



# Preventing and Slashing Vine Crop Diseases

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# Rainfall Favors Diseases

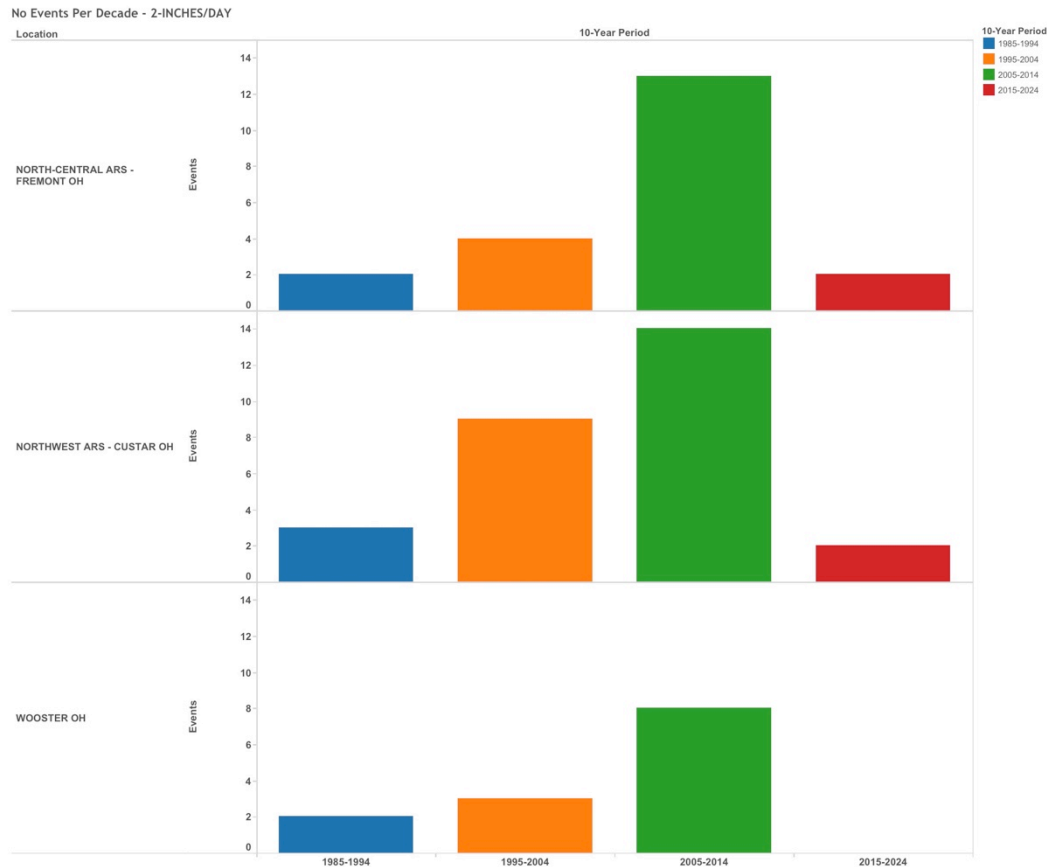


- Bacterial diseases
  - Bacterial spot
  - Angular leaf spot
  - (Bacterial wilt)
- Phytophthora blight
- Downy mildew
- Various fungal diseases
- Exception: powdery mildew



# Rainfall Events $\geq 2"$ per Day

Northwestern/Northcentral Ohio– 2-inch/day





# Vine Crop Diseases

- Downy mildew
- Phytophthora blight
- Powdery mildew



Powdery mildew



Downy mildew



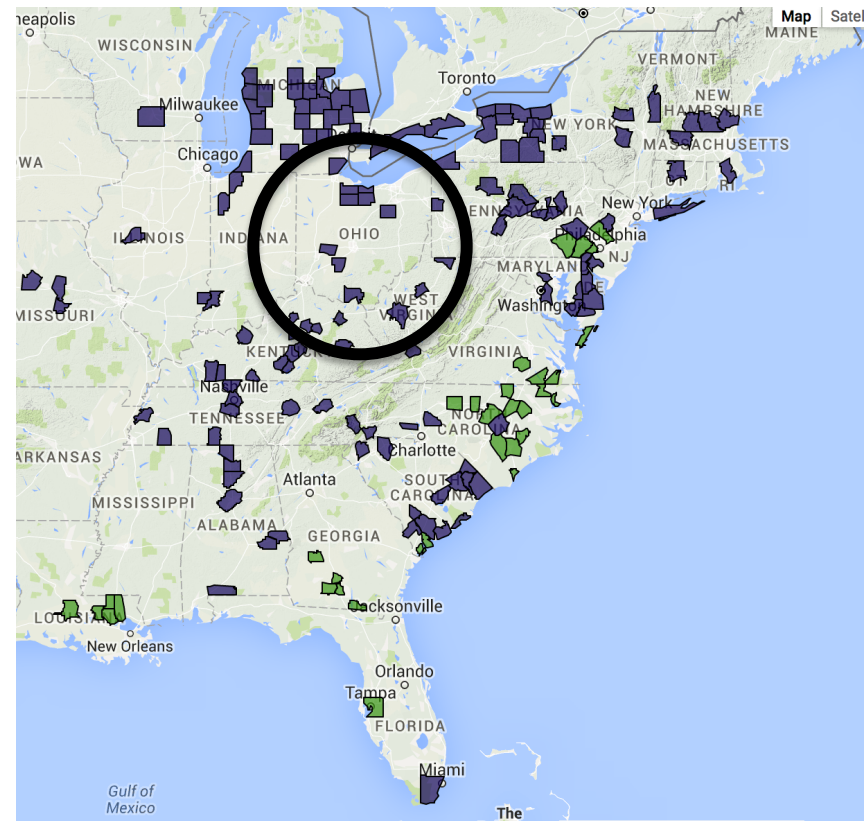
Phytophthora  
blight





# Cucurbit Downy Mildew

- Early and serious in 2015
- Northern counties first affected
- Central Ohio both cucumber/melon and squash/pumpkin
- Southern Ohio – squash/pumpkin
  - Cucumber – June 29, Seneca County
  - Cantaloupe – July 17, Sandusky County
  - Pumpkin, August 19, Scioto County



Map December 2015



# When Does Cucurbit Downy Mildew Appear in Ohio?

- Northern counties (approx. northern 1/3 of state)
  - Typically in **cucumber** late June to mid-July (northern inoculum sources)
  - Cucumber most susceptible; melons slightly less
  - Disease favored by high rainfall, high humidity, overcast or foggy weather
- Central and southern counties
  - Usually later if at all; may see more pumpkin downy mildew from southern inoculum sources



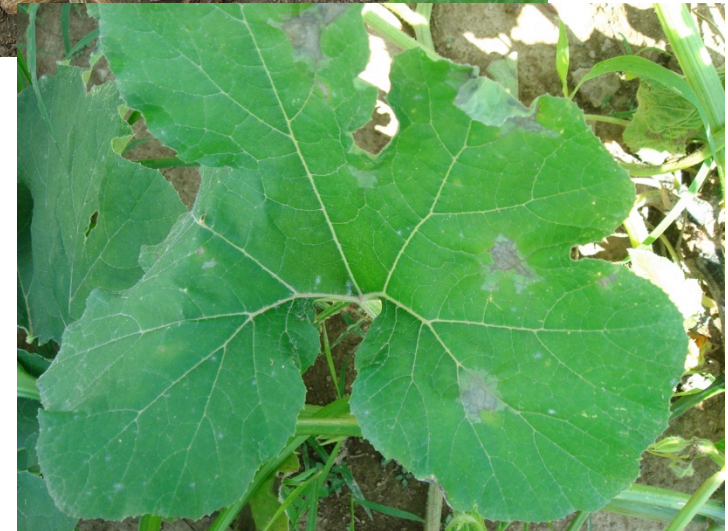
# Monitoring for Cucurbit Downy Mildew

- OSU Sentinel Plots
  - Wayne, Sandusky, Huron, Clark counties
- Submit samples to OSU Vegetable Pathology Lab
  - Physical samples – drop off in Wooster, or Celeryville or Fremont Stations or send overnight or 2-day delivery
  - Digital samples – [miller.769@osu.edu](mailto:miller.769@osu.edu) or 330-466-5249
- Digital alerts
  - VegNet ([vegnet.osu.edu](http://vegnet.osu.edu)), Twitter (@OhioVeggieDoc), Ohio Veggie Disease News ([u.osu.edu/miller.769](http://u.osu.edu/miller.769))
  - CDMipmpipe.org



# Phytophthora Blight of Vine Crops

- Soilborne pathogen; long survival (6+ years)
- Favored by warm, rainy conditions
- Symptoms usually appear beginning mid-July







# Powdery Mildew- Squash/Pumpkin

- Usually appears in early- to mid-July
- Affects foliage, stems, pumpkin handles
- Foliage killed in susceptible varieties
- Management
  - Resistant varieties
  - Fungicides





- Gummy stem blight/  
black rot
- Plectosporium blight
- Anthracnose







# Angular Leaf Spot



- Cucumber most susceptible but all cucurbits may be affected
- Favored by



d



# Bacterial Leaf Spot







# Bacterial Fruit Blotch



- Mainly an economic problem on watermelon
  - Can affect other vine crops
- First symptoms are water-soaked spots on lower sides of cotyledons
- Major symptoms are dark olive green spots on surface of fruit

R G O'Brien and Christine Horlock



# Bacterial Wilt



- Transmitted by cucumber beetles
- Cucumbers most susceptible but other cucurbits affected
- Plants infected early likely to wilt and die





# Yellow Vine Decline



- Leaves turn yellow, phloem discolored (honey yellow), plants collapse
- Transmitted by squash bug

Squash bug eggs



# Mosaic Viruses

- Cucumber mosaic
- Watermelon mosaic
- Zucchini yellow mosaic
- Transmitted by aphids





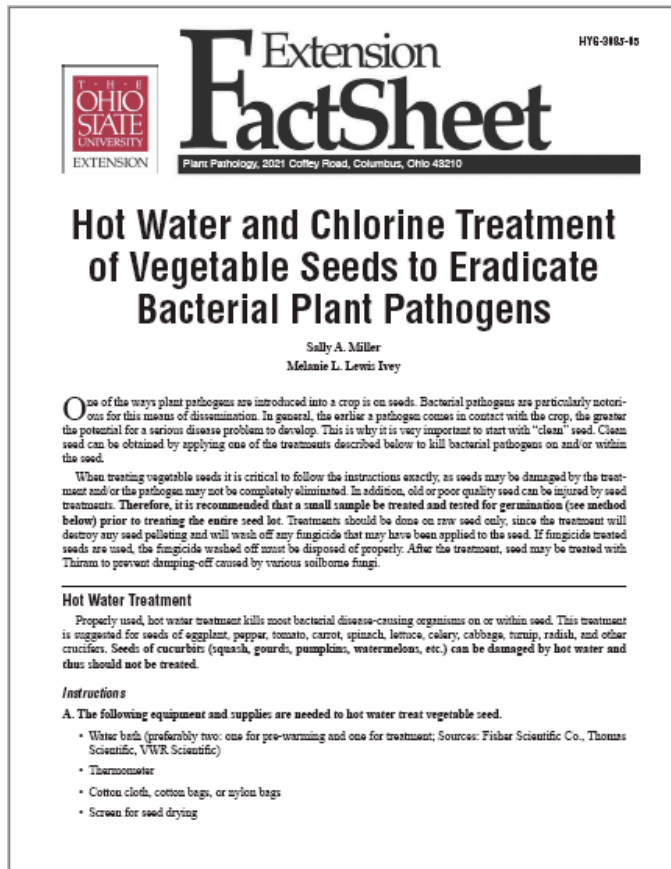


# 6-Step Integrated Vine Crop Disease Management Program

1. Use clean seed
2. Choose a resistant variety
3. Use pathogen-free transplants
4. Choose the best site and rotate
5. Use appropriate cultural practices
6. Use crop protectants as needed



# 1. Use Clean Seed

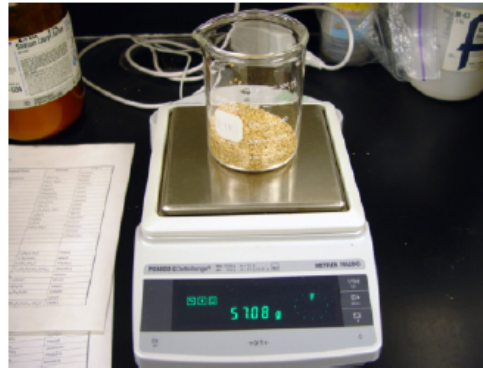


- Use certified seed
  - “Pathogen-tested”
  - Does not guarantee “pathogen-free”
- Treat seeds
  - Hot water or
  - Dilute Clorox
  - Always pre-test



# Seed Treatment with Bleach

**Step 1:** Agitate seed in a solution of 25 oz Clorox plus 100 oz water with one teaspoon surfactant for 1 minute. Use 1 gallon of disinfectant solution per pound of seed (conversions provided below) and prepare a fresh solution for each batch.



**Step 2:** Rinse seed thoroughly in cold running tap water for 5 minutes.



Then dry seeds in a single layer.

Plant within 2 weeks.



# Hot Water Seed Treatment

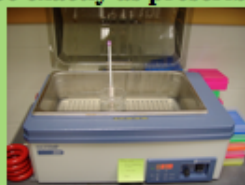
**Step 1:** Wrap seed in a loosely woven cotton bag (such as cheesecloth) or nylon bag. Seed should be loose in bag and bag should not be over one half full.



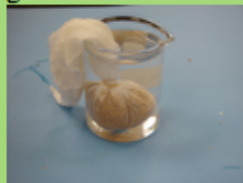
**Step 2:** Pre-warm seed for 10 minutes in 100°F (37°C) water.



**Step 3:** Place pre-warmed seed in a water bath that will constantly hold the water at 122°F (50°C) for 25 minutes. **Length of treatment time and temperature of water must be exactly as prescribed.**



**Step 4:** After treatment, place bags in cold water for 5 minutes to stop heating action.



**Step 5:** Spread seed on screen to dry.





# Seedborne Diseases of Vine Crops

Disease		Possible Treatments	
	Pathogen-Tested Seed Available	Hot Water*	Chlorine
Gummy stem blight/black rot			✓
Anthraxnose			✓
Angular leaf spot	(✓)	✓	
Bacterial spot			✓
Bacterial fruit blotch	✓		

\* Hot water treatment may damage vine crop seeds; test a small number first!



## 2. Choose a Resistant Variety

- Check with seed suppliers or Cornell Vegetable MD online tables
  - <http://vegetablemdonline.ppath.cornell.edu/Tables/TableList.htm>
- “Tolerance” means “partial resistance”
- Consider other disease problems and market requirements when choosing a variety
- Few options for resistance to bacterial diseases in vine crops

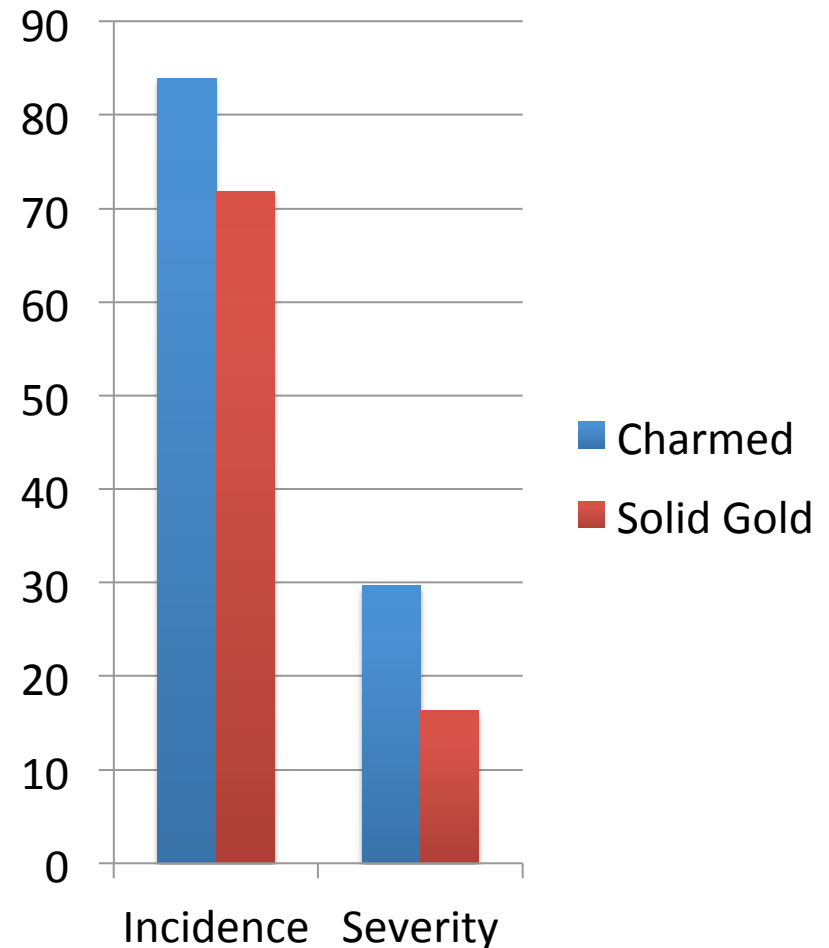


# Resistance to Diseases in Vine Crops

Disease	Cucumber	Summer Squash	Winter Squash	Pumpkin	Water-melon	Melon
Powdery mildew	+++++	+++	+++	+++++	-	+++++
Alternaria blight	+	-	-	-	-	-
Anthracnose	++	-	-	-	+++++	-
Downy mildew	partial	-	-	-	-	partial
Phytophthora fruit rot	-	-	-	+	-	-
Angular leaf spot	+++++	-	-	-	-	-
Bacterial wilt	+	-	-	-	-	-
Mosaic viruses	++	+++	+	-	-	



# Resistance to Bacterial Spot-Pumpkin



Data: Jim Jasinski et al. OSU





### 3. Use Pathogen-Free Transplants

- The goal is to keep pathogen populations low on seedlings
  - Use new or sanitized plug trays/flats and pathogen-free mixes
  - Sanitize equipment and tools regularly; install solid flooring/raise seedlings from floor
  - Restrict movement of personnel, tools and equipment between greenhouses
  - Thoroughly clean and sanitize house after each crop



### 3. Use Pathogen-Free Transplants

- Prohibit the production of exotic or experimental varieties unless seed was treated
- Scout regularly and destroy plants with symptoms and surrounding flats
- Minimize moisture – “dry growing”
- Use only municipal or well water – avoid surface water unless it is treated to kill pathogens



## 4. Choose the Best Site and Rotate

- Site selection
  - Well-drained
  - Good air movement
  - Sunny
- Rotate rotate rotate
  - Rotate out of the cucurbit family
    - ALS- 3 years
    - Xanthomonas bacterial spot – 2 years
    - Bacterial fruit blotch – 3 years
    - Bacterial wilt – 3 years
    - Phytophthora blight – 5 years
    - Anthracnose, Alternaria, Gummy stem blight/black rot – 3 years



## 5. Use Best Cultural Practices

- Avoid handling plants when they are wet
- Sanitize hands, boots and tools between fields
- Clean and sanitize equipment between fields
- Maintain reduced-stress growing conditions
  - Well-drained soil
  - Appropriate fertilizer (adequate but not excessive N)
  - Regular irrigation if needed
  - Improved organic matter content – cover crops, compost
  - Destroy weeds (especially in the cucurbit family) in and near production fields





## 5. Use Best Cultural Practices

- Remove wilted/dying plants early in an epidemic to reduce amount of inoculum present
- Destroy foliage and vines as soon as possible after harvest



Bacterial wilt diagnostic test



## 6. Use Crop Protectants

- Use fungicides in an integrated disease management program
  - Follow label recommendations
  - Follow guidelines for fungicide resistance management
- Bactericides not highly effective against bacterial diseases
  - Plant activators may be helpful for bacterial disease control



# Cucurbit Downy Mildew Fungicides

Product	PHI (days)	FRAC Code	Rel. Eff.	Comments
Chlorothalanil	0	M5	+++	Protectant –use higher rate w/high pressure
Mancozeb	5	M3	++	Protectant; tank mix partner
Orondis	0	U15	+++++	NEW – highly effective against downy mildews
Ranman	0	21	++++	High rate recommended
Previcur Flex	2	28	+++	
Tanos	3	11 + 27	++	Must be tank mixed with mancozeb or related
Gavel	5	22 + M3	++	
Zing!	0	22 + M5	+++	Like Gavel but chlorothalanil replaces mancozeb
Presidio	2	43	-	Failed in many locations in 2015
Curzate	3	27		Up to 2 days curative activity but low residual (3-5 d)
Zampro	0	40 + 45	+++	





# 2015 Cucumber Downy Mildew Trial-OSU

- Under *moderate disease pressure* (~30% disease in non-treated control) the following were equally effective:
  - Two or three Orondis AB (OXTP+Bravo WS) applications alternated with 1.5 pt/A Bravo WeatherStik
  - Zing! at 32 and 36 fl oz/A
  - Ranman 0.17 pt/A alternated with 2.0 pt/A Bravo WeatherStik + 2.0 lb/A Gavel



# Downy Mildew Management

- Protection before disease appears in area:
  - Apply effective fungicides on a 7-10 day schedule, tank mixed with Bravo, Manzate or Dithane. Alternate products.
- Management after disease appears in area:
  - Shorten above application interval to 5-7 days, unless conditions are very dry and warm.
- Follow labels for fungicide resistance management



# Phytophthora Blight Fungicides

Product	PHI (days)	FRAC Code	Rel. Eff.	Comments
Orondis A	0	U15	++++	NEW – most effective against Phytophthora blight
Ranman 400SC	0	21	+++	
Forum 4.18SC	0	40	+++	
Tanos 50WG	3	11 + 27	+++	Foliar/fruit phase only
Gavel 75DF	5	22 + M3	+++	
Zing!	0	22 + M5		Efficacy data not available
Presidio 4SC	2	43	+++	
Revus	1	40	+++	
Ridomil Gold SL	7	4	+++	Insensitivity to Ridomil occurs in some locations
Zampro	0	40 + 45	+++	





# Phytophthora Blight of Cucumber

- Cucumber vines not usually damaged seriously
- Fruit very susceptible
- Use fungicides with short PHI
- Apply fungicides + copper fungicide at 1", 3" and 5" fruit stage
- Assure good fruit coverage



Symptoms usually start appearing  
in mid-July



# Phytophthora Blight of Summer Squash

- Vines and fruit very susceptible
- Apply fungicides prior to symptoms
- Use fungicides with short PHI
  - Orondis (0)
  - Forum (0)
  - Presidio (2)
  - Revus (1) \*(not effective against downy mildew)
  - Tank mix w/ copper fungicides



Symptoms usually start appearing in mid-July





# Phytophthora Blight of Winter Squash/Pumpkin

- Vines and fruit very susceptible
- Apply fungicides prior to symptoms



Symptoms usually start appearing  
in mid-July



# Orondis: Oxathiapiprolin (OXTP)

- Highly effective against downy mildews, late blight and Phytophthora blight
- Resistance management is CRITICAL
  - 2.0-4.8 fl oz/A, 5-14 d application interval
  - MAX six foliar apps, 19.2 fl oz/A/yr
  - No more than two sequential applications of Orondis before switching to a fungicide with a different mode of action
  - Not more than 33% of foliar fungicide apps
  - Rotate with fungicides with different mode of action
  - Tank mix with a fungicide with a different mode of action
  - Do not follow soil applications of Orondis with a foliar application of Orondis Ultra A





# Orondis for 2016

- Eventually Syngenta will offer the following as pre-mix. For 2016, will offer as co-pack (both products in same box, two separate bottles + two separate labels)
- Orondis Opti = OXTP (A) + Bravo WS (B)
  - Downy mildew, Phytophthora blight and late blight management
- Orondis Ultra = OXTP (A) + Revus (B)
- Orondis Gold = OXTP (A) + Ridomil Gold\*
  - Can be used for Phytophthora blight, late blight
  - Or select Orondis Opti and alternate with effective product, e.g. Presidio, Revus, Forum, etc. (see table)

\*Insensitivity to Ridomil in the Phytophthora blight and late blight pathogens has been noted in some areas



# *Approximate Orondis Pricing*

- **All are 20 acre Co-packs containing a jug of Orondis and a jug of the companion fungicide**
  - Orondis Gold (Ridomil) approx. cost / acre = \$64.00
  - Orondis Opti (Bravo WS) approx. cost / acre based on vine crop rate = \$42.00
  - Orondis Opti (Bravo WS) approx. cost / acre based of fruiting crop rate = \$32.00
  - Orondis Ultra (Revus) approx. cost / acre = \$30.14



# Powdery Mildew Fungicides

Product	PHI (days)	FRAC Code	Rel. Eff.	Comments
Procure 50WS	0	3	+++	
Rally 40W	0	3	+++	
Monsoon, Toledo	7	3	+++	
Aprovia Top	0	3+1	+++	
Inspire Super	7	3+9	+++	
Fontelis	1	7	+++	
Merivon	0	7+11	+++	
Pristine 39WG	0	7+11	++	Fungicide insensitivity may occur
Quintec	3	13	++++	
Microthiol Disperss	0	M2	+++	Can cause crop injury at temp > 90F
Torino	0	U6	+++	

+++ = Good; ++ = Fair



# Fungicides for Other Fungal Diseases

Product	PHI (days)	FRAC Code	Relative Efficacy			
			Gummy stem blight	Plecto- sporium	Alternaria	Anthracnose
Bravo & related	0	M	+++	+++	+++	+++
Dithane & related	5	M	+++	+++	+++	+++
Cabrio, Flint Quadris	0 1	11	- (R)	+++	+++	+++
Fontelis	1	7	- (R)		+++	
Merivon	0	7+11	- (R)		+++	+++
Pristine 39WG	0	7+11	- (R)		+++	+++
Tanos	3	27+11			+++	+++
Monsoon, Toledo	7	3	+++			
Inspire Super	7	3+9	+++	+++	+++	+++
Switch	1	9+12	+++		+++	



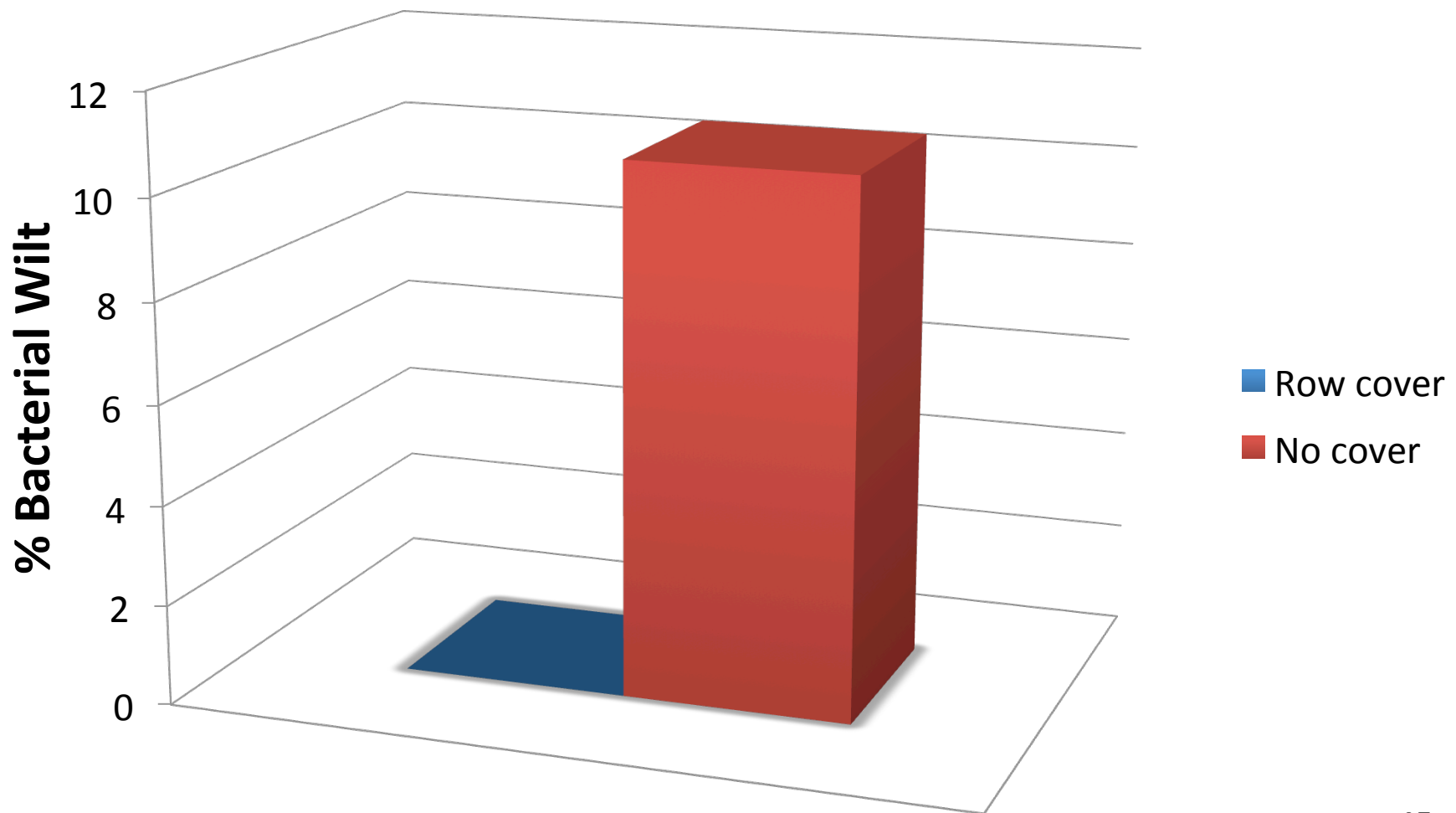


## Use of Row Covers and Biorational Fungicides to Manage Bacterial Wilt and Downy Mildew in Cucumber

- Parthenocarpic cucumber variety 'Lisboa'
- Floating row covers removed for harvest and treatments and replaced throughout season

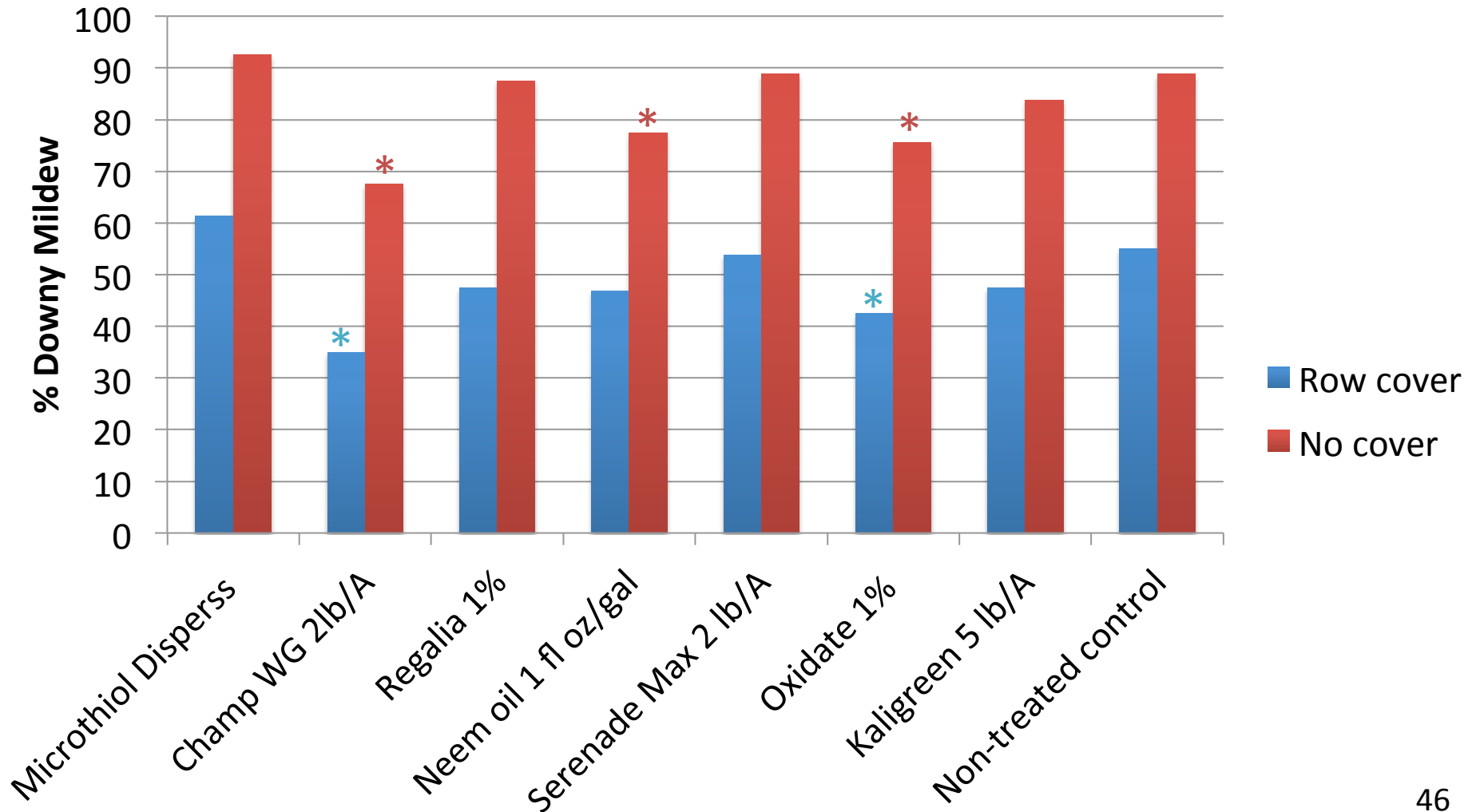


# Effect of Row Covers on Bacterial Wilt Incidence





# Effect of Row Covers on Cucumber Downy Mildew





## 6. Use Crop Protectants – Bacterial Wilt

- Scout regularly for cucumber beetles; apply insecticides once thresholds have been exceeded.
  - Pumpkins: apply insecticides after seedling emergence if threshold of 0.5 beetles/plant (cotyledon stage) or 1 beetle/plant (1-2 leaf stage) is exceeded
- At-plant (e.g. Admire) or foliar insecticides as soon as plants emerge and on 5-day intervals until cucumber beetle infestations subside.



# Effect of Antibacterial Products on Bacterial Spot of Pumpkin

Treatment and Rate/A	Bacterial spot incidence (%)		Bacterial spot severity (%)	
	Charmed	Solid Gold	Charmed	Solid Gold
<u>Actigard 50WG 1 oz</u>	45.2 b	18.6 c	5.8 c	1.9 c
<u>Kasumin 2L 1 qt +</u> <u>Activator 90 0.25 %</u>	72.0 a	64.8 <u>ab</u>	14.2 <u>bc</u>	4.7 <u>bc</u>
<u>Kocide 3000 DF 1 lb</u>	78.0 a	56.5 b	18.9 <u>ab</u>	9.3 b
<u>Serenade Max 3 lb</u>	82.7 a	60.7 <u>ab</u>	29.1 <u>ab</u>	7.6 b
<u>OxiDate 1:100</u>	88.0 a	66.5 <u>ab</u>	16.8 <u>abc</u>	8.7 b
Untreated control	83.9 a	71.8 a	29.7 a	16.3 a

Nine applications

Data provided by Jim Jasinski, OSU





# OSU Vegetable Pathology Program

- Diagnostic Lab Contacts
  - Sally Miller [miller.769@osu.edu](mailto:miller.769@osu.edu)
  - Francesca Rotondo [rotondo.11@osu.edu](mailto:rotondo.11@osu.edu)
  - [http://www.oardc.ohio-state.edu/sallymiller/t08\\_pageview3/Diagnostics\\_Services.htm](http://www.oardc.ohio-state.edu/sallymiller/t08_pageview3/Diagnostics_Services.htm)
- Ohio Veggie Disease News
  - [u.osu.edu/miller.769/](http://u.osu.edu/miller.769/)
- Veggie Disease Facts
  - [u.osu.edu/veggiediseasefacts/](http://u.osu.edu/veggiediseasefacts/)
- High Tunnel Disease Facts
  - [u.osu.edu/hightunneldiseasefacts/](http://u.osu.edu/hightunneldiseasefacts/)
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