



# Highlights from *“Control-Alt-Delete”* Alternaria Leaf Spot and Head Rot in Broccoli Project

**Susan B. Scheufele**

New England Fruit & Vegetable Conference  
December 19, 2024

UMassAmh

Extension



# Early symptoms



# Disease Progression



# Disease Spread

Can be **seed-borne**

☐ Hot-water seed treatment

**Overwinters** in crop residue

☐ 3 yr rotation  $\geq 1\text{km}$

**Spores** spread by wind,  
rainsplash, FB.



# Environment

Cool and wet conditions  
55-75°F

9+ hours **leaf wetness**  
= overnight dew

- Dense spacing
- Succession plantings
- Weeds
- Overhead Irrigation



# Alternaria Management

## Prevention

- Crop rotation (3 years)
- Hot water seed treatment
- Tolerant varieties**





# Alternaria Management

## Prevention

- Crop rotation (3 years)
- Hot water seed treatment

## •Tolerant varieties

Wolfman,  
Green Magic,  
Eastern Crown,  
Abrams,  
Covina

## June Planting

% of heads	Minimally Marketable	High-Quality
>90%	Eastern Crown, Green Magic, Wolfman	Wolfman
80–90%	Abrams, Imperial, SakExp1	Eastern Crown, Green Magic
70–80%	Covina, SakExp2	Abrams
50–70%	Castle Dome, Monty, SakExp3, Thompson	Castle Dome, Covina, Imperial, Monty, SakExp1
25–50%	Belstar, Gypsy, Luna	Belstar, Gypsy, Luna, SakExp2, SakExp3, Thompson
<10%	Ironman, Jacaranda	Ironman, Jacaranda

## August Planting

% of heads	Minimally Marketable	High-Quality
>90%	Belstar	Belstar
80–90%	Covina	Covina
70–80%	SakExp1	
50–70%	Abrams, Diplomat, Imperial, Eastern Crown, SakExp3, Thompson	SakExp1
20–50%	Asteroid, Endurance, Green Magic, Luna, Marathon, Wolfman	Abrams, Asteroid, Diplomat, Eastern Crown, Green Magic, Luna, Imperial, Marathon, SakExp3, Thompson, Wolfman
<10%	Castle Dome, Monty	Castle Dome, Endurance, Monty

*Natalie Hoidal, Charlie Rohwer, Nico Enjalbert & 88 farmers and gardeners*

# Alternaria Management

Reduce disease severity and spread

- Control weeds
- Increase spacing in fall
- Drip irrigation
- Don't work in wet fields
- Control flea beetles





# Ctrl/Alt/Delete Acknowledgements

- 4-year project (USDA-SCRI)
- Researchers from Georgia, New York, Nebraska, Virginia
- Cabbage research and development program
- Smart Lab members
- Grower cooperators
- Cornell Coop Extension and IPM Educators
- NYS Dept of Ag and Mkts
- USDA

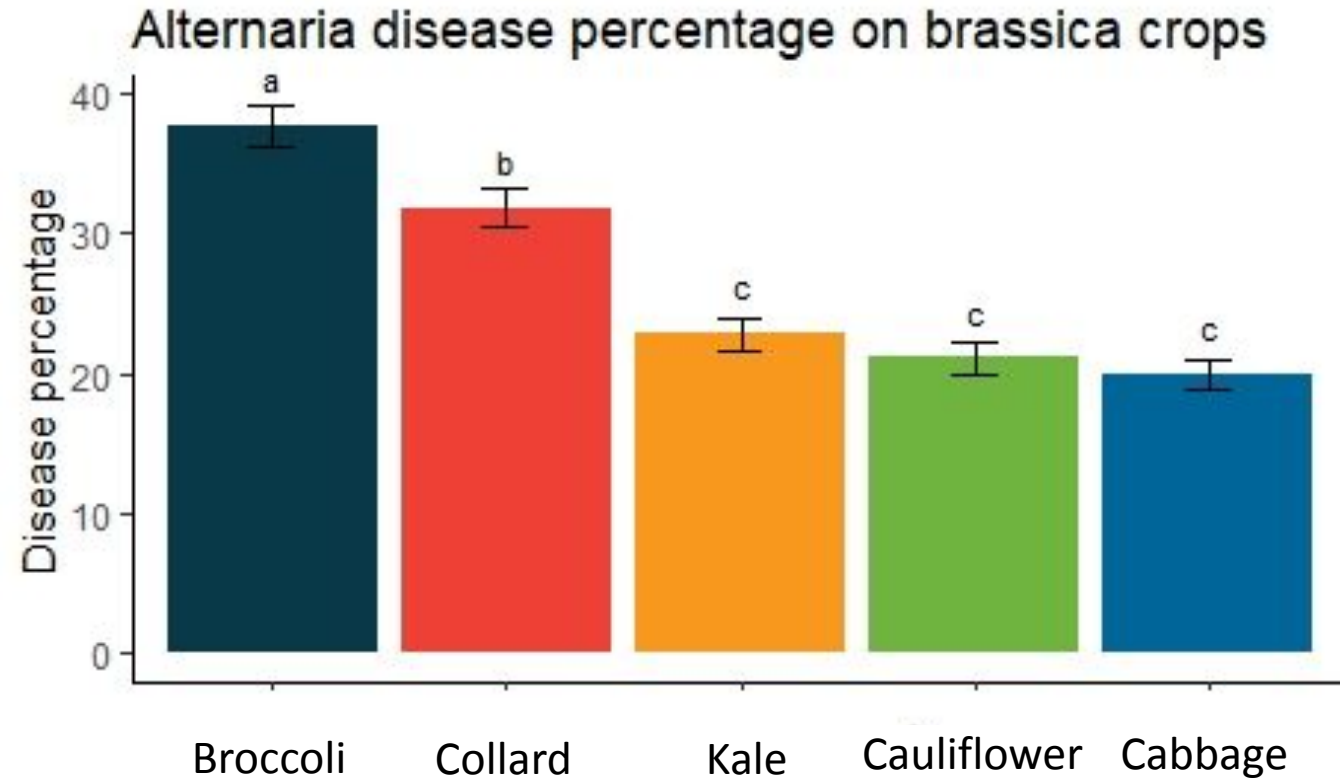


Dr. Chris Smart  
Christy Hoepting  
*Cornell University*

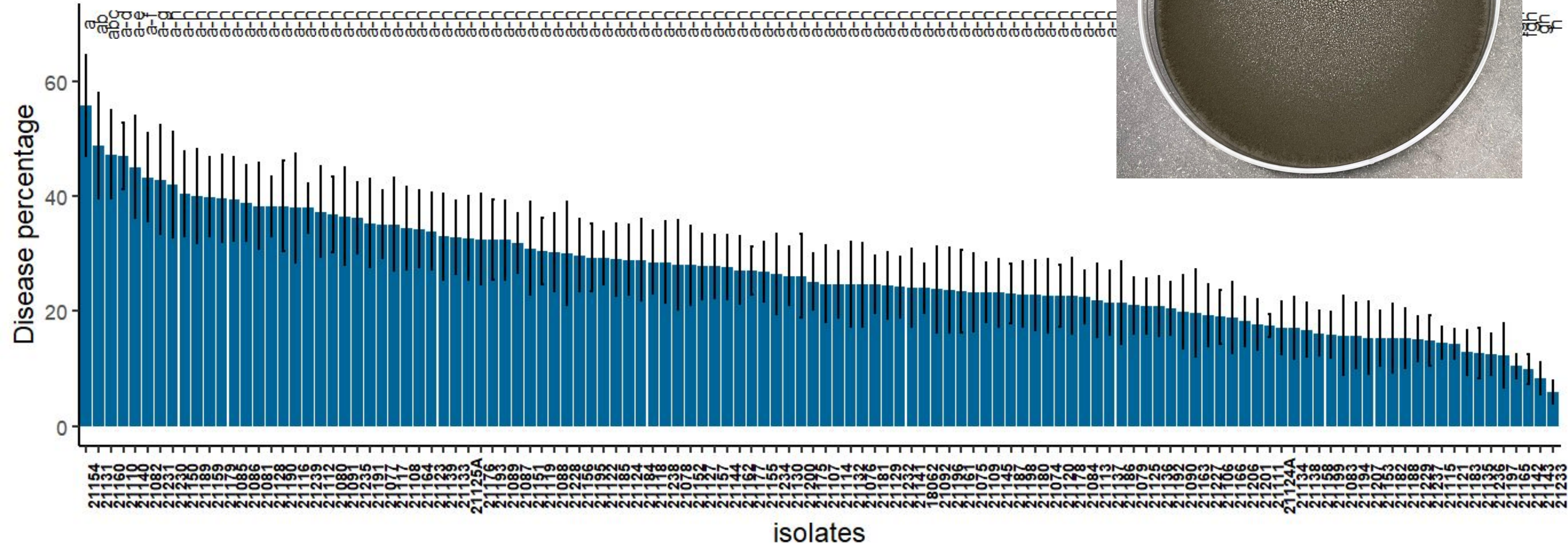


# Pathogenicity assay

- Broccoli was the most susceptible of the 5 crops tested
- All 119 *A. brassicicola* isolates were pathogenic on broccoli



# Aggressiveness of isolates



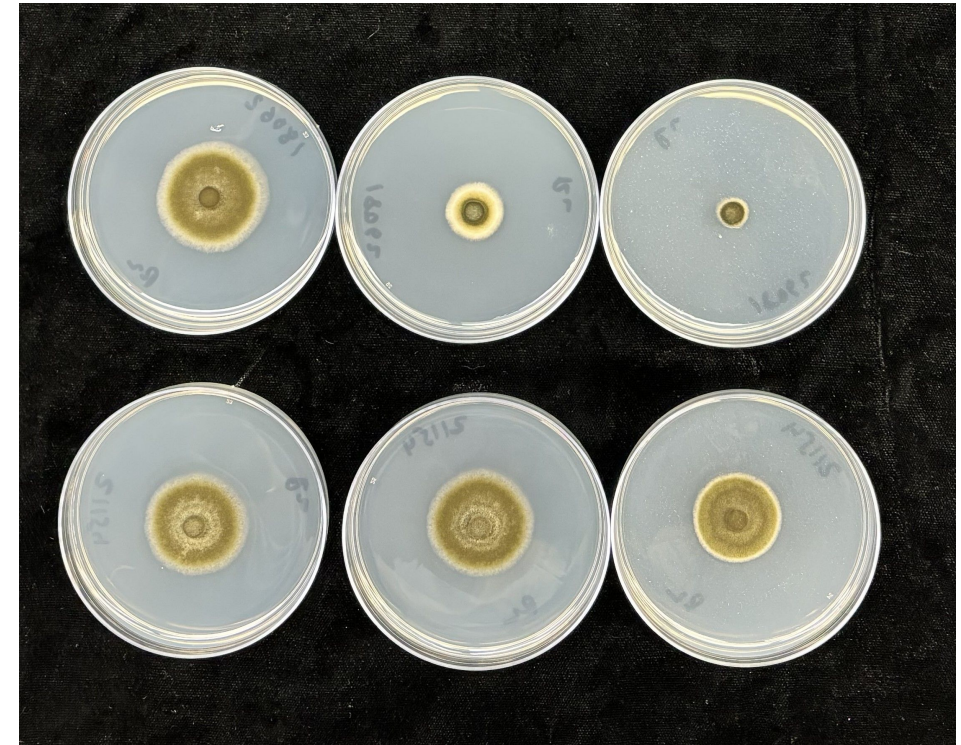
# Boscalid sensitivity in NY

- 58 out of 86 isolates were resistant to Endura (boscalid, Group 7)
- A few samples collected were *A. alternata*, and those showed resistance to azoxystrobin (Quadris, group 11).
- All *A. brassicicola* samples were sensitive to Quadris

Boscalid concentration  
0            0.5            50  
μg/ml      μg/ml      μg/ml

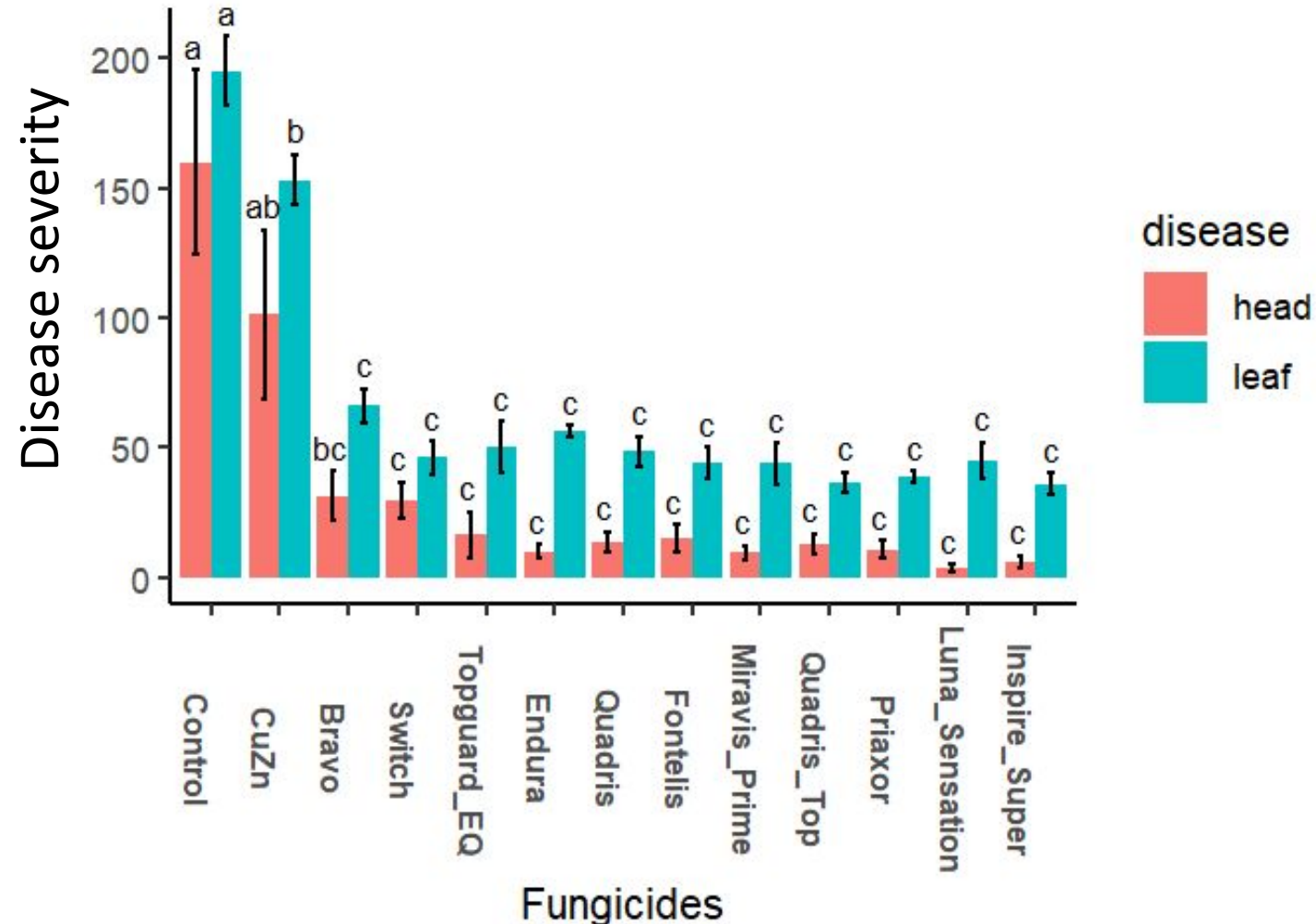
Sensitive Isolate

Resistant Isolate

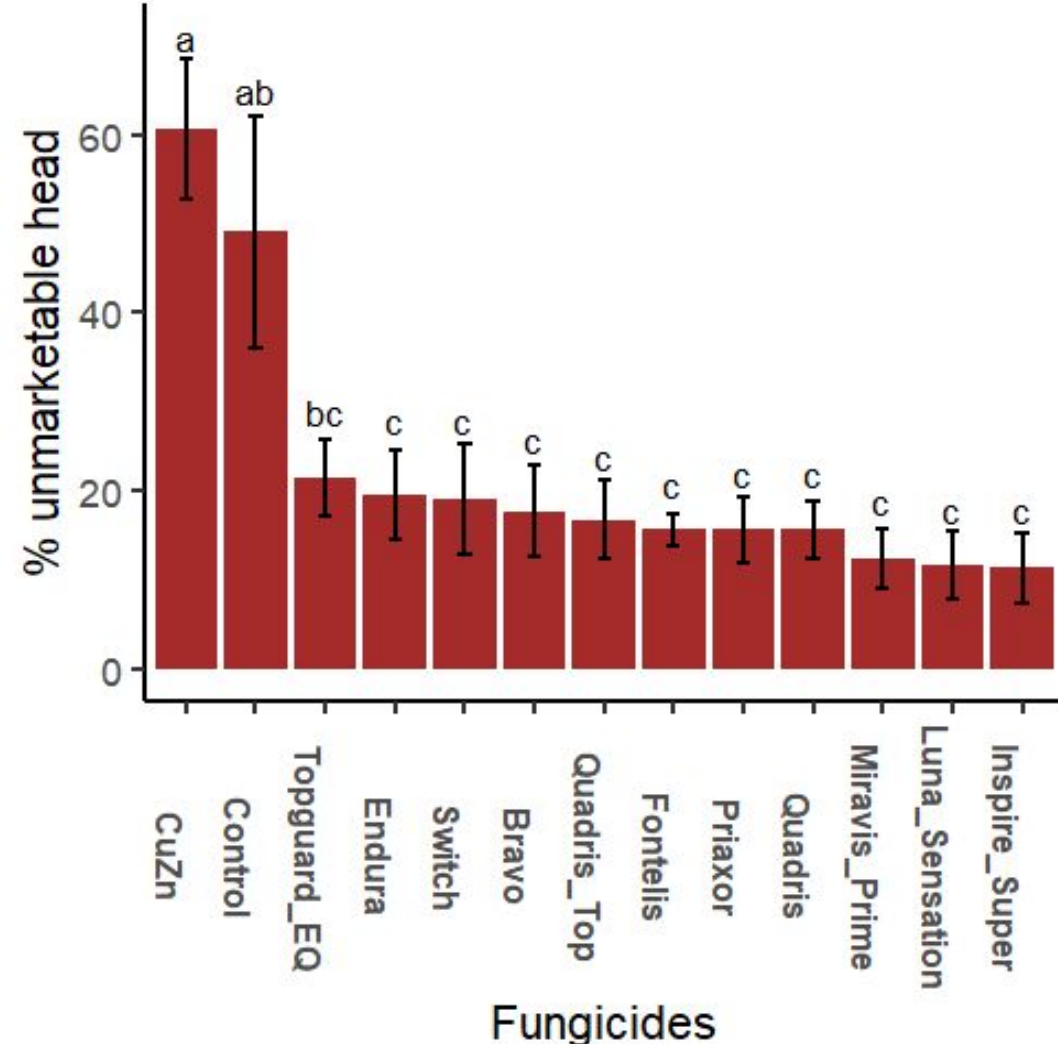


# Conventional fungicide trial results – NY 2022

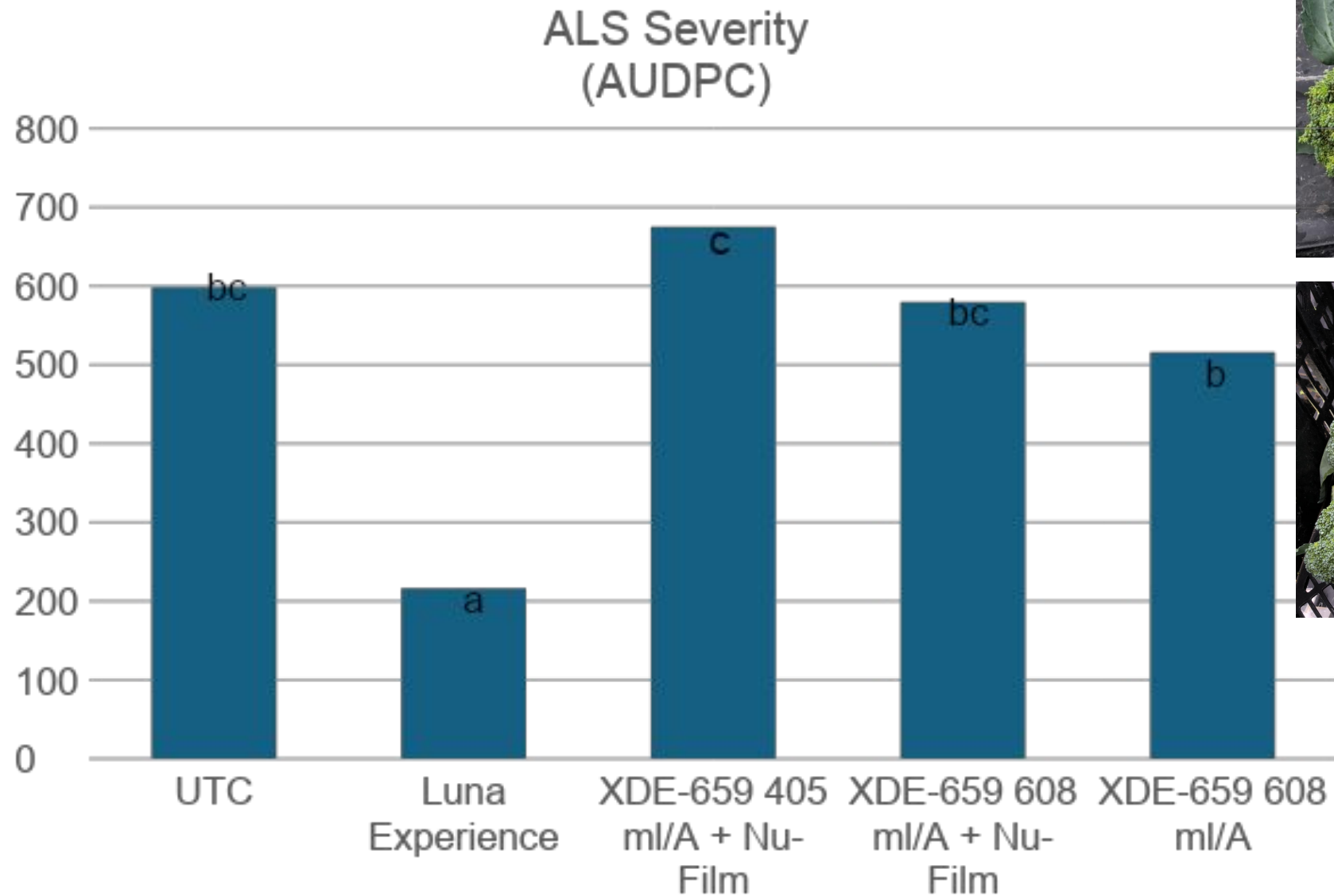
## Leaf and head disease severity



## Percentage of unmarketable heads

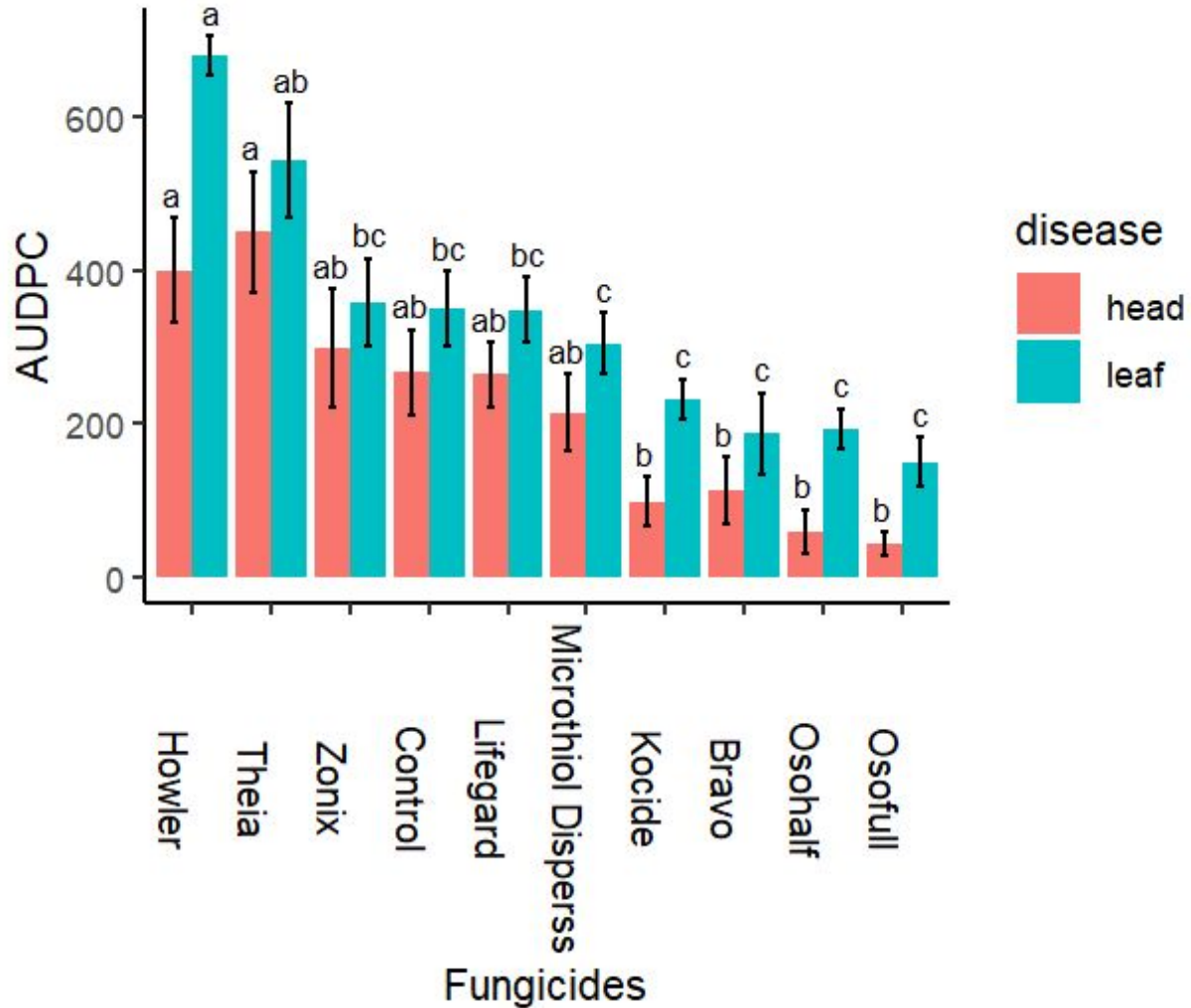


# Conv. Fungicide Trail-UMass 2022

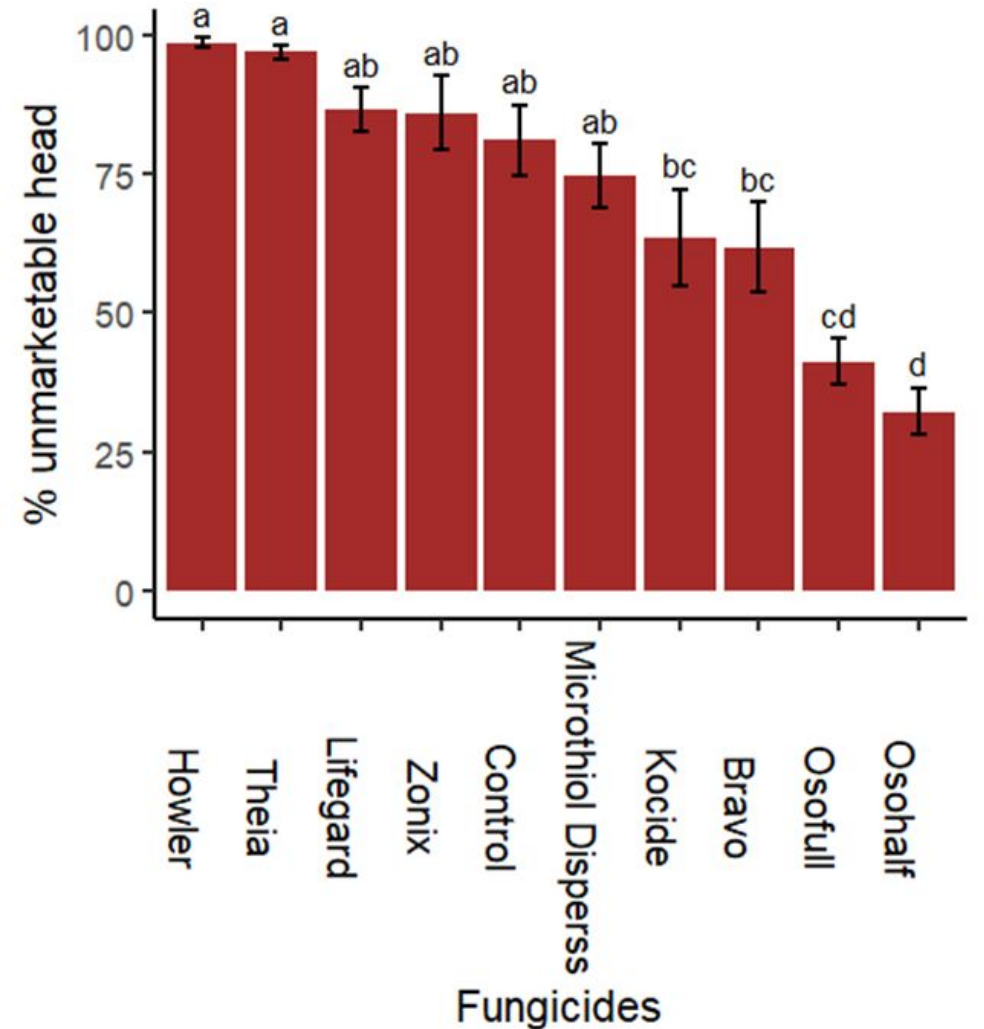


# Organic Fungicide Trial - Cornell 2022

Leaf and head disease severity

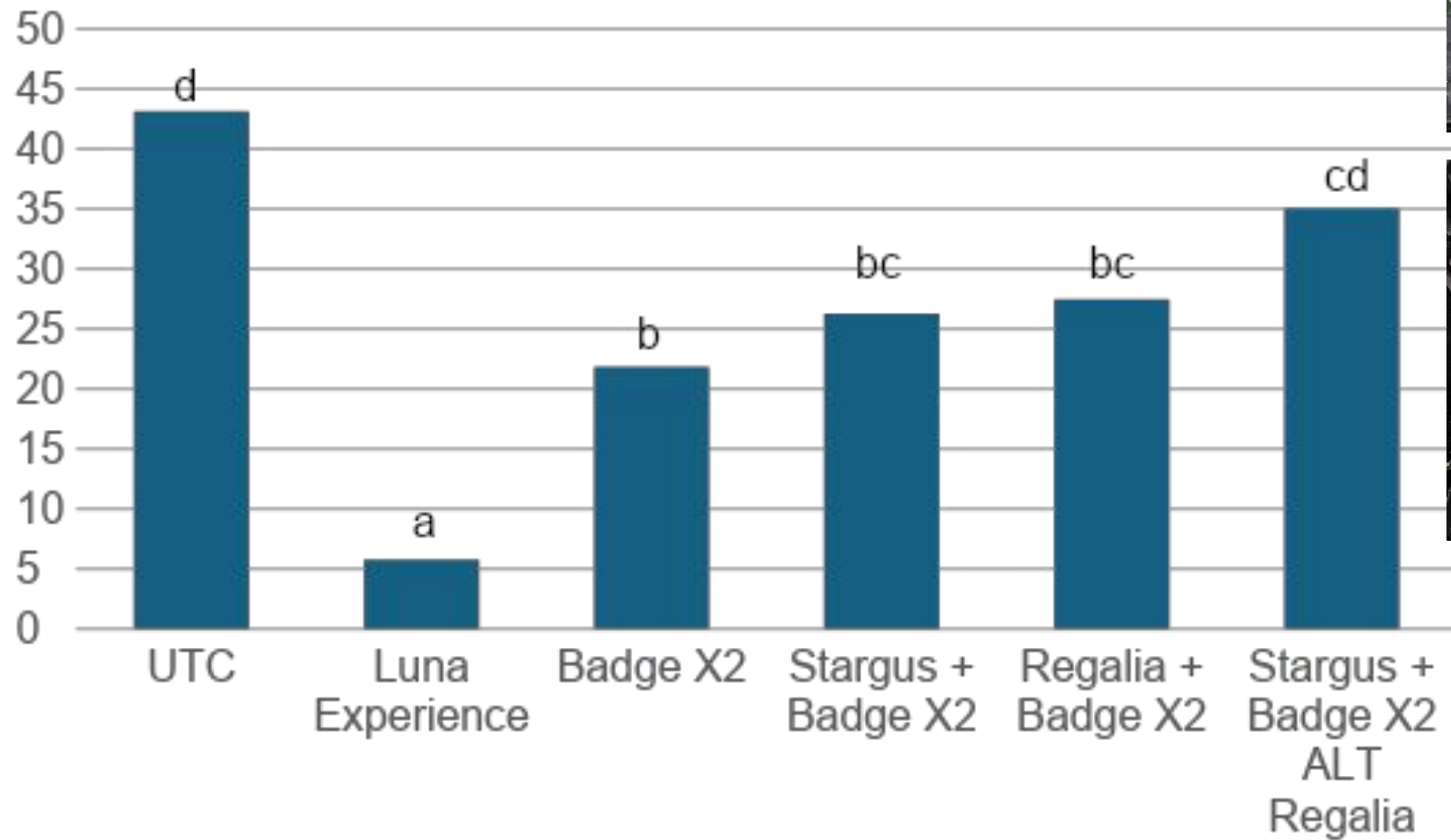


Percentage of unmarketable heads



# Organic Fungicide Trail-UMass 2021

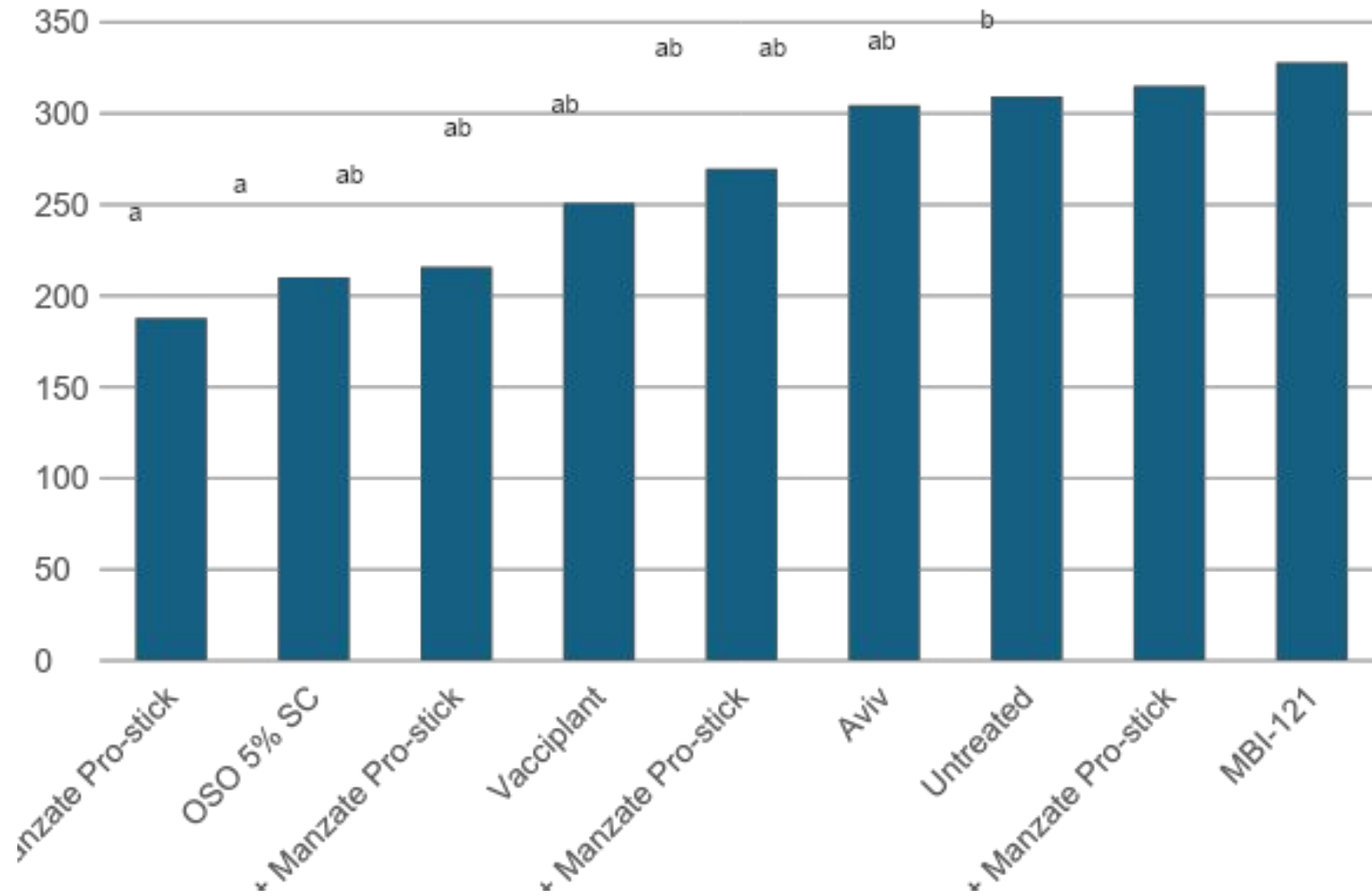
Broccoli Head Rot Severity (%)





# Organic Fungicide Trail-UMass 2022

2022 Broccoli AUDPC



# Chemical control

- **Group 3:** Tilt, Rhyme, Procure
- **Group 11:** Quadris, Cabrio, Flint, Reason
- **Group 7:** Fontelis, Endura
- Inspire Super (9+3)
- Switch (9+12)
- Luna Sensation (7+11)
- Priaxor Xemium (7 + 11)
- Miravis Prime (7 + 12)
- Velum Prime (7)
- Quadris Top (7 + 11)
- <sup>OG</sup>Copper hydroxide
- <sup>OG</sup>OSO



Christy Hoepting's  
"Cheat Sheet"





# FRAC Groups on front page of label

## Priaxor® Xemium® Brand Fungicide

Classified for  
"RESTRICTED USE"  
in New York State  
under 6NYCRR Part 326

Group 7 11 Fungicide

ACCEPTED  
FOR REGISTRATION  
AUG 25 2017

New York State Department  
of Environmental Conservation  
Division of Materials Management  
Pesticide Product Registration

For disease control and plant health in the following crops: alfalfa, barley, Brassica leafy vegetables, citrus fruit, corn (all types), cotton, dried shelled peas and beans, edible-podded legume vegetables, fruiting vegetables (including tomato), grass grown for seed, oats, oilseed crops (flax seed, rapeseed, safflower, and sunflower), peanut, rye, sorghum and millet, soybean, succulent shelled peas and beans, sugar beet, sugarcane, tuberous and corm vegetables (potato), wheat and triticale

Powered by Xemium® and F500® fungicides

### Active Ingredients:

fluxapyroxad\*: 1*H*-Pyrazole-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-(3',4',5'-trifluoro[1,1'-biphenyl]-2-yl)-..... 14.33%

pyraclostrobin\*\*: (carbamic acid, [2-[[[1-(4-chlorophenyl)-1*H*-pyrazol-3-yl]oxy]methyl]phenyl]methoxy-, methyl ester)..... 28.58%

Other Ingredients:..... 57.09%

Total:..... 100.00%

\* Equivalent to 1.39 pounds of fluxapyroxad per gallon

\*\* Equivalent to 2.78 pounds of pyraclostrobin per gallon

EPA Reg. No. 7969-311

EPA Est. No. 51036-GA-001

KEEP OUT OF REACH OF CHILDREN  
CAUTION/PRECAUCION

Doc ID: 553056

# Chemical control

## PHI 7 days

- Fontelis (7)
- Rhyme (3)
- Bravo (M05)
- Inspire Super (9+3)
- Switch (9+12)
- [Miravis Prime \(7 + 12\)](#)

## PHI 3 days

- [Priaxor Xemium \(7 + 11\)](#)

## PHI 2 days

- Reason (11)

## PHI 1 day

- Quadris Top (11 + 3)
- Procure (3)

## PHI 0 days

- Cabrio (11)
- Endura (7)
- Quadris (11)
- [Velum Prime \(7\)](#)
- [Luna Sensation \(7+11\)](#)
- <sup>OG</sup>Copper hydroxide
- <sup>OG</sup>OSO



Christy Hoepting's  
"Cheat Sheet"





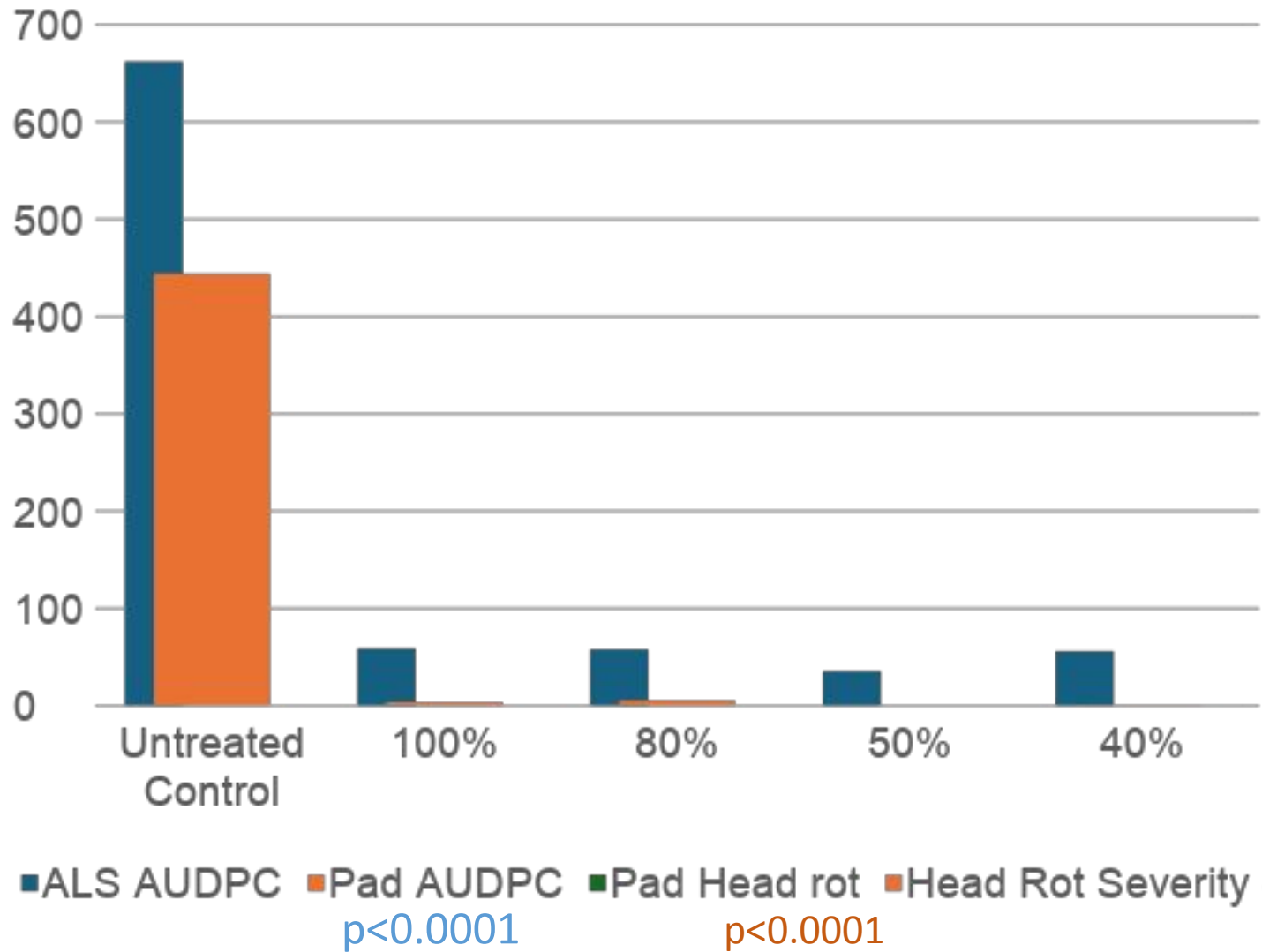
**Table 2. Crop-specific Directions: Foliar Applications** *(continued)*

Crop	Target Disease	Product Use Rate per Application (fl ozs/A)	Maximum Number of Applications per Year	Maximum Product Rate per Year (fl ozs/A)	Minimum Time from Application to Harvest (PHI) (days)
<p><b>Brassica leafy vegetables crop subgroups 5A and 5B</b></p> <p><b>Head and stem crop subgroup 5A</b></p> <p>Broccoli</p> <p>Broccoli, Chinese</p> <p>Brussels sprouts</p> <p>Cabbage</p> <p>Cabbage, Chinese</p> <p>Cabbage, Chinese mustard</p> <p>Cauliflower</p> <p>Cavalo broccolo</p> <p>Kohlrabi</p> <p><b>Leafy greens crop subgroup 5B</b></p> <p>Broccoli raab</p> <p>Chinese cabbage (bok choy)</p> <p>Collards</p> <p>Kale</p> <p>Mizuna</p> <p>Mustard greens</p> <p>Mustard spinach</p> <p>Rape greens</p>	<p>Alternaria leaf spot (<i>Alternaria</i> spp.)</p> <p>Anthracnose (<i>Colletotrichum</i> spp.)</p> <p>Black leg (<i>Phoma lingam</i>)</p> <p>Cercospora leaf spot (<i>Cercospora brassicicola</i>)</p> <p>Powdery mildew (<i>Erysiphe</i> spp.)</p> <p>Rhizoctonia blight (<i>Rhizoctonia solani</i>)</p> <p>Ring spot (<i>Mycosphaerella brassicicola</i>)</p> <p>White leaf spot (<i>Pseudocercospora capsellae</i>)</p> <p>White rust (<i>Albugo candida</i>)</p> <p><b>Suppression only</b></p> <p>Downy mildew (<i>Peronospora parasitica</i>)</p>	6 to 8.2	3	24.6	3

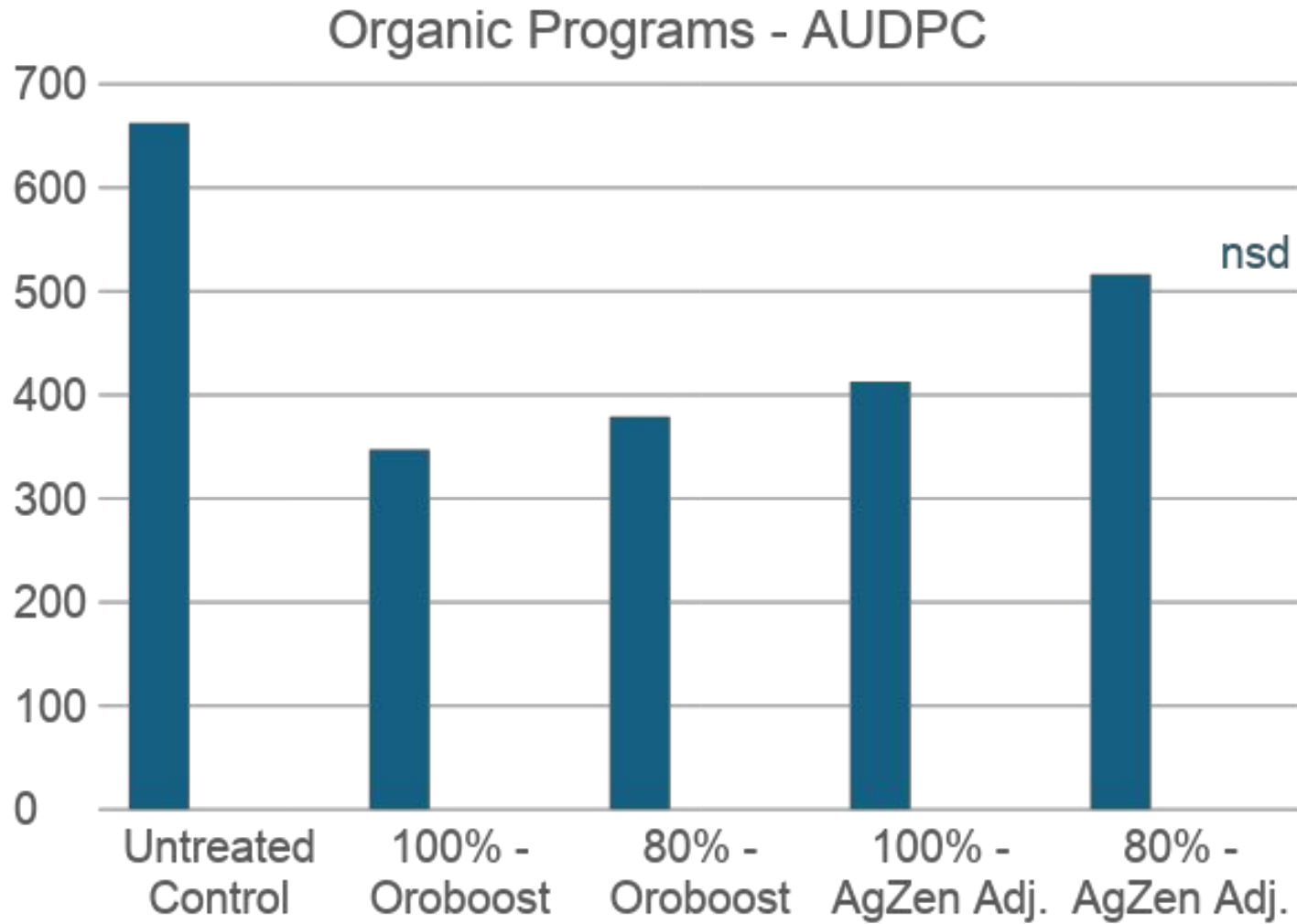
**Application Directions.** For optimal disease control, begin foliar applications of **Priaxor® Xemium® brand fungicide** prior to disease development and continue on a 7 to 14 day interval. Use the shorter interval and/or the high-

# Spray coverage Trial-UMass 2023

Conventional Program + AgZen Adjuvant



# Spray coverage Trial-UMass 2023



# Ctrl/Alt/Del Takeaways

- Broccoli and collards are most susceptible
- There are effective control options for organic and conventional production
- Resistance to the FRAC 7 fungicide boscalid present in NY
- Colleagues in Georgia have identified isolates with resistance to FRAC 11 (strobilurins)
- Some isolates of *A. alternata* with resistance to FRAC 11 (strobilurins)
- **Avoid use of only FRAC 7 or 11 fungicides!!**





# Ctrl/Alt/Del TidBits

- Alternative weed hosts can include non-brassicas:
  - broad-leaf dock, evening primrose, purple nutsedge, and lambsquarters
- ~30% commercial seedlots were infested
  - Pathogenic on broccoli
  - Sensitive to Quadris but some were 100X less sensitive than others
- Investigated effect of nitrogen fertility and found no effect between 50-150% recommended N rate
- Tested varieties, 'Eastern Crown' considered resistant control
- Developing rapid diagnostic tool including fungicide sensitivity markers
- Very diverse population structure, whether fields near or far



# Ctrl/Alt/Delete Acknowledgements

- 4-year project (USDA-SCRI)
- Researchers from Georgia, New York, Nebraska, Virginia
- Cabbage research and development program
- Smart Lab members
- Grower cooperators
- Cornell Coop Extension and IPM Educators
- NYS Dept of Ag and Mkts
- USDA



Dr. Chris Smart  
Christy Hoepting  
*Cornell University*



# Overall Takeaways

- 3-year rotation
- Use clean seed/transplants
- Control brassica weeds
- Fungicides can help!  
*Don't rely solely on Boscalid or Quadris*
- Use a spreader sticker unless using copper!

[sscheufele@umass.edu](mailto:sscheufele@umass.edu)

UMassAmh  
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Extension





# Black Rot

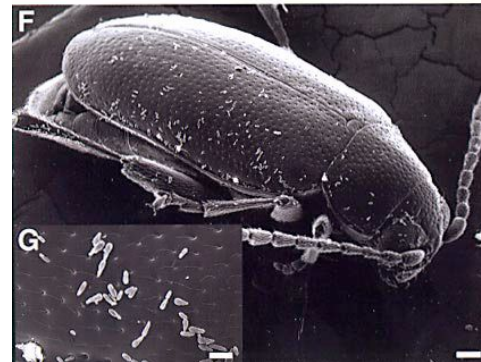
*Xanthomonas campestris* pv  
*campestris* (Xcc)



- Bacterial pathogen
- Attacks all brassica crops
- Sanitation is key!
- 3 year rotation
- Avoid a crucifer cover crop just prior to planting a crucifer cash crop
- Copper can slow the spread of disease

# Black Rot

- Organism: Bacterium
- Spread by water/humid air, mechanically, flea beetles
- **Actigard** and/or **copper** are best bet
- **Biologicals** eg Regalia, Howler, Serenade, Double Nickel etc. have some antibiotic effects but limited stand-alone efficacy in the field
- Control flea beetles to reduce spread
- *New hope in phages?*



# What's new with black rot?

- Colleagues at the University of Florida surveyed brassica fields with black rot symptoms and have identified *Xanthomonas euvesicatoria* pv *perforans* (*Xep*) causing black rot symptoms in cabbage.
- *Xep* is a TOMATO pathogen. The three isolates were pathogenic on both cabbage AND tomato





## 2023 Survey of Black Rot outbreaks in NY

- Collected 116 isolates across NY including Long Island
- All were identified as Xcc

# Control of Black Rot in Cole Crops



- Some cultivars have resistance
- Sanitation is key!
- 3 year rotation
- Avoid a crucifer cover crop just prior to planting a crucifer cash crop
- Copper can slow the spread of disease
- We tested 250 isolates and 30 of the 250 had some copper resistance



# Downy Mildew



Diffuse yellowing



Gray-black flecking  
Crusty white sporulation

- **Organism:** Oomycete
- Not a true fungus, so fungicides different than for *Alternaria*
- Occurs sporadically in the field and greenhouse.
- Cool, wet, low light conditions favor disease
- Spring and fall, not usually summer
- **Fungicides:** Orondis Opti/Ultra, Revus and Presidio provide best control. Ranman, Zampro, Forum, also good bets.
- Organic sprays probably ineffective, OSO or copper are best bet

Questions?



Get in Touch!!

[sscheufele@umass.edu](mailto:sscheufele@umass.edu)

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Extension