



# Vegetable Disease Management Research Update

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# Cucumber/Melon Diseases

- Downy mildew
- Phytophthora blight
- Powdery mildew



Powdery mildew



Downy mildew

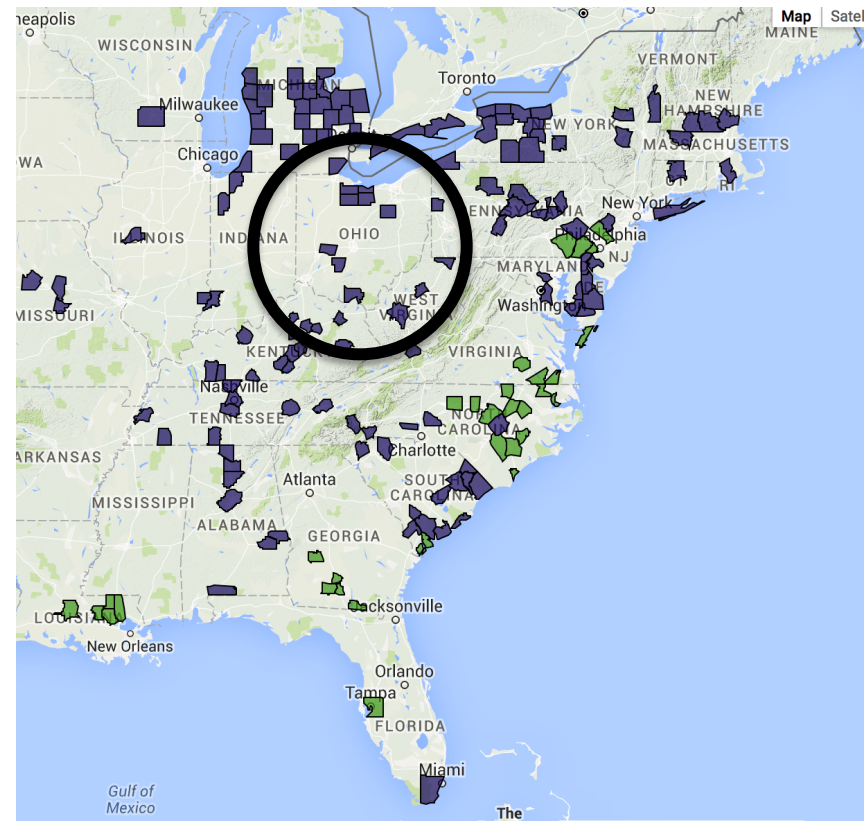


Phytophthora  
blight



# 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



# 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



# 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 Cucurbits

- Soilborne pathogen; long survival (6+ years)
- Favored by warm, rainy conditions
- Symptoms usually appear beginning mid-July
- Management
  - Crop rotation (cucurbits, peppers, tomatoes, green beans susceptible)
  - Well-drained soil
  - Irrigation water from well – many surface water sources contaminated with *Phytophthora*
  - Raised beds
  - Sanitation of equipment between fields
  - Fungicides
  - No resistant varieties



# Phytophthora Blight of Peppers

- Management
  - Crop rotation
  - Resistant varieties
  - Well-drained soil
  - Irrigation water from well
  - Raised beds
  - Sanitation of equipment between fields
  - Fungicides





# Phytophthora Blight of Peppers

- Varieties – moderate to good resistance
  - Root and crown rot phases only (fruit and foliage susceptible)
    - Paladin, Aristotle, Archimedes, Revolution, Declaration, Intruder Vanguard (bell)
    - Hechicero (jalapeño)
    - Sequoia (ancho)





# 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 Fungicides – Cucurbit/Pepper Use Allowed

Fungicide	Cucum- ber	Melon	Summer squash	Winter squash	Pumpkin	Pepper
Orondis A	✓	✓	✓	✓	✓	✓
Ranman 400 SC	✓	✓	✓	✓	✓	✓
Forum 4.18SC	✓	✓	✓	✓	✓	✓
Tanos	✓	✓	✓	✓	✓	✓
Gavel 75DF	✓	✓	✓			
Zing!	✓	✓	✓	✓	✓	
Presidio 4SC	✓	✓	✓	✓	✓	✓
Revus 2.08SC	✓	✓	✓	✓	✓	✓
Ridomil Gold SL						✓
Zampro	✓	✓	✓	✓	✓	✓





# 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 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 Winter Squash/Pumpkin

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



Symptoms usually start appearing  
in mid-July



# Tomato and Potato Late Blight

- All isolates of *P. infestans* tested from Ohio so far are US23 strains
- US23 strains generally sensitive to Ridomil
- Bravo WeatherStick and other chlorothalanil products good protectants against US23
- Some resistant tomato varieties available







# Late Blight Fungicides

- **Agri-Fos 50WP<sup>®</sup>**. See label for rate. 0-day PHI
- **Chlorothalonil** and **mancozeb**. 0-day PHI for chlorothalonil. 5-day PHI for mancozeb. Best used in tank mixes with other products.
- **Curzate<sup>®</sup>** at 3.2-5 oz. per acre. Apply Curzate<sup>®</sup> plus a contact (protectant) fungicide. 3-day PHI.
- **Gavel 75DF<sup>®</sup>** at 1.5-2 lbs. per acre. 5-day PHI.
- **Orondis** (see later slides)
- **Previcur Flex<sup>®</sup>** at 0.7-1.5 pts. per acre. GH label also. 5-day PHI.
- **Presidio<sup>®</sup>** at 3-4 fl. oz. per acre. 2-day PHI.
- **Prophyt<sup>®</sup>**. See label for rate. 0-day PHI.



# Late Blight Fungicides

- **Ranman 400SC<sup>®</sup>** at 2.1-2.75 fl. oz. per acre. 0-day PHI.
- **Revus Top<sup>®</sup>** at 5.5-8 fl. oz. per acre. 1-day PHI.
- **Ridomil Gold Bravo SC<sup>®</sup>** at 2.5 pt per acre. Only use when late blight strains in the area are known to be sensitive to Ridomil. Tank mix with a penetrating surfactant and don't use a sticker. 5-day PHI.
- **Tanos 50WP<sup>®</sup>** at 8 oz. per acre. Tank mix with a contact fungicide with a different mode of action. 3-day PHI.
- **Zampro<sup>®</sup>** at 14 fl oz (tomato) Or 11-14 fl oz (potato) per acre. 0-day PHI.



# 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- Squash/Pumpkin

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





# Powdery Mildew Fungicides

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

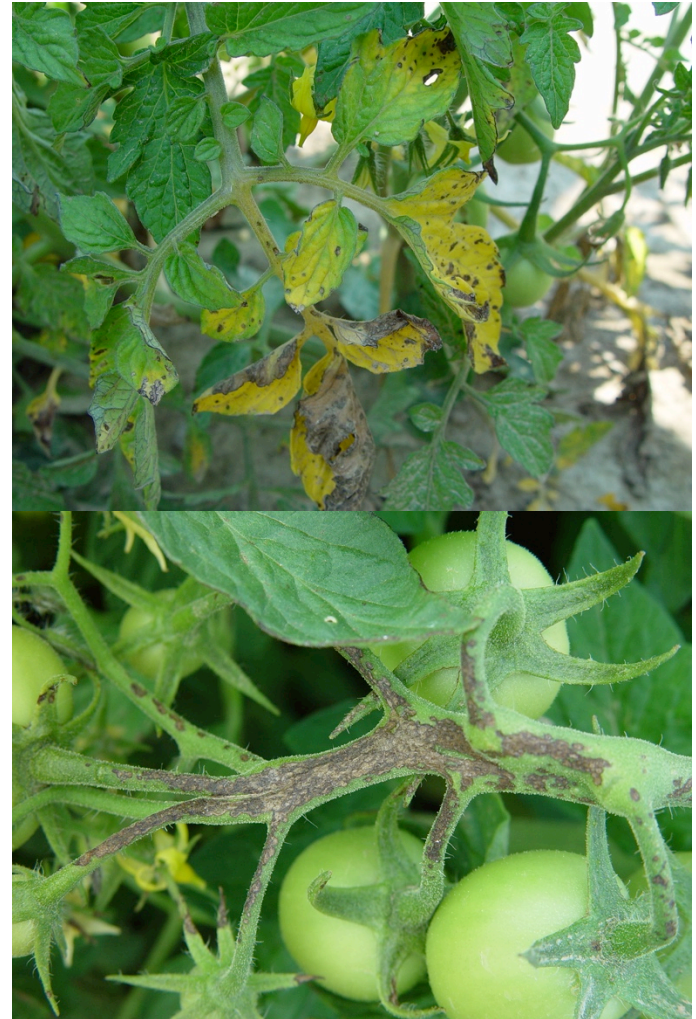


# Bacterial Disease Management



# IR-4 Project: Tomato Bacterial Canker

- Tomatoes inoculated in field with bacterial canker pathogen
  - Two plants on end of each row
- Initial treatments applied before inoculation
- Disease allowed to spread in rows
- Page 6 in PP series 145





# Results: Bactericide Treatments

Treatment and rate	Days after first application	% bacterial canker
Non-treated Non-Inoculated		8.5 f
Non-treated Inoculated		19.9 b
Actigard 50WG 0.25 oz (drench) <sup>v</sup> K-Phite 7LP 3.0 qt	0, 8, 15, 22, 32, 39, 46, 53, 60, 67	10.5 ef
CEASE 6.0 qt + MilStop 2.0 lb	0, 8, 15, 22, 32, 39, 46, 53, 60, 67	18.1 bc
Double Nickel LC 2.0 qt (drench) <sup>u</sup> Double Nickel LC 1.0 qt	0, 8, 15, 22, 32, 39, 46, 53, 60, 67	15.9 b-d
AgriPhage CMM 1 pt/50 gal alt AgriPhage CMM 2 pt/50 gal alt TerraClean 5.0 12.8 fl oz/100 gal (drench) <sup>t</sup>	8, 15 22, 32, 39, 46, 53, 60, 67 0, 15, 32, 46, 60	18.6 bc
Oxidate 2.0 1.0 gal/100 gal	8, 15, 22, 32, 39, 46, 53, 60, 67	19.8 b
Oxidate 2.0 1.0 gal/100 gal <sup>q</sup> alt AgriPhage Cmm 1.0 pt/50 gal alt AgriPhage Cmm 2.0 pt/50 gal	8, 13, 18, 27, 32 8, 15, 22, 32, 39, 46, 53, 60, 67	20.5 b



# Results: Bactericide Treatments (cont.)

Treatment and rate	Days after first application	% bacterial canker
Non-treated Non-Inoculated		8.5 f
Non-treated Inoculated		19.9 b
Actigard 50WG 0.25 oz (drench) <sup>v</sup> K-Phite 7LP 3.0 qt + AgriPhage Cmm 1.0 pt/50 gal + AgriPhage Cmm 2.0 pt/50 gal	0, 8, 15, 22, 32, 39, 46, 53, 60, 67 8, 15 22, 32, 39, 46, 53, 60, 67	11.5 d-f
K-Phite 7LP 3.0 qt + AgriPhage Cmm 1.0 pt/50 gal + AgriPhage Cmm 2.0 pt/50 gal	0, 8, 15, 22, 32, 39, 46, 53, 60, 67 8, 15 22, 32, 39, 46, 53, 60, 67	14.1 c-e
Cueva 2.0 qt	0, 8, 15, 22, 32, 39, 46, 53, 60, 67	12.3 d-f
Manzate ProStik 75DF 2.0 lb + Actigard 50WG 0.33 oz (43.8 gpa) + Actigard 50WG 0.5 oz (65.8 gpa) + Actigard 50WG 0.75 oz (82 gpa)	0, 8, 15, 22, 32, 39, 46, 53, 60, 67 0, 8 15, 22 32, 39, 46, 60, 74, 88	28.3 a



# Tomato Bacterial Spot

- All plants inoculated with the bacterial spot pathogen
- Treatments began before inoculation (applied preventatively)
- Disease pressure low-moderate
- Page 9 in PP series 145





# Results: Bactericide Treatments

Treatment and rate/A	Days after first application	Bacterial leaf spot	
		% disease (9 Sep)	AUDPC
Quintec 250SC 6.0 fl oz alt Kocide 3000WG 1.25 lb + Dithane F-45SC 48.0 fl oz	0, 17, 34, 49 7, 27, 41, 56	23.0 ab	266.9 a
Quintec 250SC 6.0 fl oz	0, 7, 17, 27, 34, 41, 49, 56, 66, 73	25.3 a	283.6 a
Quintec 250SC 6.0 fl oz + Kocide 3000WG 1.25 lb	0, 7, 17, 27, 34, 41, 49, 56, 66, 73	14.5 bcd	209.0 a
Kocide 3000WG 1.25 lb	0, 7, 17, 27, 34, 41, 49, 56, 66, 73	18.0 abc	208.4 a
Bravo WeatherStik 6SC 2.0 pt alt Fracture 254SL 24.5 oz + Activator 90SL 0.25% v/v	0, 17, 34, 49, 66 7, 27, 41, 56, 73	18.0 abc	309.4 a
Bravo WeatherStik 6SC 2.0 pt alt Fracture 254SL 24.5 oz + Activator 90SL 0.25% v/v	0, 7, 34, 41, 66, 73 17, 27, 49, 56	11.0 cd	211.3 a
Koverall 75WG 1.5 lb alt Fracture 254SL 24.5 oz + Activator 90SL 0.25% v/v	0, 17, 34, 49, 66 7, 27, 41, 56, 73	7.0 d	94.5 a
Koverall 75WG 1.5 lb alt Fracture 254SL 24.5 oz + Activator 90SL 0.25% v/v	0, 7, 34, 41, 66, 73 17, 27, 49, 56	6.8 d	122.8 a
Non-treated control		21.0 ab	256.3 a



# Pepper Bacterial Leaf Spot

- Products applied preventatively
- Bacterial spot moved into trial naturally from an adjacent inoculated trial
- Disease pressure moderate-to-high
- Page 16 in PP Series 145







# Results: Bactericide Treatments

Treatment and rate/A	Days after first application <sup>z</sup>	Bacterial leaf spot	
		% disease (12 Aug) <sup>y</sup>	AUDPC
Bravo WeatherStik 6SC 1.5 pt alt Fracture 254SL 24.5 fl oz + Activator 90SL 0.25% v/v	0, 7, 34, 41 17, 27, 49	23.0 ab <sup>u</sup>	616.8 a
Fracture 254SL 24.5 fl oz + Activator 90SL 0.25% v/v alt Bravo WeatherStik 6SC 1.5 pt	0, 27, 49 7, 17, 34, 41	23.3 ab	553.3 a
Koverall 75WG 1.5 lb alt Fracture 254SL 24.5 fl oz + Activator 90SL 0.25% v/v	0, 7, 34, 41 17, 27, 49	23.3 ab	563.7 a
Fracture 254SL 24.5 fl oz + Activator 90SL 0.25% v/v alt Koverall 75WG 1.5 lb	0, 27, 49 7, 17, 34, 41	21.3 b	496.7 a
Kocide 3000 46.1WG 1.25 lb + Koverall 75WG 1.5 lb	0, 7, 17, 27, 34, 41, 49	16.7 b	387.0 a
Non-treated Control		30.0 a	578.7 a
P Value		0.0857	0.2346





# Sanitizing Seed Treatments to Manage Bacterial Diseases

- Can seed treatment minimize bacterial diseases of muck vegetables?
  - Hot water – eradicates plant pathogenic bacteria inside seed and on seed coat
  - 20% bleach – eradicates bacteria on seed coat
- Can Actigard treatment reduce bacterial disease development?



# Experimental Approach

- Use seed lots suspected of harboring bacterial diseases
  - Parsley – bacterial leaf spot
  - Collards – peppery spot
- Treat seeds with hot water or 20% chlorine
- On-farm
  - Plots planted and managed by Buurma Farms
- On-station – Muck Crops Experiment Station
  - Plots also treated with Actigard - foliar



# Parsley Bacterial Leaf Spot

- *Pseudomonas syringae*  
pv. *coriandricola*
- Seedborne disease
- Also survives in soil  
associated with plant  
tissue several years





# Peppery Spot of Collards

- *Pseudomonas syringae*  
pv. *maculicola*
- Seedborne disease
- Also survives in soil  
associated with plant  
tissue several years





# Results: Parsley Seed Treatment- Muck Crops Station

Treatment and rate/A	Days after first application	% bacterial leaf spot (9 July)
Hot water-treated parsley seeds		5.3a
Hot water-treated parsley seeds + Actigard 50WG 0.33 oz	0, 7, 13, 29	3.3 a
Chlorine-treated parsley seeds		7.3 a
Chlorine-treated parsley seeds + Actigard 50WG 0.33 oz	0, 7, 13, 29	6.7 a
Non-treated parsley seeds		5.7 a
Non-treated parsley seeds + Actigard 50WG 0.33 oz	0, 7, 13, 29	9.7 a
P Value		0.2446



# Results: Parsley Seed Treatment- Buurma Farms

Treatment and rate/A	Bacterial leaf spot <sup>z</sup>			
	% disease (25 Jun)	% disease (9 July)	% disease (15 July)	AUDPC
Hot water-treated parsley seeds	2.3 a	2.0 b	1.0 a	23.9 b
Non-treated parsley seeds	5.3 a	7.8 a	0.8 a	71.0 a
P Value	0.1227	0.0020	0.6202	0.0010





# Results: Collards Seed Treatment- Muck Crops Station

Treatment and rate/A	Days after first application	% peppery spot (9 July)
Hot water-treated collards seed		2.7a
Hot water-treated collards seed + Actigard 50WG 0.5 oz foliar	0, 7, 13, 29	1.7 a
Chlorine-treated collards seed		5.7 a
Chlorine-treated collards seed + Actigard 50WG 0.5 oz foliar	0, 7, 13, 29	2.7 a
Non-treated collards seed		6.7 a
Non-treated collards seed + Actigard 50WG 0.5 oz foliar	0, 7, 13, 29	3.7 a
P Value		0.6573



# Results: Collards Seed Treatment- Buurma Farms

Treatment and rate/A	Peppery spot	
	% disease (25 Jun)	% disease (9 July)
Hot water treated collards seed	1.0a <sup>y</sup>	8.3
Non-treated collards seed	2.3 a	1.8
P Value	0.3308	0.1332



# Managing Bacterial Diseases

- Use resistant varieties if available
- Sanitizing seed treatment
  - If not previously treated
  - If not primed
- Sanitize equipment
- More research needed on Actigard
  - Drench applications



# 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/)
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