

# Biofungicides for Organic Management of Powdery Mildew in Winter Squash



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## Introduction

Powdery mildew (caused primarily by *Podosphaera xanthii*) is a ubiquitous disease of cucurbits and one of the largest limiting factors to their production<sup>1</sup>. Organic growers have limited options for effective chemical control<sup>2</sup>. Biofungicides are possible alternatives or additions to spray programs which warrant further testing to confirm efficacy<sup>3,4</sup>. Field trials were conducted in New York State in 2021 and 2022 to evaluate available and developmental products. Active ingredients included biological agents, plant extracts and oils, and copper (as a non-biopesticide grower standard).



Courtesy of Meg McGrath, Cornell University

Figure 1. (left) Foliar symptoms on *C. pepo*. (right) Pathogen sexual fruiting structure.

## Methods

Table 1. Field trial design. Randomized complete block design with 4 replicate blocks.

		2021	2022
<b>Cultivar</b>	<i>C. pepo</i> 'Bush Delicata' (Susceptible)	✓	✓
<b>Design</b>	5 plant plots, raised beds, drip fertigation, RCBD, 4 reps	✓	✓
<b>Inoculum</b>	Natural infection, <i>P. xanthii</i> confirmed with ITS sequencing	✓	✓
<b>Applications</b>	1x week, 40 gal/a, CO <sub>2</sub> backpack sprayer with 3-nozzle boom	7	4
<b>Ratings</b>	1x week, % disease severity on adaxial leaf surface	6	5

Table 2. Products evaluated. Alternating products were applied every other week. An untreated control was included. \* = indicates products that were field-mixed with Dyne-Amic.

Product	Company	Active Ingredient	2021	2022
1. Howler*	AgBiome	<i>Pseudomonas chlororaphis</i> strain AFS009	+	+
2. Theia*	AgBiome	<i>Bacillus subtilis</i> strain AFS032321	+	+
3. Howler / Theia*	AgBiome	<i>Pseudomonas chlororaphis</i> strain AFS009 + <i>Bacillus subtilis</i> strain AFS032321	+	+
4. Kocide 3000-O	Certis	Copper hydroxide	+	+
5. Dyne-Amic	Helena Agri	Alkylphenol ethoxylate	+	+
6. Tril-21	Kemin	Thyme oil	+	+
7. Regalia	Marrone Bio	<i>Reynoutria sachalinensis</i> extract	-	+
8. Stargus	Marrone Bio	<i>Bacillus amyloliquefaciens</i> strain F727	-	+
9. MBI-121 (Regalia + Stargus)	Marrone Bio	<i>Reynoutria sachalinensis</i> extract + <i>Bacillus amyloliquefaciens</i> strain F727	+	+
10. AVIV*	SummitAgro	<i>Bacillus subtilis</i> strain IAB/BS03	+	+
11. Timorex Act	SummitAgro	Tea tree oil	+	+
12. AVIV / Timorex Act*	SummitAgro	<i>Bacillus subtilis</i> strain IAB/BS03 + Tea tree oil	+	+
13. Curezin	VM Agritech	Copper zinc	-	+

## Results and Discussion

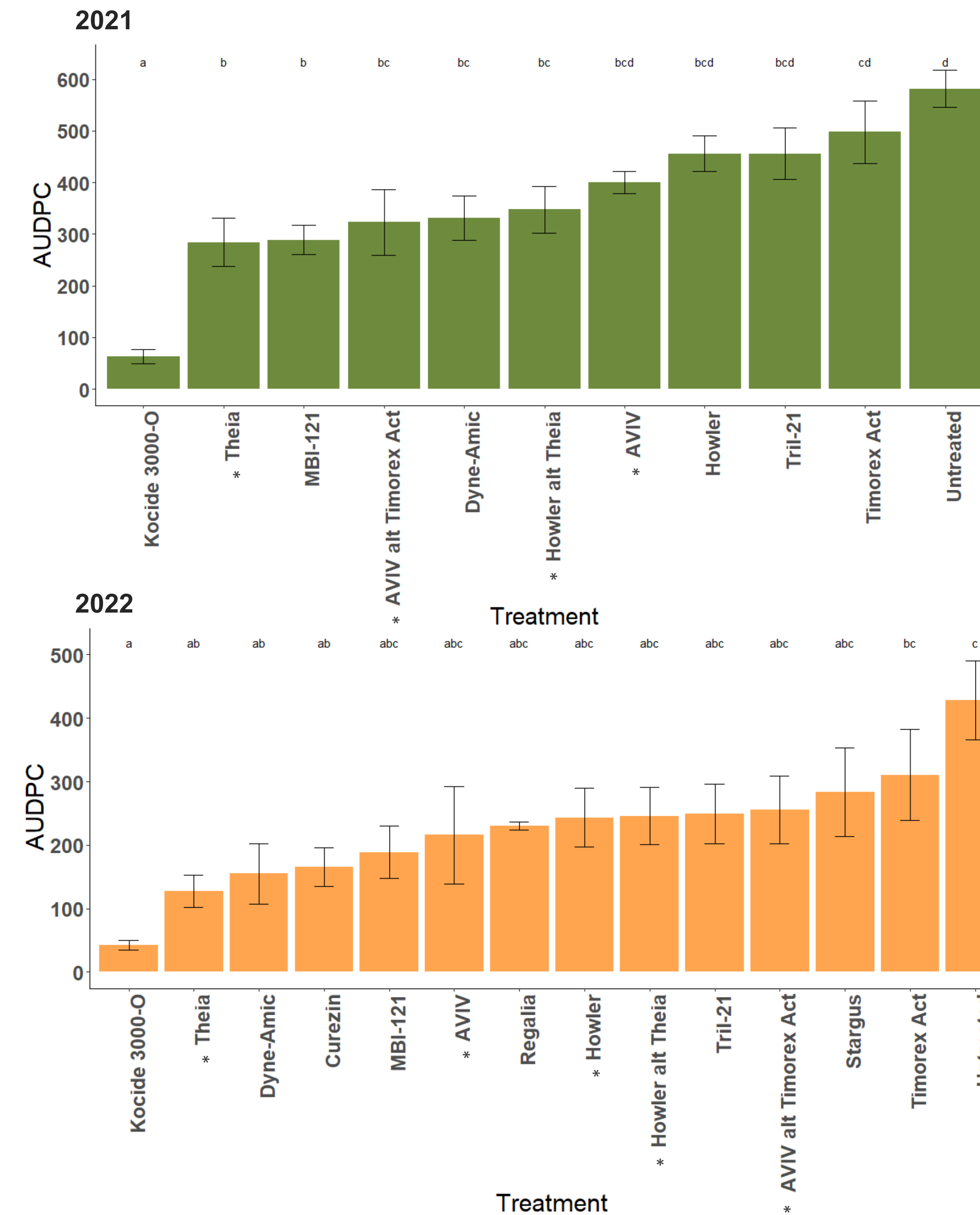


Figure 2. Powdery mildew disease severity (above 2021, below 2022). Area under the disease progress curve (AUDPC) calculated from weekly ratings.

- **Kocide 3000-O** reduced disease severity the most – statistically significant reduction in 2021.
- **Theia** was numerically the next best treatment and significantly reduced disease severity compared to the untreated control, in both years.
- Fruit yield was not different across treatments in either year.



Figure 3. Representative plots. Some phytotoxicity observed in Kocide 3000-O treatment. Theia treatment shows markedly reduced diseased severity compared to the untreated control.

## Future Directions

Evaluate moderately efficacious products on hosts with partial resistance.

## Other Disease Problems

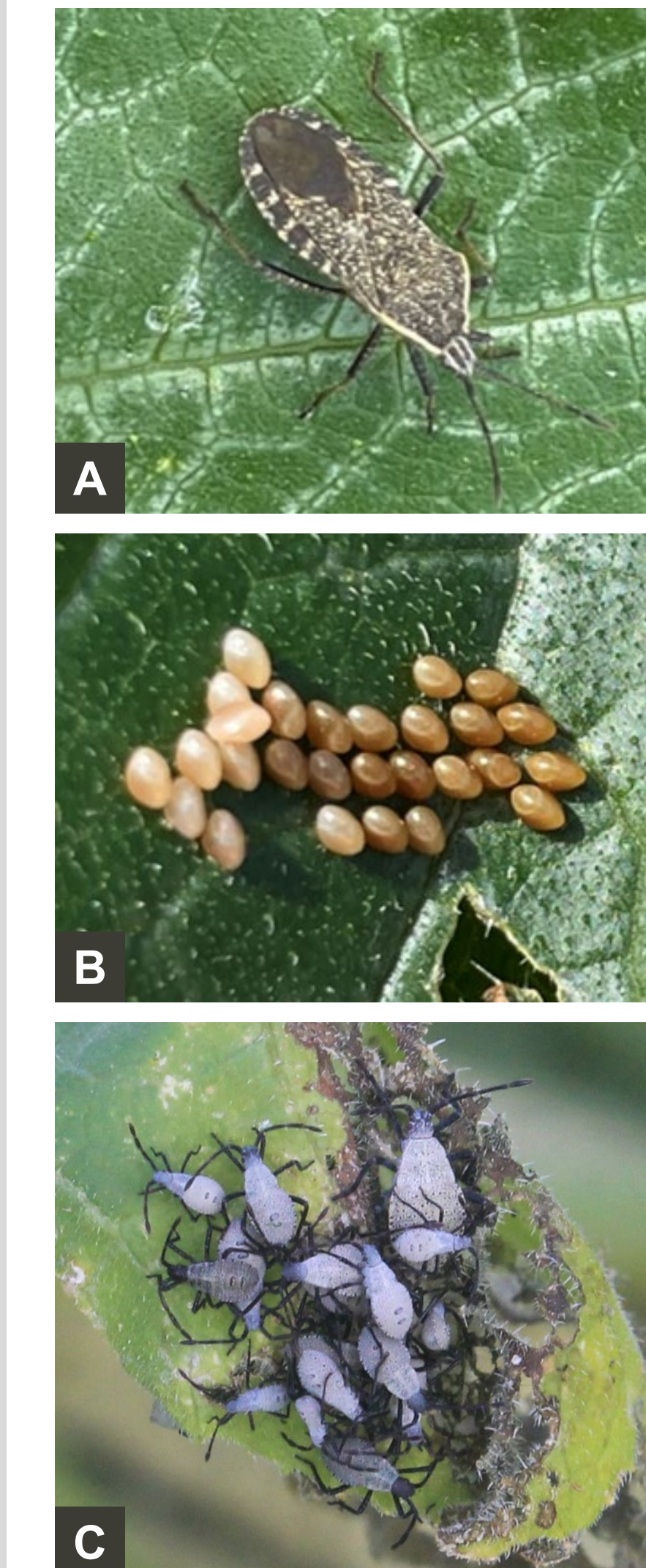


Figure 4. Cucurbit yellow vine decline (CYVD) caused by the squash bug (*Anasa tristis*)-vectored bacterium *Serratia marcescens*. A) Adult. B) Eggs on adaxial leaf surface. C) Nymphs and feeding damage. D) Squash plant infected with CYVD. E) Collapsed plant. By mid-September 2022, 12% of plants had died or were declining from CYVD.

## References

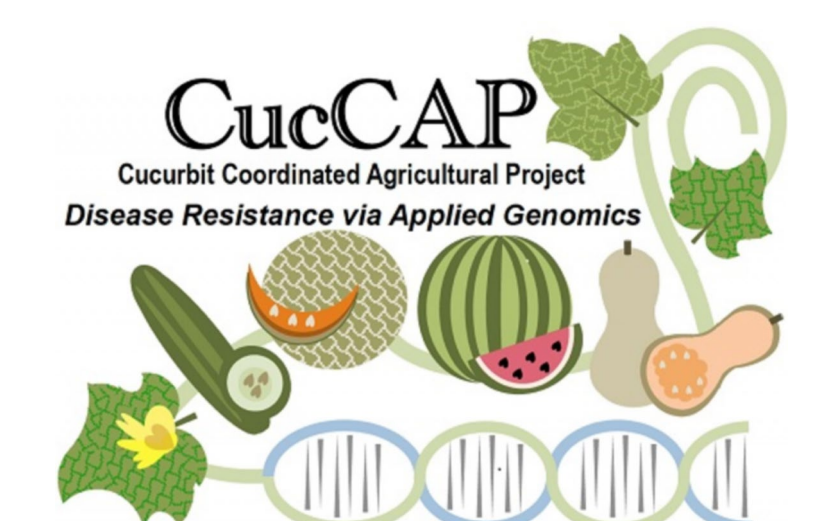
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