

# Everything You Need To Know To Effectively Manage Cucurbit Diseases In 2023

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<https://www.vegetables.cornell.edu/pest-management/disease-factsheets/>



## Disease factsheets and articles

If you were a big fan of the pioneering **Vegetable MD Online** website, much of that content has been moved here. We are in the process of moving over the rest.

- **(LIHREC)** indicates information from the Long Island Horticultural Research and Extension Center Vegetable Pathology website.
- List also **includes some herbs** (parsley, basil) and **abiotic disorder**
- Some content is available as printer-friendly .pdf versions.

### Get started:

[General tips on diagnosing plant diseases](#)

### Diseases and management practices affecting multiple crops

- **Phytophthora Blight and Its Management in Cucurbit Crops and Other Vegetables**
- **Reduced-tillage for Managing Phytophthora Blight and Other Soil-Borne Pathogens**
- **Biofumigation for Managing Phytophthora Blight and Other Soil-Borne Pathogens**
- **White Mold and Its Management in Cabbage, Beans, and Other Vegetables**
- **Diseases of Winter Greens: Downy Mildews, Powdery Mildews, Cladosporium Leaf Spot, and Root Rot**
- **Table: Fungicides for Cucurbit Crops**
- **Table: Mobile Fungicides for Managing Three Major Cucurbit Diseases: Powdery Mildew, Downy Mildew, and Phytophthora Blight**
- **Weeds and Crops Susceptible to Viruses in the Northeast**
- **Disease-resistant varieties**
- **Managing Pathogens Inside Seed with Hot Water**
- **Treatments for Managing Bacterial Pathogens in Vegetable Seed**
- **Do Rotations Matter within Disease Management Programs?**
- **Cropping Sequences and Root Health**
- **On-Farm Soil Bioassays for Assessing Root Pathogens**
- **General Guidelines for Managing Fungicide Resistance**
- **When is the Best Time to Apply Fungicides for Foliar Diseases?**
- **Managing Diseases With Sulfur: Is There A Role For Burners + Evaporators?**
- **Organic Management of Vegetable Diseases**
- **Biopesticides for Organic and Conventional Disease Management in Vegetables**
- **Copper Fungicides for Organic and Conventional Disease Management in Vegetables**
- **Minimizing Injury from Copper Fungicides**





Diseases	Arugula	Celery	Cucurbits	Garlic	Peppers	Spinach
Phytophthora blight, Septoria leaf spot, Downy mildew, Powdery mildew, Bacterial leaf spot, Fusarium crown rot, Fusarium fruit rot, Gummy stem blight, Black rot, Anthracnose, Alternaria leaf spot, Plectosporium blight, Pythium fruit rot, Pythium root rot, Scab, Sunscald, Virus diseases, White mold, Xanthomonas leaf spot	▪ Downy mildew	▪ Anthracnose	▪ Table: Fungicides for Cucurbit Crops	▪ Anthracnose of	▪ Anthracnose (LIHREC)	▪ Downy mildew
	▪ Powdery mildew	▪ Septoria leaf spot (LIHREC)	▪ Table: Mobile Fungicides for Managing Three Major Cucurbit Diseases: Powdery Mildew, Downy Mildew, and Phytophthora Blight	▪ Bloat nematode	▪ Bacterial leaf spot (LIHREC)	▪ Stemphylium leaf spot (LIHREC)
	▪ Reduce	▪ Asparagus	▪ Alternaria (LIHREC)	▪ Botrytis neck rot	▪ Chimera (genetic disorder) (LIHREC)	▪ White rust (LIHREC)
	▪ Pathogen	▪ Sweet corn diseases	▪ Angular leaf spot (LIHREC)	▪ Garlic rust (LIHREC)	▪ Cucumber mosaic virus	▪ Diseases of winter greens: downy mildew, Cladosporium leaf spot, and root rot
	▪ Biofumigation	▪ Common corn smut	▪ Anthracnose (LIHREC)	▪ Waxy breakdown	▪ Pythium crown rot	Tomatoes
	▪ Pathogen	▪ Holcus spot (LIHREC)	▪ Bacterial leaf spot (renamed Xanthomonas leaf spot) (LIHREC)	▪ Horseradish	▪ Phytophthora blight	
	▪ White Mold	▪ Northern corn leaf blight	▪ Choanephora fruit rot (LIHREC)	▪ Cercospora and	▪ Powdery mildew	
	▪ Disease	▪ Rust (LIHREC)	▪ Downy mildew	▪ Lettuce	▪ Sunscald (LIHREC)	
	▪ Leaf Spot	▪ Virus diseases of sweet corn	▪ Fusarium crown rot and fruit rot of pumpkin (LIHREC)	▪ Crown girdling	▪ Tomato chlorotic spot	
	▪ Table: Fungicides	▪ Crucifers (aka brassicas)	▪ Fusarium fruit rot of other cucurbits (LIHREC)	▪ Downy mildew	▪ Tomato spotted wilt virus	
	▪ Table: Mobile Fungicides	▪ Alternaria leaf spot on crucifers	▪ Gummy stem blight and black rot (LIHREC)	▪ Powdery mildew	▪ White mold (LIHREC)	
	▪ Weeds	▪ Alternaria leaf spot on crucifers	▪ Ozone injury (LIHREC)	▪ Septoria leaf spot	▪ Detection of pathogens	
Management, Treatment, Do Rot, Cropping, On-Farm, General, When is, Managing, Organic, Biopesticides, Vegetables, Copper, Vegetables, Minimize	▪ Disease	▪ Bacterial leaf spot on crucifers	▪ Phytophthora blight	▪ White mold (LIHREC)	▪ Black dot disease	▪ Anthracnose (LIHREC)
	▪ Managing	▪ Bacterial leaf spot on crucifers	▪ Plectosporium blight (LIHREC)	▪ Diseases of winter greens: spot, Botrytis crown rot, and root rot	▪ Blackleg caused by Pythium	▪ Bacterial canker of tomatoes
	▪ Treatment	▪ Black leg on kale (LIHREC)	▪ Powdery mildew	▪ Onion	▪ Blackleg caused by Pythium	▪ Bacterial speck of tomatoes
	▪ Do Rot	▪ Black rot on Brussels sprouts	▪ Pythium fruit rot (LIHREC)	▪ Black mold (LIHREC)	▪ Blackleg stem rot (LIHREC)	▪ Bacterial speck of tomatoes (LIHREC)
	▪ Cropping	▪ Black rot on cabbage	▪ Pythium root rot (LIHREC)	▪ Stemphylium leaf spot	▪ Early blight (LIHREC)	▪ Blossom-end rot (fruit disorder) (LIHREC)
	▪ On-Farm	▪ Black rot on ornamental plants	▪ Scab	▪ Parsley	▪ Late blight	▪ Buckeye fruit rot (LIHREC)
	▪ General	▪ Cabbage chimera (genetic disorder)	▪ Sunscald of pumpkin and winter squash (LIHREC)	▪ Septoria leaf spot	▪ Early blight (LIHREC)	▪ Chimera (genetic disorder) (LIHREC)
	▪ When is	▪ Clubroot of crucifers	▪ Virus diseases of cucurbits	▪ Peas	▪ Fusarium dry rot	▪ Drought stress (LIHREC)
	▪ Managing	▪ Clubroot on bok choy	▪ White mold on cucurbits (LIHREC)	▪ Powdery mildew	▪ Gray mold (LIHREC)	▪ Early blight (LIHREC)
	▪ Organic	▪ Diseases of winter greens: spot, Botrytis crown rot, and root rot	▪ Xanthomonas leaf spot (formerly Bacterial leaf spot)	▪ Septoria leaf spot	▪ Late blight	▪ Gray mold (LIHREC)
Biopesticides, Vegetables, Copper, Vegetables, Minimize	▪ Tomato and	▪ Black rot on ornamental plants	▪ Dill	▪ Horseradish	▪ Leaf spot caused by Pythium	▪ Late blight
	▪ Virus diseases	▪ Cabbage chimera (genetic disorder)	▪ Eggplant	▪ Lettuce	▪ Ozone injury (LIHREC)	▪ Late blight resistant tomato variety evaluations
	▪ Beets and	▪ Clubroot of crucifers	▪ Anthracnose (LIHREC)	▪ Crown girdling	▪ Potato virus Y	▪ Leaf mold
	▪ Alternaria	▪ Clubroot on bok choy	▪ Phytophthora blight	▪ Downy mildew	▪ Rhizoctonia crown rot	▪ Ozone injury (LIHREC)
	▪ Bacterial	▪ Diseases of winter greens: spot, Botrytis crown rot, and root rot	▪ Plectosporium blight (LIHREC)	▪ Powdery mildew	▪ Scab	▪ Phytophthora blight
	▪ Cercospora	▪ Downy mildew on cauliflower	▪ Cercosporoid leaf blight (LIHREC)	▪ Septoria leaf spot	▪ Silver scurf of potatoes	▪ Pith necrosis (LIHREC)
	▪ Cercospora	▪ Downy mildew on seedlings	▪ Fusarium crown rot and fruit rot of pumpkin (LIHREC)	▪ Peas	▪ Tomato spotted wilt virus	▪ Powdery mildew (LIHREC)
	▪ Phoma blight	▪ Fusarium yellows of crucifers	▪ Gummy stem blight and black rot (LIHREC)	▪ Lettuce	▪ Tomato virus Y	▪ Septoria leaf spot (LIHREC)
	▪ Rhizoctonia	▪ Head rot (soft rot) of crucifers	▪ Ozone injury (LIHREC)	▪ Horseradish	▪ Rhizoctonia crown rot	▪ Stemphylium (aka gray) leaf spot (LIHREC)
	▪ Carrots	▪ Heat stress damage	▪ Verticillium wilt (LIHREC)	▪ Lettuce	▪ Scab	▪ Tomato brown rugose fruit virus
Gene	▪ Leaf blight	▪ Powdery mildew (LIHREC)	▪ Anthracnose (LIHREC)	▪ Peas	▪ Silver scurf of potatoes	▪ Tomato chlorotic spot virus (TCSV)
	▪ Powdery	▪ Virus diseases of crucifers	▪ Phytophthora blight	▪ Lettuce	▪ Tomato spotted wilt virus	▪ Tomato spotted wilt virus (LIHREC)
	▪ Downy mildew	▪ Anthracnose	▪ Alternaria (LIHREC)	▪ Crown girdling	▪ Virus and viroids	▪ White mold (timber rot) (LIHREC)
	▪ Powdery	▪ Septoria leaf spot (LIHREC)	▪ Angular leaf spot (LIHREC)	▪ Downy mildew	▪ White mold (LIHREC)	▪ Zippering (fruit disorder) (LIHREC)
	▪ Downy mildew	▪ Common corn smut	▪ Anthracnose (LIHREC)	▪ Bloat nematode	▪ Anthracnose (LIHREC)	
	▪ Powdery	▪ Holcus spot (LIHREC)	▪ Bacterial leaf spot (renamed Xanthomonas leaf spot) (LIHREC)	▪ Botrytis neck rot	▪ Bacterial leaf spot (LIHREC)	
	▪ Downy mildew	▪ Northern corn leaf blight	▪ Choanephora fruit rot (LIHREC)	▪ Garlic rust (LIHREC)	▪ Chimera (genetic disorder) (LIHREC)	
	▪ Powdery	▪ Rust (LIHREC)	▪ Downy mildew	▪ Waxy breakdown	▪ Cucumber mosaic virus	
	▪ Downy mildew	▪ Virus diseases of sweet corn	▪ Fusarium crown rot and fruit rot of pumpkin (LIHREC)	▪ Horseradish	▪ Pythium crown rot	
	▪ Powdery	▪ Crucifers (aka brassicas)	▪ Fusarium fruit rot of other cucurbits (LIHREC)	▪ Lettuce	▪ Phytophthora blight	



# Cucurbit Powdery Mildew





# Integrated Disease Management

## Cucurbit Powdery Mildew

- Resistant varieties provide limited (pumpkin, squash) to excellent (cucumber, cantaloupe) suppression.
- Onset coincides with start of fruiting.
- Many biopesticides and protectant fungicides (sulfur, chlorothalonil) effective on upper leaf surfaces.
- Targeted fungicides can be excellent.

Effective on lower leaf surface.

Resistance is major issue.

Isolates with multi-fungicide resistance.

Inherent differences in efficacy including within FRAC group

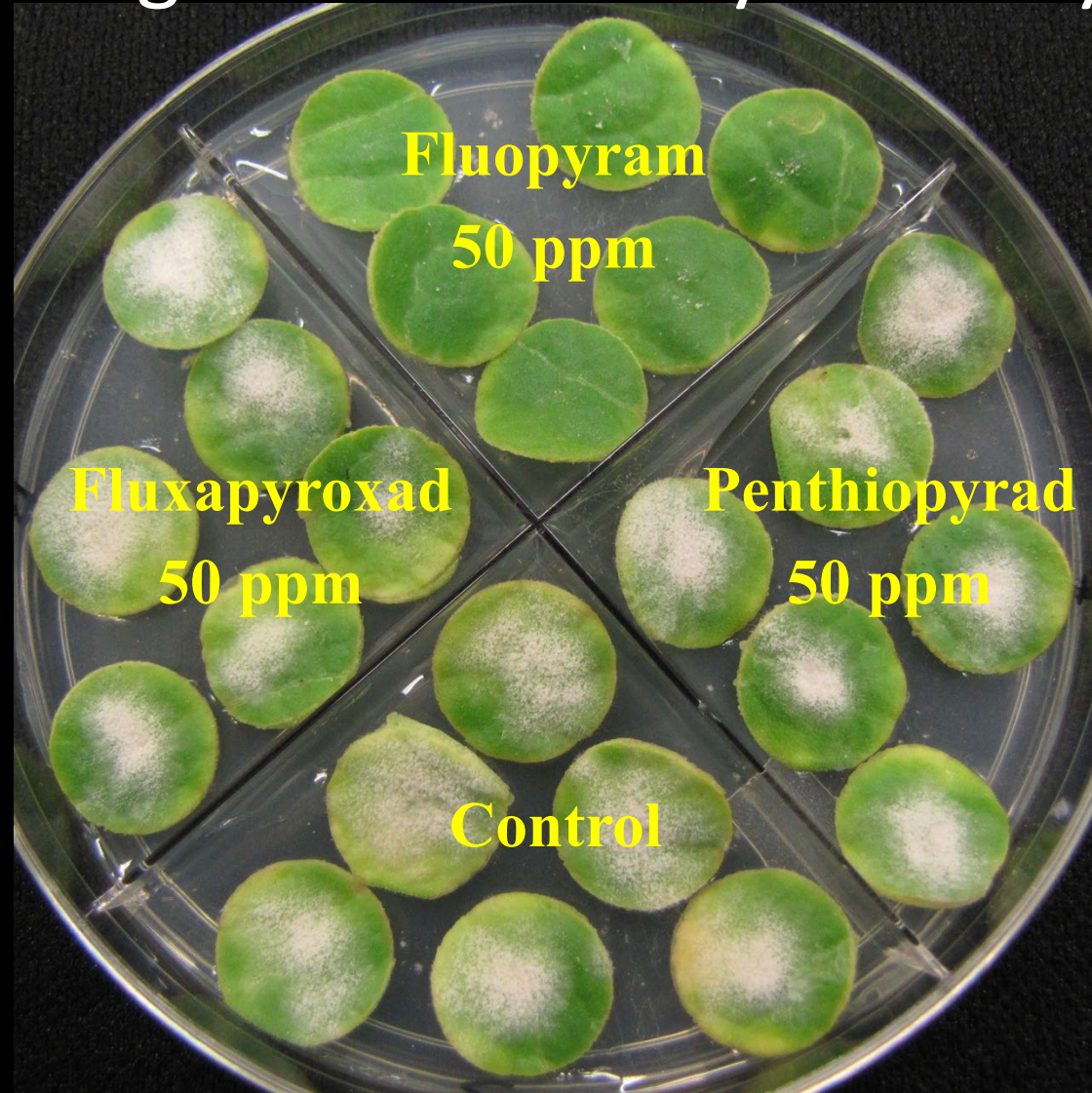


# Fungicide Evaluation - Pumpkin





# Fungicide Sensitivity Bioassay





# Fungicides - Cucurbit Powdery Mildew

Fungicide Group	FRAC Code	Fungicide	Active Ingredient	Registered In U.S.	Resistance In U.S.
MBC	1	Benlate	benomyl	1972	1967
DMI	3	Bayleton	triadimefon	1984	1990
QoI	11	Quadris	azoxystrobin	1999	2002
DMI	3	multiple	multiple	2000-	
SDHI	7	Pristine	boscalid + QoI	2003	2009
Aza-naphthalene	13	Quintec	quinoxifen	2007	2015
Phenyl-acetamide	U6	Torino	cyflufenamid	2012	2017
Aryl-phenyl-ketone	50	Vivando	metrafenone	2014	
SDHI	7	Luna series	fluopyram	2016	
Cyano-methylene-thiazolidines	U13	Gatten	flutianil	2018	



# Fungicide Resistance - Cucurbit Powdery Mildew

MBC fungicides (FRAC 1) – resistance common, single gene.

QoI fungicides (11) – resistance common, single gene.

DMI fungicides (3) - resistance partial. Also range in inherent activity: Proline and Procure most effective. Cevya least.

SDHI fungicides (7) – resistance common to Endura (Pristine, Fontelis, Merivon). partial to Luna Experience, Miravis Prime and Aprovia Top; recommended.

Quintec (13) – resistance detected since 2015. Variable occurrence partly due to use. Efficacy can be impacted.

Torino (U6) – resistance detected since 2017. Variable occurrence partly due to use. Efficacy can be impacted.

Vivando (50) - reduced sensitivity. Prolivo efficacy inconsistent.

Gatten (U13) - ??. Inherently less effective.



# Powdery Mildew Isolate Bioassays – Fungicides

Endura (7)	500 ppm (= field rate)	Resistant
Torino (U6)	50 ppm (= field rate)	
Quintec (13)	200 ppm (= field rate)	
Rally (3)	40, 80 ppm (field rate = 300 ppm)	Reduced Sensitivity
Vivando (50)	50, 150 ppm (field rate = 600 ppm)	
Luna Privilege (7)	50, 150 ppm (field rate = 390 ppm)	

**Field rate** = highest label rate applied at 50 gpa.

Luna Privilege used instead of Luna fungicides labeled for this use because Luna Experience and Luna Sensation have another AI.

Fungicide resistance is result of change in single or multiple genes.



**Quintec**

**Sensitive  
Isolate**

**Luna Privilege**

**Torino**

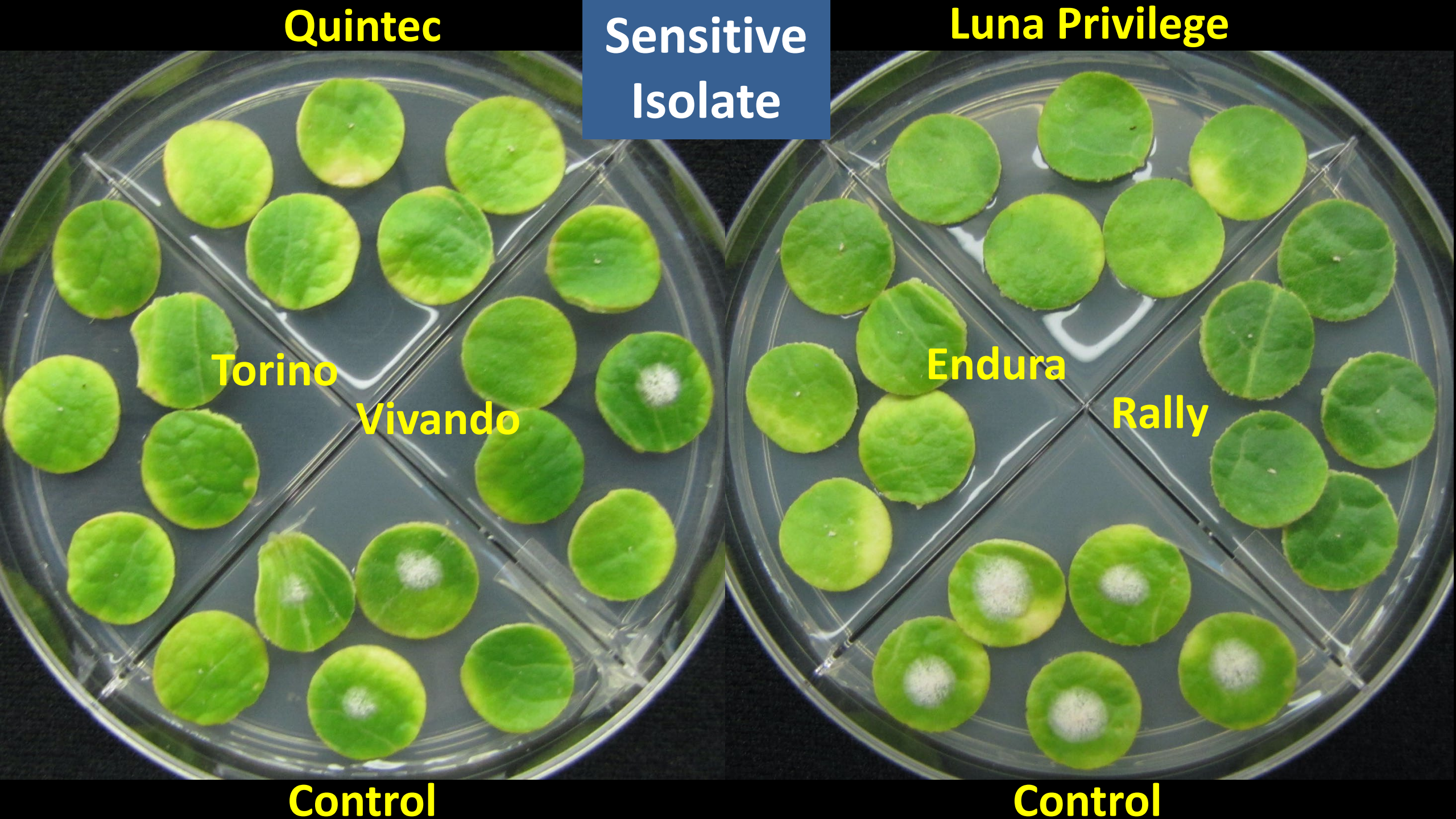
**Vivando**

**Endura**

**Rally**

**Control**

**Control**





**Quintec**

**Resistant  
Isolate**

**Luna Privilege**

**Torino**

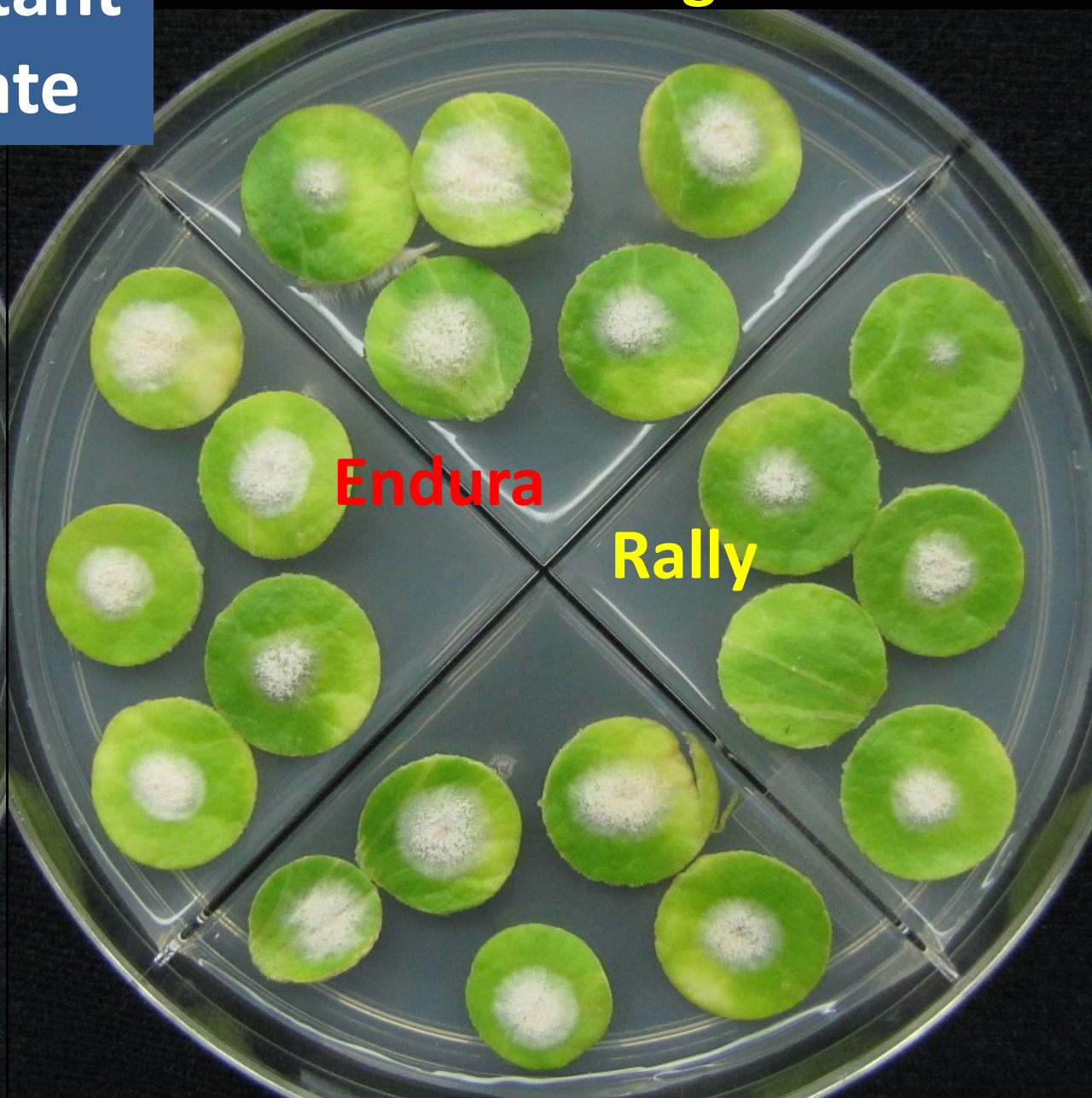
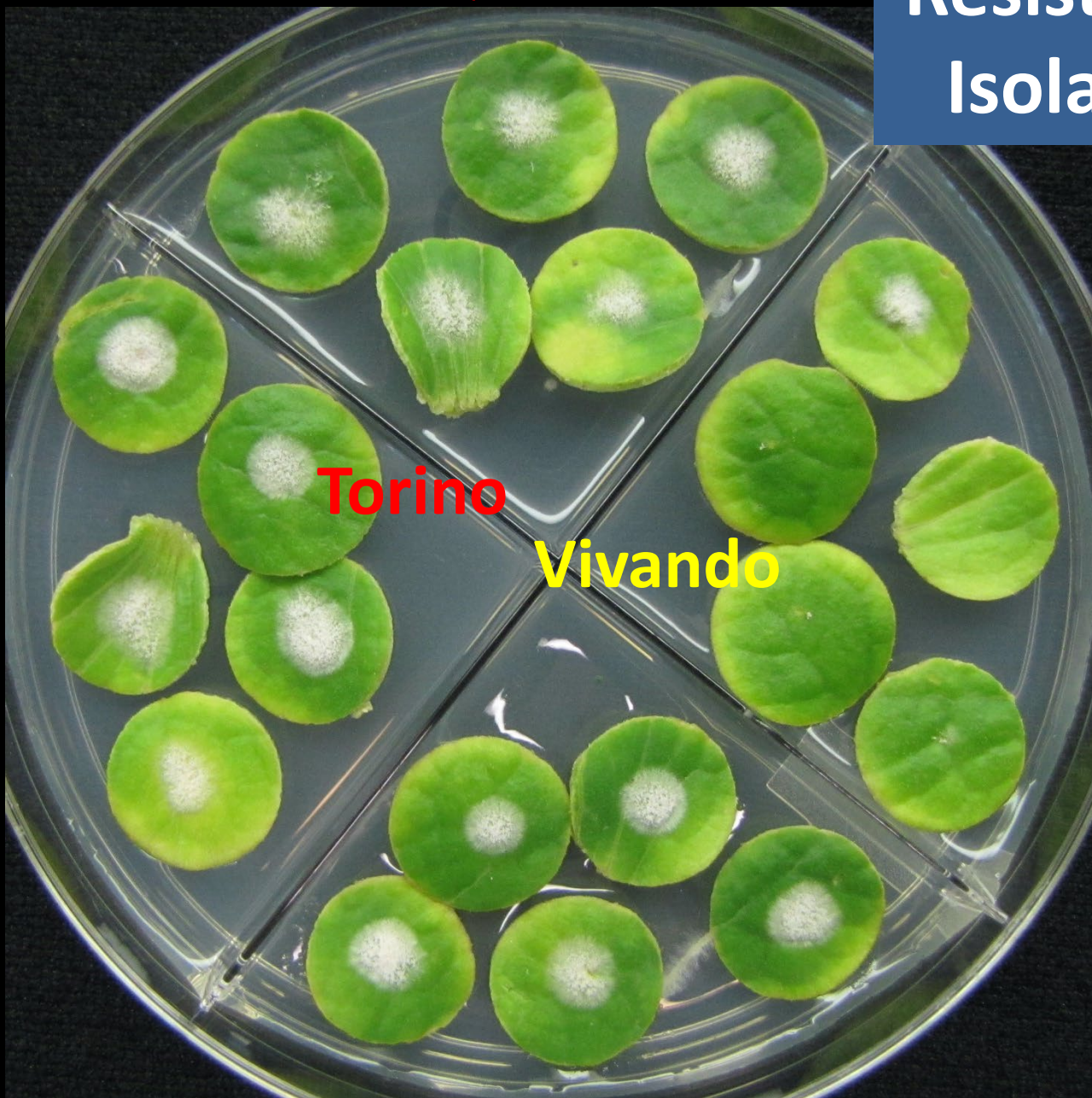
**Vivando**

**Endura**

**Rally**

**Control**

**Control**





# Fungicide Resistance Occurrence in Powdery Mildew Isolates from Cucurbit Crops, Eastern NY, 2021

Powdery Mildew Fungicides used	Percent Resistant Isolates		
	Torino	Quintec	Endura
Just protectants (copper, chlorothalonil)	0	0	14

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	Torino	Quintec	Endura
Just protectants (copper, chlorothalonil)	0	0	14
Quintec, Vivando, Vivando (all applied with protectants)	0	0	56



# Fungicide Resistance – Powdery Mildew - Eastern NY, 2021

Powdery Mildew Fungicides used	Resistant Isolates (%)		
	Torino	Quintec	Endura
Just protectants (copper, chlorothalonil)	0	0	14
Quintec, Vivando, Vivando *	0	0	56
Vivando, Quintec, Rhyme, Vivando, Quintec *	0	67	67
Quintec, Vivando, Quintec + Vivando *	67	100	100
Quintec, Rhyme, Prolivo, Gatten, Prolivo, Quintec, Prolivo, Gatten *	71	71	86

\* all applied with protectants

# Fungicide Resistance – Powdery Mildew - Eastern NY, 2021

Powdery Mildew Fungicides used	Resistant Isolates (%)		
	Torino	Quintec	Endura
Just protectants (copper, chlorothalonil)	0	0	14
Quintec, Vivando, Vivando *	0	0	56
Vivando, Quintec, Rhyme, Vivando, Quintec *	0	67	67
Quintec, Vivando, Quintec + Vivando *	50	100	100
Quintec, Rhyme, Prolivo, Gatten, Prolivo, Quintec, Prolivo, Gatten *	71	71	86
Gatten, Vivando, Gatten *	11	11	44

\* all applied with protectants



# Fungicide Resistance - Cucurbit Powdery Mildew

Resistant isolates are fit. Found in plantings not treated.

Frequency of resistance in a planting can change with fungicide use during a season.

Applying a fungicide ineffective due to resistance may not be evident when other fungicides used are effective.

Pathogen isolates with resistance to multiple fungicide chemistry groups have been found increasingly.

All 2020 isolates found to be resistant to Quintec were also resistant to Torino, Endura, and QoI fungicides.

Expect resistance to develop to additional fungicides.

# Fungicide Programs - Cucurbit Powdery Mildew

Proline, Vivando, Proline, Vivando, Procure, Vivando.

Vivando, Vivando, Aprovia Top, Vivando, Aprovia Top.

Vivando, Aprovia Top, Aprovia Top, Vivando, Aprovia Top.

FRAC: 50 3 3 + 7

**Start preventive (start of fruit formation) or  
at threshold (1 of 50 older leaves)**

**Apply with protectant:** sulfur, chlorothalonil, mineral oil,  
biopesticide



# organic Biopesticides

## Cucurbit Mildews + Other Diseases

**Double Nickel.** *Bacillus amyloliquefaciens* strain D747

**Taegro 2.** *Bacillus amyloliquefaciens* strain FZB24

**Serifel.** *Bacillus amyloliquefaciens* strain MBI 600

**LifeGard.** *Bacillus mycoides* isolate J

**Sonata.** *Bacillus pumilus* strain QST 2808

**Aviv.** *Bacillus subtilis* strain IAB/BS03

**Companion.** *Bacillus subtilis* strain GB03

**Serenade.** *Bacillus subtilis* strain QST 713

**LALSTOP G46 / Prestop.** *Gliocladium catenulatum* J1446

**Romeo.** cerevisane (cell walls of *Saccharomyces cerevisiae*)

**Howler.** *Pseudomonas chlororaphis* strain AFS009

**Carb-O-Nator.** potassium bicarbonate

**Kaligreen.** potassium bicarbonate

**MilStop.** potassium bicarbonate

**Regalia.** extract of giant knotweed.

**EcoSwing.** extract of *Swinglea glutinosa*.

**Problad Verde.** Banda de *Lupinus albus* doce.

**ECOWORKS.** cold pressed neem oil.

**Rango.** cold pressed neem oil.

**TerraNeem.** cold pressed neem oil.

**Trilogy.** extract of neem oil.

**Timorex Act.** tea tree oil.

**Thymox Control.** thyme oil.

**GreenFurrow BacStop.** several botanical oils.

**GreenFurrow EF400.** several botanical oils.

**Mildew Cure.** several botanical oils.

**Sporan EC<sup>2</sup>.** several botanical oils.

**Sil-MATRIX.** potassium silicate

**OSO.** polyoxin D zinc salt

**PerCarb.** sodium carbonate peroxyhydrate

**Seican.** cinnamaldehyde

# Role of Biopesticides in Cucurbit Disease MGT

Organic production.

Good coverage important because of contact activity.

Conventional production:

In place of contact fungicides (chlorothalonil, copper)  
tank mixed with targeted fungicides.

Applied in place of targeted fungicides.

Preventive and late season best.



# Biopesticide Efficacy – Powdery Mildew - Pumpkin

% Control based on AUDPC on both leaf surfaces 2022

Fungicide (7-day)	Upper		Lower	
Serifel	69	b	27	a bc
Stargus + Regalia	71	bc	17	a b
Trillium	73	bc	24	a bc
Theia	76	bc	24	a bc
Microthiol Disperss (sulfur)	99	d	33	bc
Stargus + Regalia alt. sulfur	96	d	35	bc
Theia alt. sulfur	96	d	37	bc

Trial conducted on powdery mildew intermediate resistant 'Bayhorse Gold'.

First application 21 July before powdery mildew seen.

Values in column with same letter not statistically different. **a=ineffective**.

# Biopesticide Efficacy – Powdery Mildew - Pumpkin

% Control based on AUDPC on both leaf surfaces 2022

Fungicide (7-day)	Upper		Lower	
Theia (2), Proline alt Vivando (3), Theia (2)	95	c	83	b
Serifel (2), Proline alt Vivando (3), Serifel (2)	93	bc	87	b
TACT (2), Proline alt Vivando (3), TACT (2)	91	bc	84	b
Proline alt Vivando (3)	68	b	83	b
Proline alt Vivando alt Procure (5)	99	c	90	b

Trial conducted on powdery mildew susceptible 'Gold Challenger'.

First application 21 July before powdery mildew seen.

TACT = Timorex ACT

Values in column with same letter not statistically different. **a=ineffective**.



# Biopesticides & Conventional Fungicides

## Powdery Mildew on Pumpkin



8-5-22



**Control**



**Microthiol Disperss**



**Serifel**



**Theia**



**9-7-22**



**Stargus + Regalia**



**Trillium**



**Serifel**



**Theia**



**9-7-22**



Microthiol Disperss (sulfur)



Stargus + Regalia alt. sulfur



Theia alt. sulfur



Serifel (2), Proline alt. Vivando (3), Serifel (2)



9-7-22



**Control**



**Serifel, Proline, Vivando**



**sulfur, Proline, Vivando**



**Proline, Vivando (3 apps)**



**Proline, Vivando, Procure (5 apps)**

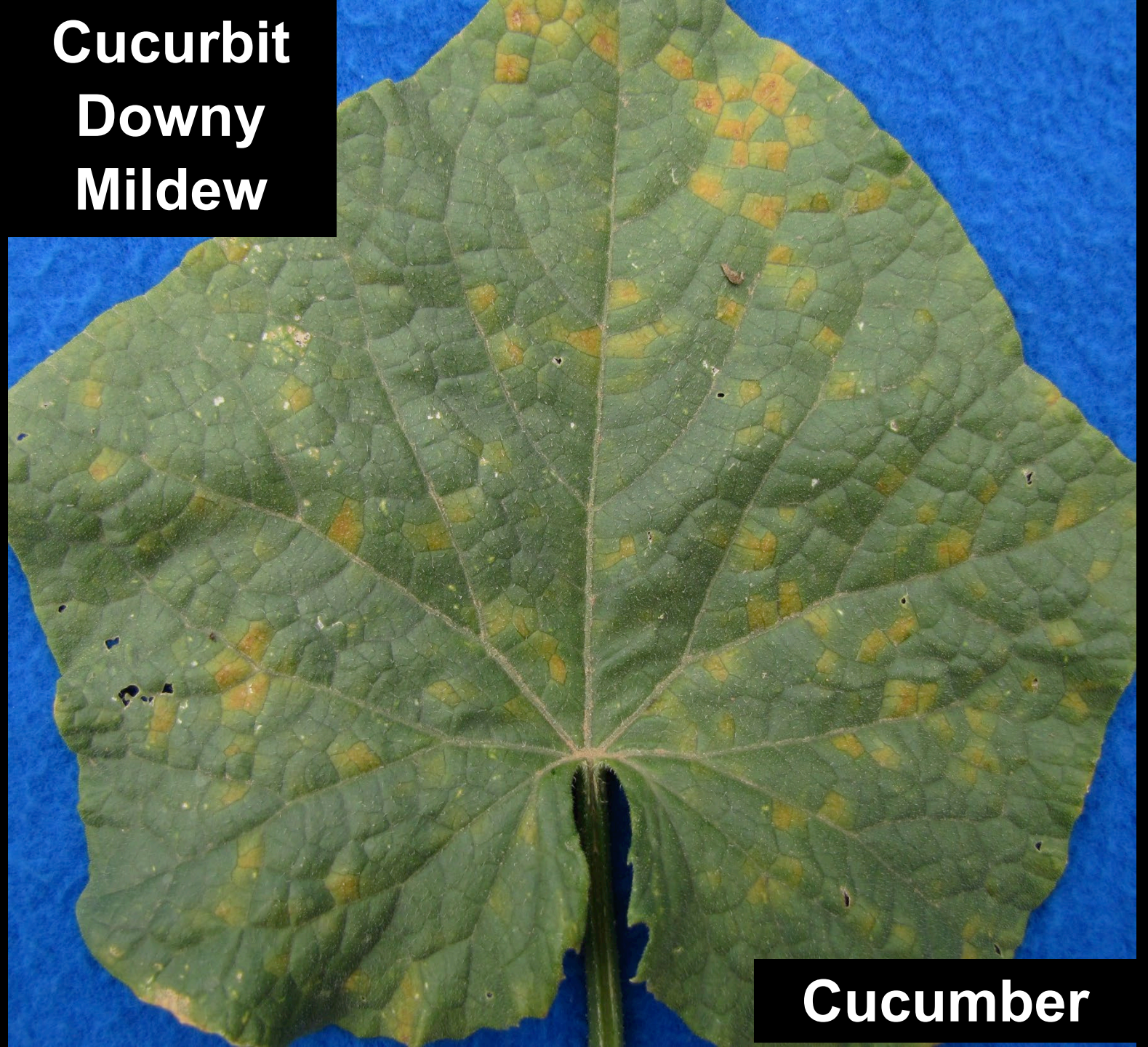
**9-7-22**







**Cucurbit  
Downy  
Mildew**



**Cucumber**



# Fungicide Efficacy – Downy Mildew – Cucumber

Biopesticides tested in 2022 and copper (Kocide 3000-O) ineffective based on symptom severity and % leaves affected.

Symptoms first seen 16 days after the first application.

## **Biopesticides tested:**

- Serifel (microbial)

- Theia (microbial)

- Trillium (thyme oil)

- Regalia + Stargus (extract giant knotweed + microbial)

Conventional fungicide program very effective (99% control):

- Ranman alt. Orondis Ultra alt. Previcur Flex

Documents CDM is difficult to manage with contact fungicides.



**Control**



**Serifel**



**Theia**



**Trillium**



**8-29-22. 24 days after first symptoms. 1 day before 7th app.**



**Downy Mildew**

**Cantaloupe**





# Management – Downy Mildew – Cantaloupe

## Downy Mildew Resistant Varieties

Trifecta      Edisto 47      Planter's Jumbo

29% control (AUDPC values); 72% control (defoliation)

## Conventional Fungicide Program

Ranman alt. Previcur Flex alt. Orondis Ultra

7-27 started preventive applications.

8-17 started IPM program.

98 – 100% control including on susceptible variety.



# Conventional Fungicide Programs + Resistant Varieties

## Downy Mildew on Cantaloupe



8-15-22



**Ambrosia (nontreated)**



**Ambrosia (preventive)**



**Ambrosia (IPM)**



**Trifecta (nontreated)**



**9-12-22**





Ambrosia (IPM)

Trifecta (IPM)

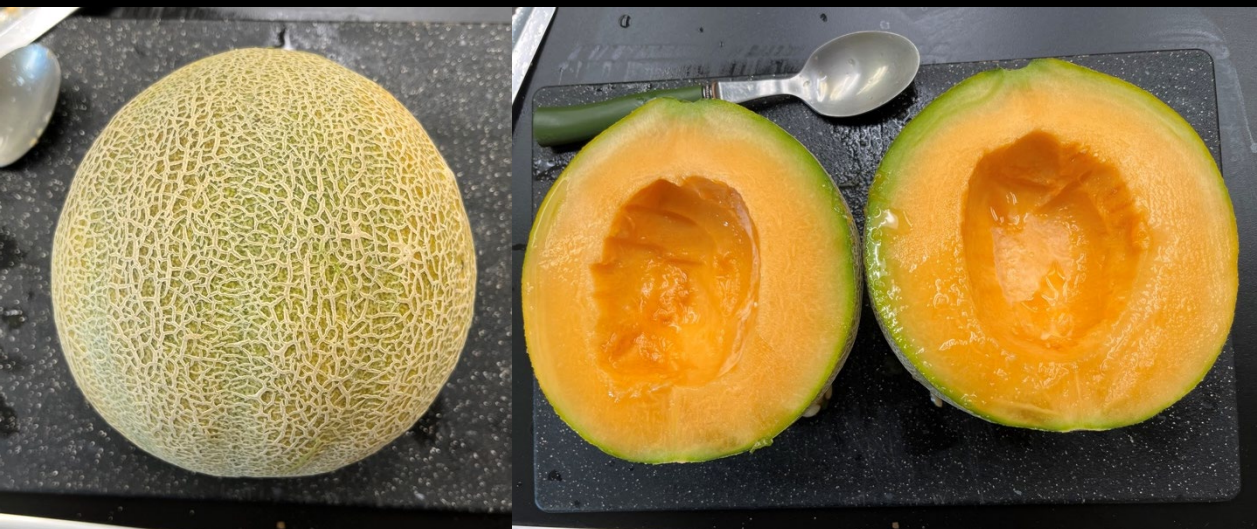
Edisto 47 (IPM)

Planter's Jumbo (IPM)

9-12-22



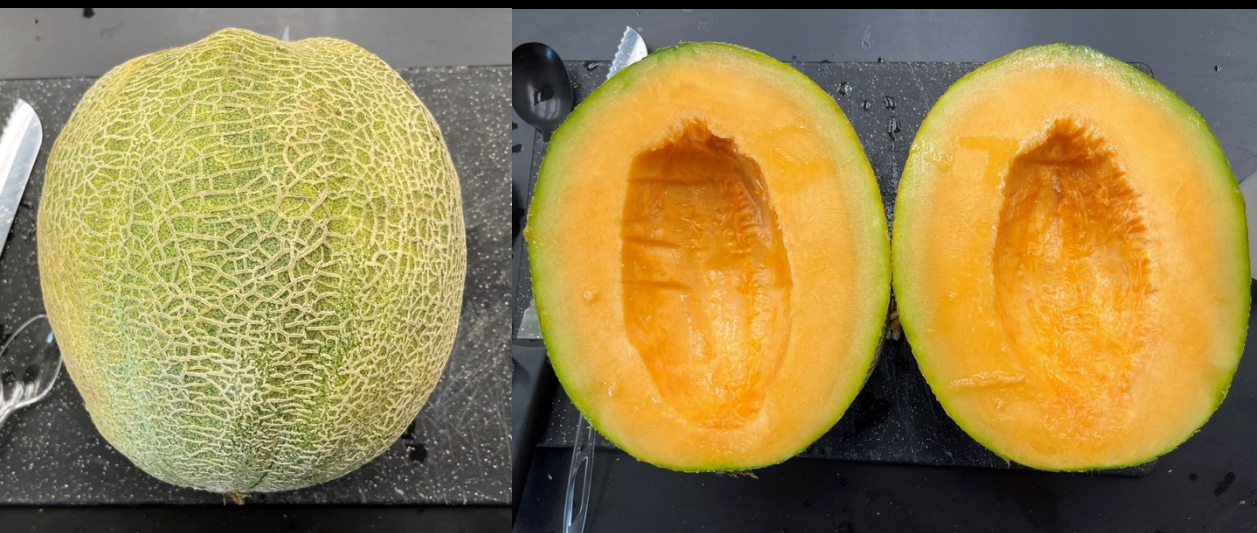
**Ambrosia**



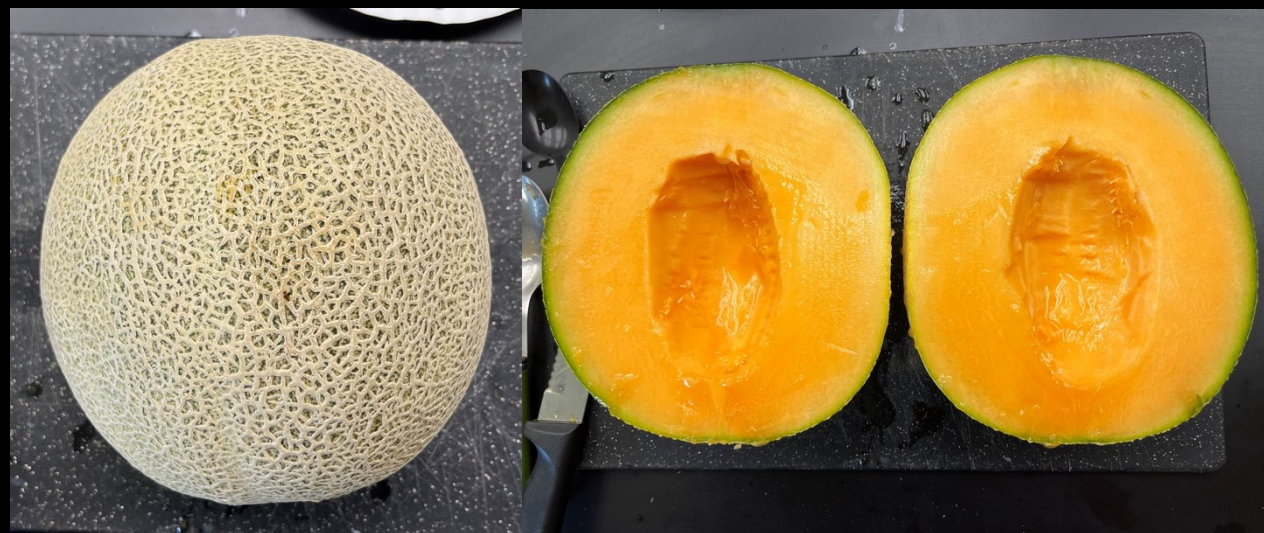
**Trifecta**



**Edisto 47**



**Planter's Jumbo**







**Virus**  
**Symptoms**

**Leaves**  
**Fruit**





# Cucurbit Virus Survey 2022

Area	# Locations	# Samples	Viruses Detected (# samples)
Western NY	1	1	ZYMV (1)
Eastern NY	2	7	ZYMV (7), CMV (7), SqMV (1)
Long Island	2	7	ZYMV (7)
Virginia	3	3	ZYMV (1), WMV (2)

## Zucchini Yellow Mosaic Virus

Seed-borne. Volunteer plants potential source.

Aphid, mechanical transmission.

Potyvirus.





Leaves  
that tested  
positive for

**ZYMV**





