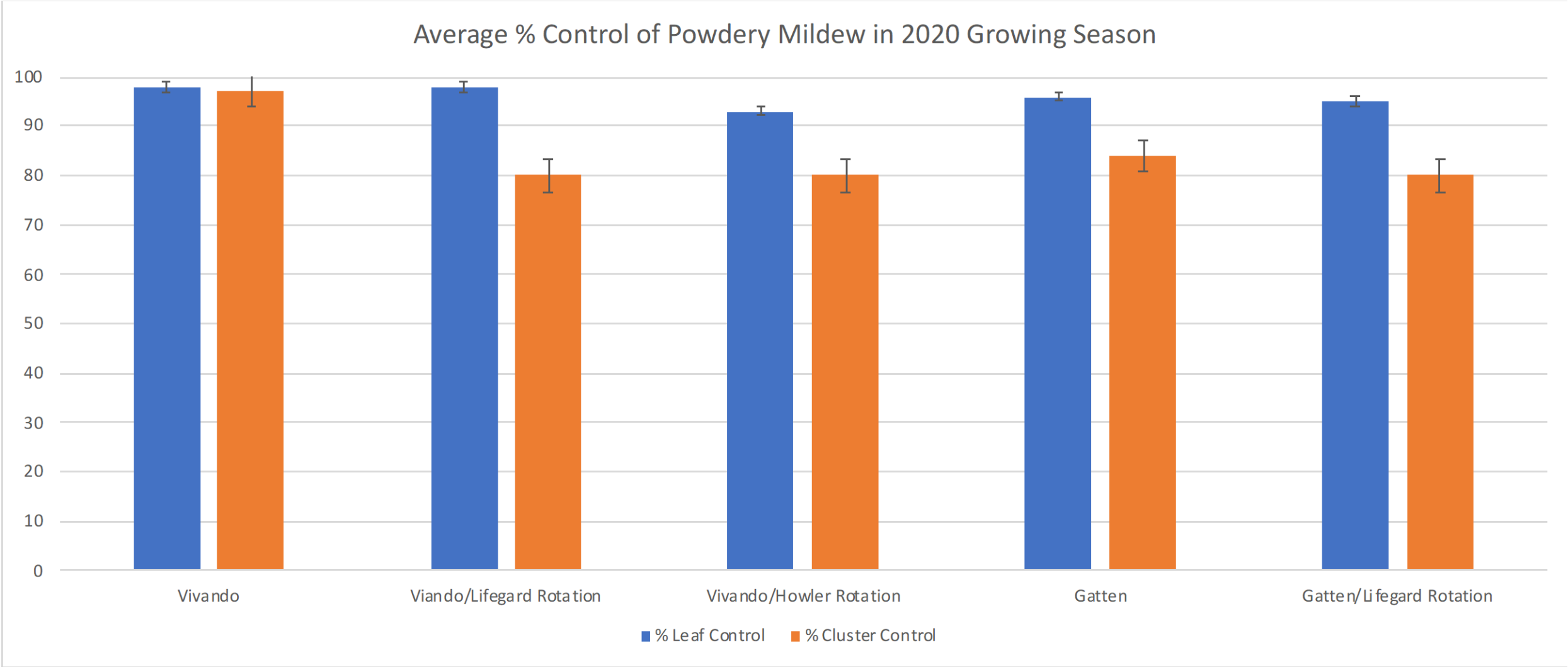
- They work!
- No off-target effects
- Logistics – short reentry interval, no pre-harvest interval restrictions
- No risk of pathogen resistance development
- **Most importantly- can reduce conventional pesticide usage while maintaining crop quality and yield**

Using biopesticides can help preserve the longevity of highly effective conventional fungicides for grape disease control!



* Chardonnay

Addition of Lifegard reduces synthetic chemistry input while still maintaining comparable control

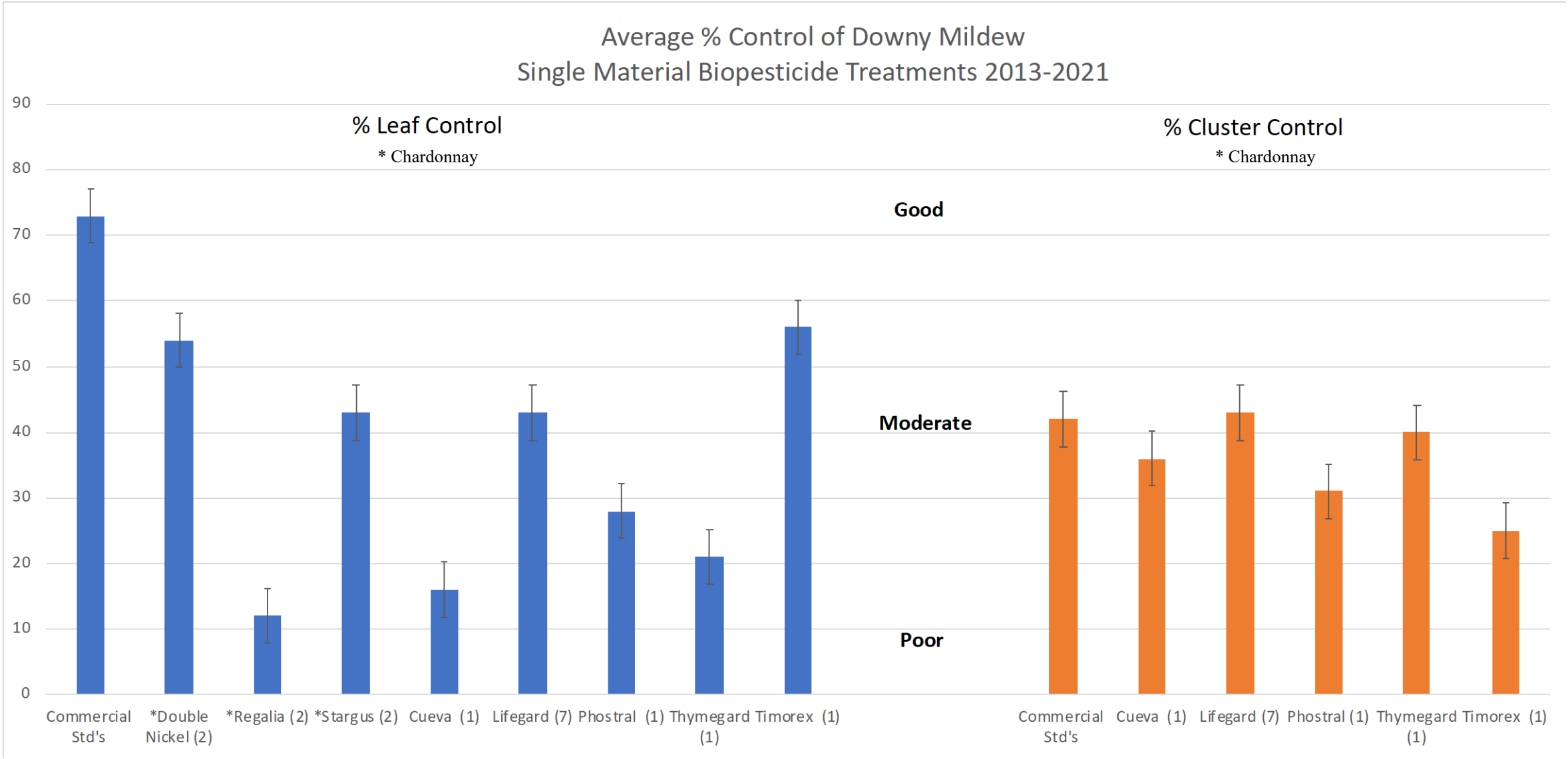


* Chardonnay

Addition of different biopesticides reduces synthetic chemistry input while still maintaining comparable control

However… downy mildew is driving factor in eastern vineyards

- Fair amount of biopesticides that control powdery mildew (Sulfur, Oil, Nutrol)
- Downy mildew is likely the biggest challenge going forward
- Resistance to FRAC 40 materials documented
- How well do they work?
  - Keep in mind, Cornell test vineyard will be the worst scenario these materials will likely ever attempt to control



- Some materials comparable to commercial standards
- # years consistently tested is low, will improve over time

Choose Your Battles

- not all materials work on all diseases

- some materials have not been extensively tested

- initial data looks promising, but needs further testing

- new materials entering vineyard testing in 2023

Type	Name	Disease	% Leaf Control	% Cluster Control	Years Tested
Live Microbe	Double Nickel *Competition*	DM	54	NA	2
		PM	31	15	4
		BOT	NA	35	4
	Stargus *Competition*	DM	43	NA	2
		PM	79	69	1
		BOT	NA	13	1
	Lifegard *Defense Activation*	DM	43	43	7
		PM	54	43	5
		BR	58	1	1
		BOT	NA	43	5
	Howler *Antibiosis & Competition*	BR	78	24.5	1
		BOT	NA	65	2
Plant Extract	Regalia	DM	12	NA	2
	Thymeguard	DM	21	40	1
		PM	0	0	1
		BOT	NA	24	1
	Timorex	DM	56	25	1
		PM	35	25	2
		BOT	NA	31	1
	Ecoswing	PM	11	39	1
		BOT	NA	100	1
	Fracture/ProBlad Verde	PM	100	61	2
		BOT	NA	35	7
Microbial Extract	Oso	PM	88	72	1
		BR	45	0	1
		BOT	NA	0	1
	Romeo	DM	13	29	2
		PM	53	53	2
		BR	16	6	1
Misc.	Cueva	DM	16	36	1
	Phostrol	DM	28	31	1
	Stylet Oil	PM	40	30	2
		BOT	NA	30	1
	Silmatrix	PM	0.3	87	1

Cost comparison of commonly used biofungicides and conventional fungicides. (mid-range label rates)

Material	$/A
Cueva	$42
Double Nickel	$21
Ecoswing	$44
Howler	$43
Lifegard	$34
Oso	$36

Material	$/A
Phos. Acid	$21
Stylet Oil	$29
Sil-Matrix	$30
Stargus	$62
Regalia	$73

Material	$/A
Gatten	$26
Revus	$25
Revus Top	$18
Vivando	$24
Zampro	$38

Average cost of biofungicides	$40/A
Average cost of biofungicides (minus 2 outliers)	$33/A
Average cost of conventional fungicides	$26/A

Cost comparison is only for the materials listed

Key Takeaways

- Biopesticides are a practical and useful tool in vineyard disease management
- Efficacy has improved with new innovative materials
- Fundamentally different MoAs than conventional chemistry
  - Resistance to biopesticides is unlikely
- Protectants, not rescue materials
- In low to moderate disease pressure, biopesticides tend to work as well as conventionals
- However, they struggle in high pressure
- Biopesticides generally add the most value as a rotational partners

Future Research

- Tank mixing biopesticides and conventional materials?
  - Benefit or bust?
  - Common practice among growers in 22’
- Cultivar specific biopesticide testing arena
  - Does varietal/disease susceptibility make a large impact on efficacy?
- Multiple disease efficacy trials
  - Can we use biopesticides for complete hybrid disease control?

Our new Traminettes, est. 2022!

Cornell AgriTech

New York State Agricultural Experiment Station

- USDA Specialty Crop Block Grant toNY
- New York Farm Viability Institute
- New York Wine & Grape Foundation
- Allied industry support

- Gold Lab Staff and Students
  - Angela Paul
  - Alex Walbridge
  - Jonas Compagna
  - Erik Winarski

dbc10@cornell.edu

USDA

Boldly. NY.
NEW YORK WINE & GRAPE FOUNDATION

CW
CanandaiguaWine

NY farm viability INSTITUTE