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Vegetable Disease Management Research Reports 2016

Tomato, Pepper, Cucumber, Squash and Cantaloupe

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Evaluation of fungicides and bactericides for the control of bacterial leaf spot of processing tomatoes, 2016.

The experiment was conducted at the Ohio Agricultural Research and Development Center's North Central Agricultural Research Station in Fremont, OH on Colwood fine sandy loam soil. On 18 Apr the test field was plowed and potassium (240 lb/A K_2O), phosphorous (52 lb/A P_2O_5), nitrogen (126 lb/A NH_4NO_3), and boron (10 lb/A) were incorporated. The field was disked on 19 Apr and raised beds were prepared on 5 ft centers on 25 April. Tomato 'Peto 696' seeds were hot water-treated (10 min pre-soak at 100° F, treatment for 25 min at 122° F) and sown on 15 Apr into 288-cell plug trays containing Baccto Professional Grower Mix. Raised beds were reshaped on 19 May. The herbicides Dual II Magnum (20 fl oz/A) plus Sencor (0.33 lb/A) were applied and incorporated into the test field on 23 May. An additional application of Sencor (0.33 lb/A) was made on 30 Jun. Tomato seedlings were transplanted on 7 Jun. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 25 plants spaced 1 ft apart with 5 ft between rows. Treated rows were alternated with non-treated border rows. Warrior II (1.9 fl oz/A), Hero EW (5 fl oz/A) and Coragen® Insect Control (5.0 fl oz/A) were applied on 21 Jun and 11 Aug; 7 Jul; and 21 Aug, respectively. Treatments were applied using a tractor-mounted CO_2-pressurized sprayer (55 psi, 43.2 gal/A, 3 mph) beginning 8 Jun and ending 1 Sep for a total of thirteen applications. The field was cultivated on 16 Jun and hand weeded and hoed on 21 Jun. Plants were overhead irrigated with 1.0 in. of water on 23 Jun, 15 and 28 Jul and 8 Aug. Plants were naturally infected with bacterial leaf spot, *X. euvesicatoria.* The severity of bacterial leaf spot on foliage was evaluated on 3, 12, 19 and 29 Aug and 7 Sep using a scale of 0-100% foliage affected, and Area Under the Disease Progress Curve (AUDPCs) was calculated. Fruits were harvested from five plants in the center of each treatment row on 15 Sep; weights of healthy fruit, fruit with bacterial leaf spot, anthracnose, blossom end rot, and minor fungal fruit rots were measured. Average maximum temperatures for 7-30 Jun, Jul, Aug and 1-15 Sep were 82.8, 85.9, 85.7 and 81.2°F; average minimum temperatures were 59.8, 64.9, 64.9 and 58.2°F; and rainfall amounts were 0.69, 1.45, 2.45 and 0.98 in., respectively. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Bacterial spot pressure was moderate in this trial; disease severity reached 45% in non-treated control plots by 7 Sep. All of the treatments significantly reduced bacterial spot foliar disease severity rated at the end of the season, as well as season-long disease progress (AUDPC) compared to the non-treated control. There were no significant differences among treatments in final disease severity or AUDPC. Plants treated with either of two programs containing Koverall 75WG + Topguard EQ alternated with Fracture SL produced significantly higher yields of marketable tomato fruit than plants treated with the other products or not treated. Plants treated with Koverall 75WG + Rhyme alternated with Fracture SL, or Oxidate SL + AquaSil also produced significantly higher marketable yields than non-treated control plants. Similar results were observed for the percentages of marketable fruits. The yield of tomato fruits with bacterial spot symptoms was low, and all treatments except Koverall 75WG 1.5 lb/A + Rhyme alternated with Fracture SL reduced the tonnage of fruit with bacterial spot symptoms compared to the non-treated control. All of the treatments reduced the percentage of ripe fruit with bacterial spot symptoms compared to the non-treated control. Plants treated with either of two programs containing Koverall 75WG + Topguard EQ alternated with Fracture SL produced significantly higher total fruit yield and percentage of healthy fruit, and significantly lower yield and percentage of fruit with anthracnose than plants treated with any of the other products or not-treated.

Treatment and rate (application timing[z])	Bacterial leaf spot - foliar	
	Severity (%) (7 Sep)[y]	AUDPC[yx]
Non-treated control	45.5 a[w]	926.0 a
Koverall 75WG 1.5 lb/A (1,2,5,6,7,8,9,11,12) + Topguard EQ 8 fl oz/A (5,7,8,9) alt Fracture SL 24.4 oz/A (3,4,10,13)	14.5 b	190.6 b
Koverall 75WG 1.5 lb/A (1,2,4,5,6,7,8,9,11,12) + Topguard EQ 8.0 fl oz/A (6,8,9,10) alt Fracture SL 24.4 oz/A (3,13)	9.0 b	104.6 b
Koverall 75WG 1.5 lb/A (1,2,4,5,6,7,8,9,11,12) + Rhyme 8 fl oz/A (6,8,9,10) alt Fracture SL 24.4 oz/A (3,13)	14.5 b	236.1 b
Oxidate 2.0 128 fl oz/100 gal + AqualSil 0.07% v/v + Serenade Optimum 26.2WP 8 oz/A (1-13)	16.3 b	172.6 b
Serenade Optimum 26.2WP 8 oz/A (1-13)	9.0 b	110.9 b
Oxidate 2.0 128 fl oz/100 gal + AqualSil 0.07% v/v (1-13)	14.0 b	155.8 b
P value	0.0729	0.0062

[z]Application dates: 1= 8 Jun; 2= 15 Jun; 3= 22 Jun; 4= 29 Jun; 5= 6 Jul; 6= 13 Jul; 7= 20 Jul; 8= 27 Jul; 9= 3 Aug; 10= 11 Aug; 11= 18 Aug; 12= 25 Aug; 13= 1 Sep.

[y]Disease ratings and area under the disease progress curve (AUDPC) were based on the percent foliar disease.

[x]Area under the disease progress curve values were calculated according to the formula: $\Sigma\ ([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.

[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$. Means were separated using Fisher's least significant difference test.

Treatment and rate (application timing[z])	Marketable (t/A)[y]	% marketable	BLS[x] (t/A)[y]	% BLS (ripe)
Non-treated control	16.8 d[w]	55.6 c	0.4 a	1.1 a
Koverall 75WG 1.5 lb/A (1,2,5,6,7,8,9,11,12) + Topguard EQ 8 fl oz/A (5,7,8,9) alt Fracture SL 24.4 oz/A (3,4,10,13)	42.7 a	88.4 a	0.1 c	0.1 b
Koverall 75WG 1.5 lb/A (1,2,4,5,6,7,8,9,11,12) + Topguard EQ 8.0 fl oz/A (6,8,9,10) alt Fracture SL 24.4 oz/A (3,13)	43.8 a	89.4 a	0.0 c	0.1 b
Koverall 75WG 1.5 lb/A (1,2,4,5,6,7,8,9,11,12) + Rhyme 8 fl oz/A (6,8,9,10) alt Fracture SL 24.4 oz/A (3,13)	32.1 b	71.5 b	0.3 ab	0.5 b
Oxidate 2.0 128 fl oz/100 gal + AqualSil 0.07% v/v + Serenade Optimum 26.2WP 8 oz/A (1-13)	23.0 cd	64.4 bc	0.0 c	0.1 b
Serenade Optimum 26.2WP 8 oz/A (1-13)	23.2 cd	64.5 bc	0.1 bc	0.2 b
Oxidate 2.0 128 fl oz/100 gal + AqualSil 0.07% v/v (1-13)	26.3 bc	68.4 b	0.1 bc	0.2 b
P value	<0.0001	<0.0001	0.0195	0.0043

[z]Application dates: 1= 8 Jun; 2= 15 Jun; 3= 22 Jun; 4= 29 Jun; 5= 6 Jul; 6= 13 Jul; 7= 20 Jul; 8= 27 Jul; 9= 3 Aug; 10= 11 Aug; 11= 18 Aug; 12= 25 Aug; 13= 1 Sep.

[y]Values were calculated based on 8712 plants per acre.

[x]BLS (t/A) values are based on BLS ripe and BLS green combined.

[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

Treatment and rate/A (application timing[z])	% healthy[y]	% anthracnose	Total yield (t/A)[x]	Anthracnose (t/A)[x]
Non-treated control	56.5 c[w]	35.9 a	30.3 d	10.9 a
Koverall 75WG 1.5 lb/A (1,2,5,6,7,8,9,11,12) + Topguard EQ 8 fl oz/A (5,7,8,9) alt Fracture SL 24.4 oz/A (3,4,10,13)	91.2 a	4.8 c	48.2 ab	2.2 b
Koverall 75WG 1.5 lb/A (1,2,4,5,6,7,8,9,11,12) + Topguard EQ 8.0 fl oz/A (6,8,9,10) alt Fracture SL 24.4 oz/A (3,13)	91.8 a	4.4 c	48.9 a	2.2 b
Koverall 75WG 1.5 lb/A (1,2,4,5,6,7,8,9,11,12) + Rhyme 8 fl oz/A (6,8,9,10) alt Fracture SL 24.4 oz/A (3,13)	73.8 b	21.4 b	44.8 abc	9.5 a
Oxidate 2.0 128 fl oz/100 gal + AqualSil 0.07% v/v + Serenade Optimum 26.2WP 8 oz/A (1-13)	65.3 bc	27.7 ab	35.8 cd	10.0 a
Serenade Optimum 26.2WP 8 oz/A (1-13)	66.1 bc	28.6 ab	35.9 cd	10.2 a
Oxidate 2.0 128 fl oz/100 gal + AqualSil 0.07% v/v (1-13)	69.6 b	26.0 b	38.7 bcd	9.9 a
P value	<0.0001	<0.0001	0.0034	0.0003

[z]Application dates: 1= 8 Jun; 2= 15 Jun; 3= 22 Jun; 4= 29 Jun; 5= 6 Jul; 6= 13 Jul; 7= 20 Jul; 8= 27 Jul; 9= 3 Aug; 10= 11 Aug; 11= 18 Aug; 12= 25 Aug; 13= 1 Sep.

[y]Percentage healthy values are based on healthy red and healthy green.

[x]Values were calculated based on 8712 plants per acre.

[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

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Bacterial leaf spot symptoms were observed on tomato seedlings at low levels in the greenhouse prior to transplanting. Disease incidence in seedlings treated with Mycoshield alone, Mycoshield alternated with Kocide 3000, or Innovotech B was significantly higher than that of non-treated control seedlings. Disease severity was very low (<1%) but significantly higher in seedlings treated with Mycoshield alone than in seedlings treated with other products or the non-treated control. Bacterial leaf spot disease pressure was moderate in the field. Disease incidence on tomato leaflets was significantly lower in plants drenched twice with Actigard 50WG in the greenhouse, followed by three Actigard 50WG treatments in the field, and plants treated with USF2018A 200SC or Innovotech B in the greenhouse and field, compared to non-treated control plants. Disease severity on leaflets was significantly lower for plants treated with either of the Actigard 50WG programs, USF 2018 200SC, Manzate Flowable + Kocide 3000, Agri-Mycin 17, or Innovotech B in the greenhouse and field. All of the treatments significantly reduced the incidence of bacterial spot lesions on fruit compared with the non-treated control, although there were no significant differences in the number of bacterial spot lesions on fruit collected from treated and non-treated plots. Assessment of bacterial spot in full plots did not differentiate among treatments, all of which significantly reduced final disease severity and season-long disease progress (AUDPC) compared to the non-treated control.

Bacterial leaf spot in seedlings (greenhouse)

Treatment and rate (application timing)	Bacterial leaf spot	
	Incidence (%)[z]	Severity (%)[y]
Non-treated control	0.2 d[v]	0.1 b
Actigard 50WG 0.25 oz/100 gal drench (1)[x]	4.2 b-d	0.1 b
Actigard 50WG 0.25 oz/100 gal drench (1,2)[x]	1.3 cd	0.0 b
USF2018A 200SC 3.4 fl oz/A (4)[w]	3.8 bcd	0.1 b
Manzate Flowable 2.4 qt/A + Kocide 3000 1 lb/A (2-4)[w]	3.1 bcd	0.0 b
Mycoshield 3.9 oz/25 gal (2-4)[w]	7.7 ab	0.4 a
Mycoshield 3.9 oz/25 gal (2,4)[w] alt Kocide 3000 1 lb/A (3)[w]	9.6 a	0.2 b
Agri-Mycin 17 3.9 oz/25 gal (2-4)[w]	1.0 cd	0.0 b
Innovotech A 0.10 % w/v (1-4)[w]	4.6 bcd	0.1 b
Innovotech B 0.14 % w/v (1-4)[w]	5.2 abc	0.1 b
P value	0.0061	0.0072

[z]Bacterial leaf spot disease incidence was calculated by randomly picking ten leaflets from each of the 12 selected plants per rep (288-cells flat divided into four sections). Incidence = (number of diseased leaves/number of leaves selected) x 100.
[y]Ten leaflets were picked from each of 12 randomly selected plants per replication from each treatment on 6 Jun and disease severity was rated using a scale of 0-100% foliage affected.
[x]Greenhouse drench application dates: 1= 23 May; 2= 31 May.
[w]Greenhouse foliar application dates: 1= 9 May; 2= 16 May; 3= 23 May; 4= 31 May.

[v]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

Bacterial leaf spot incidence and severity in the field

Treatment and rate (application timing)	Bacterial leaf spot			
	Leaflets		Fruits	
	Incidence (%)[z]	Severity (%)[y]	Incidence (%)[x]	Total w/ spots[w]
Non-treated control	37.3 a[r]	6.3 a	13.5 a	6.8
Actigard 50WG 0.25 oz/100 gal GH drench (1)[v] Actigard 50WG 0.33 oz/A + Activator 90SL 0.25% v/v (1,2)[ts] Actigard 50WG 0.5 oz/A + Activator 90SL 0.25% v/v (3,4)[ts] Actigard 50WG 0.75 oz/A + Activator 90SL 0.25% v/v (5-10)[ts]	20.5 ab	2.2 b	0.0 b	1.5
Actigard 50WG 0.25 oz/100 gal GH drench (1,2)[v] Actigard 50WG 0.33 oz/A + Activator 90SL 0.25% v/v (1,2)[ts] Actigard 50WG 0.5 oz/A + Activator 90SL 0.25% v/v (3,4)[ts] Actigard 50WG 0.75 oz/A + Activator 90SL 0.25% v/v (5-10)[ts]	8.3 b	0.5 b	2.1 b	0.5
USF2018A 200SC 3.4 fl oz/A GH foliar (4)[u] USF2018A 200SC 3.4 fl oz/A + (1-10)[t]	6.0 b	0.2 b	0.0 b	0.0
Manzate Flowable 2.4 qt/A + Kocide 3000 1 lb/A GH foliar (2-4)[u] Manzate Flowable 2.4 qt/A + Kocide 3000 1.75 lb/A (1-10)[t]	17.5 ab	1.3 b	0.0 b	0.0
Mycoshield 3.9 oz/25 gal GH foliar (2-4)[u] Mycoshield 15.7 oz/100 gal + Activator 90SL 0.25% v/v (1-10)[t]	33.0 a	4.2 ab	2.1 b	2.8
Mycoshield 3.9 oz/25 gal (2,4)[u] alt Kocide 3000 1 lb/A GH foliar (3)[u] Mycoshield 15.7 oz/100 gal + Activator 90SL 0.25% v/v (1,3,5,7,9)[t] alt Kocide 3000 1.75 lb/A + Activator 90SL 0.25% v/v(2,4,6,8,10)[t]	24.3 ab	3.1 ab	4.2 b	1.5
Agri-Mycin 17 3.9 oz/25 gal GH foliar (2-4)[u] Agri-Mycin 17 15.7 oz/100 gal + Activator 90SL 0.25% v/v (1-10)[t]	21.0 ab	1.7 b	2.1 b	0.8
Innovotech A 0.10 % w/v GH foliar (1-4)[u] Innovotech A 0.10 % w/v (1-10)[t]	17.8 ab	2.6 ab	5.2 b	4.0
Innovotech B 0.14 % w/v GH foliar (1-4)[u] Innovotech B 0.14 % w/v (1-10)[t]	8.0 b	0.6 b	0.0 b	0.0
P value	0.1069	0.1024	0.0307	0.1606

[z]Bacterial leaf spot disease incidence was calculated by randomly picking ten leaflets from each of the 12 selected plants in the field per replicate. Incidence = (number of diseased leaves/number of leaves selected) x 100.

[y]Ten leaflets were picked from each of 12 selected plants in the field per replication from each treatment on 12 Sep and disease severity was rated using a scale of 0-100% foliage affected.

[x]Bacterial leaf spot disease incidence on fruits was calculated by randomly picking 24 fruits per treatment per rep. Incidence = (number of diseased fruits/number of fruits selected) x 100.

[w]Values are the sum of the total number of spots counted on 24 fruits randomly selected from the field.

[v]Greenhouse drench application dates: 1= 23 May; 2= 31 May.

[u]Greenhouse foliar application dates: 1= 9 May; 2= 16 May; 3= 23 May; 4= 31 May.

[t]Field application dates: 1= 8 Jun; 2= 15 Jun; 3= 22 Jun; 4= 29 Jun; 5= 6 Jul; 6= 13 Jul; 7= 20 Jul; 8= 18 Aug; 9= 25 Aug; 10= 1 Sep.

[s]Gallons per acre (GPA): applications 1 and 2: 43.2 GPA; applications 3 and 4: 65.0 GPA; applications 5-10: 86.6 GPA.

[r]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.10. Means were separated using Fisher's least significant difference test.

Bacterial leaf spot disease progression in the field

Treatment and rate (application timing)	Foliar bacterial leaf spot[z]	
	Severity (%) (7 Sep)	AUDPC[y]
Non-treated control	45.5 a[t]	926.0 a
Actigard 50WG 0.25 oz/100 gal GH drench (1)[x] Actigard 50WG 0.33 oz/A + Activator 90SL 0.25% v/v (1,2)[vu] Actigard 50WG 0.5 oz/A + Activator 90SL 0.25% v/v (3,4)[vu] Actigard 50WG 0.75 oz/A + Activator 90SL 0.25% v/v (5-10)[vu]	5.0 b	41.5 b
Actigard 50WG 0.25 oz/100 gal GH drench (1,2)[x] Actigard 50WG 0.33 oz/A + Activator 90SL 0.25% v/v (1,2)[vu] Actigard 50WG 0.5 oz/A + Activator 90SL 0.25% v/v (3,4)[vu] Actigard 50WG 0.75 oz/A + Activator 90SL 0.25% v/v (5-10)[vu]	1.5 b	20.8 b
USF2018A 200SC 3.4 fl oz/A GH foliar (4)[w] USF2018A 200SC 3.4 fl oz/A + (1-10)[v]	2.2 b	46.0 b
Manzate Flowable 2.4 qt/A + Kocide 3000 1 lb/A GH foliar (2-4)[w] Manzate Flowable 2.4 qt/A + Kocide 3000 1.75 lb/A (1-10)[v]	6.3 b	59.7 b
Mycoshield 3.9 oz/25 gal GH foliar (2-4)[w] Mycoshield 15.7 oz/100 gal + Activator 90SL 0.25% v/v (1-10)[v]	8.5 b	99.3 b
Mycoshield 3.9 oz/25 gal (2,4)[w] alt Kocide 3000 1 lb/A GH foliar (3)[w] Mycoshield 15.7 oz/100 gal + Activator 90SL 0.25% v/v (1,3,5,7,9)[v] alt Kocide 3000 1.75 lb/A + Activator 90SL 0.25% v/v(2,4,6,8,10v	14.3 b	193.0 b
Agri-Mycin 17 3.9 oz/25 gal GH foliar (2-4)[w] Agri-Mycin 17 15.7 oz/100 gal + Activator 90SL 0.25% v/v (1-10)[v]	15.8 b	233.8 b
Innovotech A 0.10 % w/v GH foliar (1-4)[w] Innovotech A 0.10 % w/v (1-10)[v]	11.3 b	143.3 b
Innovotech B 0.14 % w/v GH foliar (1-4)[w] Innovotech B 0.14 % w/v (1-10)[v]	16.8 b	208.5 b
P value	0.0018	<0.0001

[z]Disease ratings were based on the percent (1-100%) foliar disease.

[y]Area under the disease progress curve values were calculated according to the formula: $\Sigma([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.

[x]Greenhouse drench application dates: 1= 23 May; 2= 31 May.

[w]Greenhouse foliar application dates: 1= 9 May; 2= 16 May; 3= 23 May; 4= 31 May.

[v]Field application dates: 1= 8 Jun; 2= 15 Jun; 3= 22 Jun; 4= 29 Jun; 5= 6 Jul; 6= 13 Jul; 7= 20 Jul; 8= 18 Aug; 9= 25 Aug; 10= 1 Sep.

[u]Gallons per acre (GPA): applications 1 and 2: 43.2 GPA; applications 3 and 4: 65.0 GPA; applications 5 and 10: 86.6 GPA

[t]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

TOMATO (*Solanum lycopersicum* 'Peto 696')
Bacterial canker; *Clavibacter michiganensis* subsp. *michiganensis*

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Evaluation of biorational products for the control of bacterial canker of processing tomatoes, 2016.

The experiment was conducted at the Ohio Agricultural Research and Development Center, Snyder Farm in Wooster, OH on Wooster silt loam. The herbicide Roundup (1 qt/A) was applied on 15 Apr. The test field was plowed on 27 Apr and disked on 16 May; then 19-19-19 (N-P-K) fertilizer at 300lb/A was broadcast, top dressed, and incorporated. Tomato 'Peto 696' seeds were hot water-treated (10 min pre-soak at 100° F, treatment for 25 min at 122° F) and sown on 15 Apr into 288-cell plug trays containing Baccto Professional Grower Mix. On 26 May, Dual II Magnum (1.3 pt/A) and Sencor (1.0 lb/A) were applied and incorporated into the test field for weed control. Treatment applications in the greenhouse started at emergence, beginning on 29 Apr and ending 31 May. Drench applications were made using a watering can while foliar treatments were applied using hand held sprayer. Tomato seedlings were transplanted in the field on 6 Jun. Starter fertilizer solution (N-P-K 12-48-8; 3 lb/50 gal water) was applied at transplanting. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 20 plants per row spaced 1 ft apart with 5 ft between rows. Treated rows were alternated with non-treated border rows. Actigard 50WG (0.25 oz/100 gal) and Double Nickel LC (1 or 2 qt/A) treatments were applied as a drench on the day of transplanting by pouring 3.4 fl oz and 8 fl oz of diluted product, respectively, around the base of each plant. Foliar treatments were applied using a tractor-mounted CO_2-pressurized sprayer (40 psi, 44.1 gal/A, 3 mph) beginning 7 Jun and ending 23 Aug for a total of twelve applications. On 6 Jun, two flats of tomato seedlings were inoculated in the greenhouse with approximately 10^8 CFU/ml of *Clavibacter michiganensis* subsp. *michiganensis* strains C290 and A226. On 15 Jun, two inoculated tomato seedlings were transplanted at the beginning and at the end of each treatment row except for the non-treated, non-inoculated control. Due to lack of spread of bacterial canker to non-inoculated plants, the greenhouse-inoculated plants were re-inoculated with a suspension of 10^8 CFU/ml *Clavibacter michiganensis* subsp. *michiganensis* strains C290 and A226 on 15 Jul using a CO_2 pressurized backpack sprayer. The field was cultivated on 28 Jun and hoed and hand weeded on 6, 13 and 21 Jul and 3 Aug. Plants were overhead irrigated with 1.0, 1.3, 0.6 and 1.3 in. water on 14 Jun; 20 Jun, 15 Jul and 25 Jul, respectively. The insecticide Baythroid XL (2.8 fl oz/A) was applied on 24 Jun. Foliar bacterial canker incidence and severity were evaluated in the non-inoculated plants on 16, 23 and 29 Jul, 7, 13, 19 and 26 Aug and 2 Sep using a scale of 0-100% foliage affected. On 6 Sep fruits were harvested from the third and the fourth plants from each end of the row and one from the center, for a total of five plants per plot. Weights of marketable fruit, fruit with bacterial canker, fruit with anthracnose, blossom end rot, and "other" rots (minor fungal fruit rots) were measured. Average maximum temperatures for 6-30 Jun, Jul, Aug and 1-6 Sep were 81.4, 85.5, 86.4 and 81.7°F; average minimum temperatures were 57.8, 63.5, 64.6 and 54.8°F; and rainfall amounts were 1.1, 2.9, 3.9 and 0.0 in., respectively. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Environmental conditions were hot and dry in June and much of July, and bacterial canker severity was very low in non-inoculated plants until August. Rainfall increased in August and the disease spread throughout the plots. At the final rating on 2 Sep, bacterial canker incidence and severity were 88% and 31.3%, respectively, in the inoculated, non-treated control plots. Actigard 50WG applied as a drench in the greenhouse and field, followed by 12 applications of K-Phite 7LP in the field; Cease + Milstop applied in the greenhouse, followed by 12 applications of Serenade Opti + Milstop in the field; K-Phite 7LP + Agriphage CMM applied in the greenhouse, plus Actigard 50WG drench in the greenhouse and field, followed by 12 applications of K-Phite 7LP + AgriPhage CMM in the field; and Kocide 3000 applied 12 times in the field significantly reduced bacterial canker severity (final rating 2 Sep) as well as the Area Under the Disease Progress Curve (AUDPC) for both disease incidence and severity compared to the inoculated, non-treated control. K-Phite 7LP + AgriPhage CMM applied in the greenhouse and field, and Manzate ProStik 75DF + Actigard 50WG applied in the greenhouse followed by Manzate ProStik 75DF and Actigard 50WG in the field reduced disease severity but not incidence compared to the control. Cueva applied in the greenhouse and field reduced disease progress based on severity ratings, but not the final severity rating nor disease incidence compared to the inoculated, non-treated control. There were no significant differences in total and marketable yield among treated and control plots, but all treatments except Double Nickel LC (drench) followed by Double Nickel LC (foliar), and Double Nickel LC (drench) followed by Double Nickel LC + Cueva (foliar) significantly increased the percentage of marketable (ripe) and asymptomatic (ripe + green) fruit compared to the inoculated, non-treated control. The yield of ripe and green fruit with bacterial canker symptoms was significantly reduced compared to the inoculated, non-treated control in all treated plots except those treated with Double Nickel LC (drench) followed by Double Nickel LC (foliar); Double Nickel LC (drench) followed by Double Nickel LC + Cueva (foliar); and Manzate ProStick 75DF + Actigard 50WG (drench followed by Actigard 50WG). There were no significant differences among treated and control plots in the percentage of fruits with anthracnose (range 7.6-21.2%) or other rots (range 5.9 – 24%).

Treatment and rate	Bacterial canker				Total yield (t/A)
	Severity[z] (%)	Incidence[y] (%)	Severity AUDPC[x]	Incidence AUDPC[x]	
Non-treated non-inoculated control	16.5 de[s]	58.3	210.6 e	1105.9 cd	26.2
Non-treated inoculated control	31.3 a	87.9	470.0 a	1978.0 a	24.9
Actigard 50WG 0.25 oz/100 gal drench (6,7)[w] fb K-Phite 7LP 3.0 qt/A (1-12)[v]	14.3 e	60.0	194.0 e	1226.8 bcd	25.0
CEASE 4 qt/100 gal + MilStop 2 lb/100 gal (2-5)[u] Serenade Opti 20.0 oz/A + Milstop 2.0 lb/A (1-12)[v]	19.5 cde	59.9	274.2 cde	1334.4 bcd	24.1
Double Nickel LC 1.0 qt/100 gal drench (1-5,7)[w] Double Nickel LC 1.0 qt/A (1-12)[v]	28.8 abc	78.3	443.5 ab	1797.7 ab	29.7
K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-5)[u] + Actigard 50WG 0.25 oz/100 gal drench (6,7)[w] fb K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-12)[v]	20.0 b-e	70.8	237.0 e	1284.8 bcd	28.8
K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-5)[u] K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-12)[v]	18.5 de	74.1	264.6 cde	1533.2 abc	30.0
Cueva 2.0 qt/A (1-5)[u] Cueva 2.0 qt/A (1-12)[v]	23.8 a-e	67.9	320.5 b-e	1602.0 abc	25.1
Manzate ProStik 75DF 2.0 lb/A foliar (1-5)[u] Actigard 50WG 0.25 oz/100 gal drench (6,7)[w] fb Manzate ProStik 75DF 2.0 lb/A (1-12)[v] + Actigard 50WG 0.33 oz/A (1,3)[v] + Actigard 50WG 0.50 oz/A (5,7)[v] + Actigard 50WG 0.75 oz/A (9,11)[v]	18.8 de	74.6	252.4 de	1414.7 a-d	33.4
MBI-110 (Regalia) 4 qt/A (1-12)[v]	25.8 a-d	78.3	385.4 abc	1750.3 ab	25.5
Kocide 3000 1.75 lb/A (1-12)[v]	15.3 e	41.5	205.4 e	867.8 d	28.8
Double Nickel LC 2.0 qt/A drench every 3 weeks (1-5)[t] fb Double Nickel LC 1.0 qt/A (3,6,9,11) + Cueva 2.0 qt/A (1-12)[v]	29.3 ab	78.6	378.8 a-d	1721.6 ab	22.0
P value	0.0064	0.1229	0.0003	0.0292	0.2743

[z]Disease severity was rated using a scale of 0-100% foliage affected; final rating on 2 Sep.

[y]Disease incidence values were calculated according to the formula: (number of disease plants/total plants) x 100; final rating on 2 Sep

[x]Area under the disease progress curve values were calculated according to the formula: Σ ($[(x_i+x_{i-1})/2](t_i-t_{i-1})$) where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.

[w]Drench application dates: 1= 29 Apr; 2= 6 May; 3= 13 May; 4= 20 May; 5= 27 May; 6= 31 May; 7= 6 Jun.

[v]Field foliar application dates: 1= 7 Jun; 2= 14 Jun; 3= 21 Jun; 4= 28 Jun; 5= 5 Jul; 6= 12 Jul; 7= 19 Jul; 8= 26 Jul; 9= 2 Aug; 10= 9 Aug; 11= 16 Aug; 12= 23 Aug.

[u]Greenhouse foliar application dates: 1= 29 Apr; 2= 6 May; 3= 13 May; 4= 20 May; 5= 27 May.

[t]Double Nickel LC was drenched 1= 6 Jun; 2= 21 Jun; 3= 12 Jul; 4=2 Aug; 5=23 Aug.

[s]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$. Means were separated using Fisher's least significant difference test.

Treatment and rate	Marketable yield (t/A)[z]	% marketable (ripe)	% asymptomatic fruit (ripe + green)	Total yield of fruit with canker (t/A)[z]	% ripe fruit with canker
Non-treated non-inoculated control	18.3[u]	68.8 a	80.1 a	0.18 c	0.48 b
Non-treated inoculated control	10.3	42.1 c	47.2 d	2.20 a	8.63 a
Actigard 50WG 0.25 oz/100 gal drench (6,7)[y] fb K-Phite 7LP 3.0 qt/A (1-12)[x]	14.5	58.3 ab	74.9 ab	0.75 bc	2.13 b
CEASE 4 qt/100 gal + MilStop 2 lb/100 gal (2-5)[w] Serenade Opti 20.0 oz/A + Milstop 2.0 lb/A (1-12)[x]	14.7	61.5 ab	70.8 abc	0.63 c	2.65 b
Double Nickel LC 1.0 qt/100 gal drench (1-5,7)[y] Double Nickel LC 1.0 qt/A (1-12)[x]	17.4	56.8 ab	61.7 bcd	2.40 a	8.85 a
K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-5)[w] + Actigard 50WG 0.25 oz/100 gal drench (6,7)[y] fb K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-12)[x]	18.9	65.1 ab	79.0 a	0.70 bc	2.30 b
K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-5)[w] K-Phite 7LP 3.0 qt/A + AgriPhage CMM 1 pt/50 gal/A (1-12)[x]	17.9	58.5 ab	68.9 abc	0.68 bc	1.95 b
Cueva 2.0 qt/A (1-5)[w] Cueva 2.0 qt/A (1-12)[x]	16.1	64.0 ab	73.1 ab	0.13 c	0.43 b
Manzate ProStik 75DF 2.0 lb/A foliar (1-5)[w] Actigard 50WG 0.25 oz/100 gal drench (6,7)[y] fb Manzate ProStik 75DF 2.0 lb/A (1-12)[x] + Actigard 50WG 0.33 oz/A (1,3)[x] + Actigard 50WG 0.50 oz/A (5,7)[x] + Actigard 50WG 0.75 oz/A (9,11)[x]	20.8	61.6 ab	73.7 ab	1.35 abc	2.85 b
MBI-110 (Regalia) 4 qt/A (1-12)[x]	16.1	62.1 ab	68.5 abc	0.50 c	1.85 b
Kocide 3000 1.75 lb/A (1-12)[x]	17.6	61.2 ab	73.9 ab	0.63 c	1.93 b
Double Nickel LC 2.0 qt/A drench every 3 weeks (1-5)[v] fb Double Nickel LC 1.0 qt/A (3,6,9,11) + Cueva 2.0 qt/A (1-12)[x]	11.7	52.9 bc	58.3 cd	1.93 ab	8.13 a
P value	0.1663	0.0788	0.0029	0.0064	0.0025

[z]Tons per acre values were calculated based on 8712 plants/A.

[y]Drench application dates: 1= 29 Apr; 2= 6 May; 3= 13 May; 4= 20 May; 5= 27 May; 6= 31 May 7= 6 Jun.

[x]Field application dates: 1= 7 Jun; 2= 14 Jun; 3= 21 Jun; 4= 28 Jun; 5= 5 Jul; 6= 12 Jul; 7= 19 Jul; 8= 26 Jul; 9= 2 Aug; 10= 9 Aug; 11= 16 Aug; 12= 23 Aug.

[w]Greenhouse application dates: 1= 29 Apr; 2= 6 May; 3= 13 May; 4= 20 May; 5= 27 May.

[v]Double Nickel LC was drenched 1= 6 Jun; 2= 21 Jun; 3= 12 Jul; 4=2 Aug; 5=23 Aug.

[u]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.1. Means were separated using Fisher's least significant difference test.

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Evaluation of fungicides for the control of anthracnose of bell pepper, 2016.

The experiment was conducted at the Ohio Agricultural Research and Development Center's North Central Agricultural Research Station in Fremont, OH on Colwood fine sandy loam soil. Pepper 'Archimedes' seeds were treated by agitating them in a 20% Clorox (1.05% sodium hypochlorite) solution for 1 min, followed by a 5 min rinse in running tap water and air-drying. Seeds were sown on 11 Apr into 200-cell plug trays containing Metro-Mix 360 seedling mix. On 18 Apr the test field was plowed and potassium (240 lb/A K_2O), phosphorous (52 lb/A P_2O_5), nitrogen (126 lb/A NH_4NO_3), and boron (10 lb/A) were incorporated. The field was disked on 19 Apr. Raised beds were prepared on 5 ft centers on 25 Apr and reshaped on 19 May. The herbicides Dual II Magnum (16 fl oz/A) and Command 3ME (8 fl oz/A) were applied and incorporated into the test field on 24 May. Pepper seedlings were transplanted and the starter fertilizer (N-P-K 10-34-0; 0.7 qt/50 gal water) was applied in the transplant water on 1 Jun. To protect plants from Phytophthora blight, 8 fl oz of diluted Ridomil Gold at 1 pt/A was poured around the base of each plant at transplanting. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 25 plants spaced 1 ft apart with 5 ft between rows. Treated rows were alternated with non-treated border rows. Arctic 3.2EC (6 fl oz/A), Assail 70WP (4 oz/A), Coragen®Insect Control (5 fl oz/A), Spinosad ME (1.8 qt/A), Sevin 50W (2 lb/A), Orthene 75SP (1.0 lb/A), Capture 2EC-CAL (6.4 fl oz/A) and Lannate LV (48 fl oz/A) were applied on 5 Jul and 5 Aug; 14 and 29 Jul; 20 Jul and 2 Sep; 9 Aug; 22 Aug; 26 Aug; 8 Sep; and 16 Sep, respectively. Treatments were applied using a tractor-mounted CO_2-pressurized sprayer (55 psi, 43.2 gal/A, 3 mph) beginning 19 Jul and ending 13 Sep for a total of nine applications. The field was cultivated on 16 and 27 Jun, and 6 and 20 Jul and hand weeded and hoed on 15 and 28 Jun, and 6 and 21 Jul. Plants were inoculated at the late flowering/early fruit set stage with 10^5 spores/ml of *Colletotrichum acutatum* isolates AN1 and AN2 on 5 and 19 Aug, using a hand-held Herbi Sprayer (red nozzle) at a rate of 7.6 gal/A and an approximate walking speed of 1.2 mph. Plants were overhead irrigated with 1.1 in. water on 21 Jun, 7 and 27 Jul and 8 Aug. Plant foliage was checked weekly for phytotoxicity, and no damage was observed. Fruits were harvested from 15 plants in each treated and non-treated control plot on 26 Aug and 20 Sep and the number and weight of marketable fruit, healthy cull fruit, fruit with anthracnose lesions and fruit with minor fungal fruit rots were determined. Average maximum temperatures for Jun, Jul, Aug and 1-20 Sep were 82.9, 85.9, 85.7 and 81.7°F; average minimum temperatures were 59.9, 64.9, 64.9 and 58.1°F; and rainfall amounts were 1.7, 1.5, 2.5 and 1.9 in., respectively. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Anthracnose pressure was moderate in this trial, with 35% of fruit with anthracnose symptoms in non-treated control plots. All of the fungicide treatments significantly reduced anthracnose on pepper fruits compared to non-treated control fruits. Plants treated with Koverall 75WG + Topguard EQ alternated with Fracture SL produced significantly lower tonnage of fruit with anthracnose than plants treated with the lower rate of Zing! 4.9SC or Koverall 75WG + Rhyme alternated with Fracture SL. There were no differences in yield (t/A) of fruit with anthracnose symptoms among plants treated with Koverall 75WG + Topguard EQ alternated with Fracture SL, the higher rate of Zing! 4.9SC, or Quadris Top. Marketable yield was increased compared to the non-treated control in plots treated with the higher rate of Zing! 4.9SC, Koverall 75WG + Topguard EQ alternated with Fracture SL, or Koverall 75WG + Rhyme alternated with Fracture SL. All fungicide treatments also increased the percentage of marketable fruit compared to the non-treated control. The severity of anthracnose on fruit treated with any of the fungicides or programs was also significantly lower than disease severity in the non-treated control.

Treatment and rate/A (application timing[z])	Fruit with anthracnose (t/A)[y]	Marketable yield (t/A)[y]	% marketable[x]	% fruit with anthracnose[x]	Anthracnose severity[w]
Zing! 4.9SC 32.0 fl oz (1-9)	1.6 bc[v]	11.0 bc	53.9 ab	13.4 b	7.9 b
Zing! 4.9SC 36.0 fl oz (1-9)	1.3 bcd	12.8 ab	54.6 ab	10.4 bc	5.2 d
Koverall 75WG 1.5 lb (1,2,4,5,6,7,8,9) + Topguard EQ 8.0 fl oz (6,8,9) alt Fracture SL 24.4 oz (3)	1.0 d	15.2 a	59.3 a	7.1 c	6.3 cd
Koverall 75WG 1.5 lb (1,2,4,5,6,7,8,9) + Rhyme 8.0 fl oz (6,8,9) alt Fracture SL 24.4 oz (3)	1.9 b	12.2 ab	50.1 b	14.7 b	6.8 bc
Quadris Top 10.0 fl oz (1-9)	1.1 cd	11.5 abc	51.3 b	9.4 bc	6.8 bc
Non-treated control	2.7 a	7.7 c	40.7 c	35.4 a	11.4 a
P value	0.0003	0.0176	0.0006	<0.0001	<0.0001

[z]Application dates: 1= 19 Jul; 2= 25 Jul; 3= 1 Aug; 4= 8 Aug; 5= 16 Aug; 6= 23 Aug; 7= 30 Aug; 8= 6 Sep; 9= 13 Sep.
[y]Tons per acre values were calculated based on 8712 plants/A.
[x]Values are based on number of fruits per plot.
[w]Anthracnose severity was calculated based on the formula= ([Σ category midpoint*number of fruit in category)]/n, where n= is the sum of fruits from each category.
[v]Values are the mean of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

CUCUMBER (*Cucumis sativus* 'Hi Jack')
Powdery mildew; *Podosphaera xanthii*

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Evaluation of fungicides for the control of powdery mildew of indeterminate greenhouse cucumber, 2016.

The experiment was conducted at an Ohio Agricultural Research and Development Center greenhouse in Wooster. Cucumber 'Hi Jack' seeds, provided by Nunhems Netherlands BV, were sown on 8 Aug into 50-cell plug trays containing Baccto Professional Grower Seedling Mix. On 16 Aug the greenhouse was cleaned and disinfected. On 30 Aug cucumber seedlings were transplanted into 15 L pots containing Wooster silt loam. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 10 plants spaced 1 ft apart with 6.5 ft between rows. A drip irrigation system was set up at transplant and the fertilizer Peter (N-P-K 20-20-20; 6.7 oz/gal water) was injected twice per day to the cucumber plants at 1:100 by using a Dosatron D14MZ2 injector and emitter flow rate of 0.5 gal/hr beginning 30 Aug and ending 26 Oct. For weight support and ease of pruning, trellis twine with hooks were hung from main wire lines and each plant was tied with trellis clips to the vine stalk on 14 Sep. Treatments were applied using a backpack CO_2-pressurized sprayer (40 psi, 66.4 gal/A, 0.5 mph) beginning 14 Sep and ending 12 Oct for a total of five applications. On 9 Sep, plants were inoculated by placing three squash leaves with sporulating *P. xanthii* colonies brought from a squash field trial, on the top of the first, the middle and the last plant in each treatment row. Plants were tied and pruned on 19 and 28 Sep and 5, 12 and 19 Oct. To control downy mildew Ranman 400SC (2.75 fl oz/A) and Orondis Ultra (6 fl oz/A) were applied on 30 Aug, 6 and 19 Sep and 3 and 10 Oct; and 26 Sep and 17 Oct, respectively. The insecticides Enstar AQ (16.0 fl oz/100 gal) and Avid 0.15FC (8.0 fl oz/100 gal) were applied on 6, 19 and 26 Sep and 3, 10 and 17 Oct. The severity of powdery mildew on foliage was evaluated on 19 and 28 Sep and 5, 12, 19 and 26 Oct using a scale of 0 - 100% foliage affected. The Area Under the Disease Progress Curve (AUDPC) was calculated based on foliar disease severity data. On 14, 17, 19 and 24 Oct, fruits from all plants in each plot were harvested and the number and weight of marketable, scarred, zippered and misshapen fruits were measured. The maximum temperatures for 30-31 Aug, Sep and 1-26 Oct were 106.4, 104.3 and 83.8°F; the minimum temperatures were 68.1, 64.8 and 64.9°F; and the average monthly temperatures were 81.5, 80.2 and 75.3°F. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Crop injury was observed on the foliage of cucumber plants treated with Terraguard SC and Pyriofenone 300SC, but not in non-treated control plants. Injury was significantly less in plants treated with Pyriofenone 300SC than in plants treated with Terraguard SC. Powdery mildew disease pressure was high in this greenhouse trial, reaching 64% in non-treated control plots by 12 Oct, 0 and 7 days after the final applications of Terraguard SC and Pyriofenone 300SC, respectively. Powdery mildew development by 12 Oct was negligible in plants treated with either of the two fungicides. Disease severity and season-long disease progress (AUDPC) was significantly lower in plants treated with either fungicide than in the non-treated control, but neither value was significantly different between fungicide treatments. Powdery mildew severity increased to 85% and 93% in non-treated control plots by 19 and 26 Oct, respectively. Disease severity in plants treated with Terraguard SC remained low (4%) 2 weeks after the final product application. Similarly, powdery mildew severity in plants treated with Pyriofenone 300SC remained low (7%) 2 weeks after the final product application, despite high disease pressure in the greenhouse. Total and marketable yields were significantly higher for plants treated with either fungicide than for non-treated control plants, but there were no yield differences between plants treated with Terraguard SC and those treated with Pyriofenone 300SC. There were no significant differences between treated and non-treated control plants in the percentages of scarred and zippered fruits (data not shown). However, the percentage of scarred fruit was significantly lower in plots treated with Terraguard SC (8%) or Pyriofenone 300 SC (16.8%) than in non-treated plots (33.8%). Differences in fruit scarring between plants treated with Terraguard SC and Pyriofenone 300 SC were not significant.

Treatment and rate/A (application timing[z])	Phytotoxicity		Powdery mildew	
	Injury (%)[y] (12 Oct)	AUPPC[x]	Severity (%)[y] (12 Oct)	AUDPC[x]
Non-treated control	0.0 b[w]	0.0 b	63.8 a	509.3 a
Terraguard SC 8 fl oz (1,2,3,4,5)	9.0 a	151.6 a	0.1 b	17.1 b
Pyriofenone 300SC 4 fl oz (1,2,3,4)	2.3 b	31.9 b	0.8 b	27.8 b
P value	0.0001	<0.0001	<0.0001	<0.0001

[z]Application dates: 1= 14 Sep; 2= 21 Sep; 3= 28 Sep; 4= 5 Oct; 5= 12 Oct.
[y]Crop injury and disease severity were rated using a scale of 0-100% foliage affected.
[x]Area under the disease progress curve (AUDPC) or phytotoxicity progress curve (AUPPC) values were calculated according to the formula: $\Sigma([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.
[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

Treatment and rate/A (application timing[z])	Powdery mildew		Marketable yield (no./plot)	Marketable yield (lb/plot)	Total yield (t/A)[y]
	Severity (%)[y] (19 Oct)	Severity (%)[y] (26 Oct)			
Non-treated control	85.0 a[x]	92.8 a	43.8 b	33.5 b	11.2 b
Terraguard SC 8 fl oz (1,2,3,4,5)	0.4 c[w]	4.3 c[w]	63.3 a	47.4 a	15.9 a
Pyriofenone 300SC 4 fl oz (1,2,3,4)	7.3 b[v]	11.5 b[v]	58.0 a	44.7 a	14.9 a
P value	<0.0001	<0.0001	0.0220	0.0422	0.0412

[z]Application dates: 1= 14 Sep; 2= 21 Sep; 3= 28 Sep; 4= 5 Oct; 5= 12 Oct.
[y]Total yield (t/A) values were calculated based on 6700 plants/A.
[x]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.
[w]Disease severity values for plants treated with Terraguard SC on 19 and 26 Oct were recorded 1 and 2 weeks after the last application.
[v]Disease severity values for plants treated with Pyriofenone 300SC on 19 and 26 Oct were recorded 2 and 3 weeks after the last application.

SQUASH (*Cucurbita maxima* 'Autumn Delight')
Powdery mildew; *Podosphaera xanthii*

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Evaluation of fungicides for the control of powdery mildew of winter squash, 2016.

The experiment was conducted at the Ohio Agricultural Research and Development Center's North Central Agricultural Research Station in Fremont, OH on Colwood loamy fine sandy soil. On 18 Apr the test field was plowed and potassium (240 lb/A K_2O), phosphorous (52 lb/A P_2O_5), nitrogen (126 lb/A NH_4NO_3), and boron (10 lb/A) were incorporated. The field was disked on 19 Apr and raised beds were prepared on 5 ft centers on 25 April. 'Autumn Delight' squash seeds were sown on 16 May into 72-cell plug trays containing Metro-Mix 360 seedling mix. Raised beds were reshaped on 19 May. The herbicides Dual II Magnum (1.0 pt/A), Command 3ME (0.5 pt/A), Roundup PowerMax (22.0 fl oz/A), Choice® (8.0 fl oz) and InterLock (6.0 fl oz/A) were applied and incorporated into the test field on 1 Jun. Squash seedlings were transplanted on 1 Jun. Starter fertilizer (N-P-K 10-34-0; 0.7 qt/50 gal) was applied in the transplant water. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 13 plants spaced 2 ft apart with 5 ft between rows. Treated rows were alternated with non-treated border rows. The insecticides Asana (5.8 fl oz/A), Assail 30SG (5.3, 4.0, 5.0 fl oz/A), Warrior II with Zeon Technology (1.9 fl oz/A), Capture LFR (5.2 fl oz/A), Lannate LV (3.0 pt/A), Arctic 3.2EC (6.0 fl oz/A), Hero EW (5 fl oz/A) and Coragen®Insect Control (5.0 fl oz/A), were applied on 3 Jun; 15 Jun, 14 Jul and 22 Aug; 20 Jun, 26 Jul and 11 Aug; 30 Jun; 5 Jul; 7 Jul; and 20 Jul, respectively. Treatments were applied using a tractor-mounted CO_2-pressurized sprayer (55 psi, 43.2 gal/A, 3 mph) beginning 11 Jul and ending 30 Aug for a total of eight applications. The field was cultivated on 16 Jun and hand weeded and hoed on 20 Jun and 25 Jul. Plants were overhead irrigated with 1.0 in. water on 27 Jun and 28 Jul. The severity of powdery mildew on foliage was evaluated on 3, 10, 17, 24 and 31 Aug using a scale of 0-100% foliage affected, and Area Under the Disease Progress Curve (AUDPC) was calculated. Two weeks prior to harvest fruits, Phytophthora blight (*Phytophthora capsici*) spread across the test field killing some of the plants. Squash fruits from all surviving plants in each treatment row were harvested, counted and weighed on 2 Sep. Yield data are based on the yield of fruit per plant. Average maximum temperatures for Jun, Jul, Aug and 1-2 Sep were 82.9, 85.9, 85.7 and 74.1°F; average minimum temperatures were 59.9, 64.9, 64.9 and 56.2°F; and rainfall amounts were 1.7, 1.5, 2.5 and 0.0 in., respectively. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Powdery mildew disease pressure was moderate in this trial, reaching a severity rating of 66% in non-treated control plants by the end of the experiment. All of the products tested significantly reduced powdery mildew severity and season long disease progress (AUDPC) compared to the non-treated control. Powdery mildew severity was negligible (<1%) in plants treated with Luna Experience 400SC alternated with Quintec 2.08 SC, Bravo Weather Stik 6SC alternated with Aprovia TOP, Quintec 2.08SC, and Inspire Super 2.82EW, Bravo Weather Stik 6SC alternated with A20259E (both rates), Quintec 2.08SC, and Inspire Super 2.82EW, or Quintec 2.08SC alone. Total and marketable fruit yield, as well as percentage of marketable fruit were not increased in plots treated with any of the fungicide programs, and in some cases were decreased. However, the occurrence of Phytophthora blight in the plots may have contributed to the differences observed.

Treatment and rate/A (application timing[z])	Powdery mildew[y]	
	Severity (%) (31 Aug)	AUDPC[x]
Luna Experience 400SC 6.0 fl oz + Activator 90SL 0.125 % v/v (1,3,5,7) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (2,4,6,8)	0.5 c[w]	3.5 b
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt Aprovia TOP 8.5 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	3.5 b	31.5 b
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt Aprovia TOP 10.5 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	2.1 bc	17.1 b
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt A20259E 11.0 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	0.3 c	4.4 b
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt A20259E 13.7 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	0.8 c	2.6 b
Quintec 2.08SC 6.0 fl oz + Activator 90SL 0.25 % v/v (1-8)	0.3 c	0.9 b
Non-treated control	66.0 a	1022.9 a
P value	<0.0001	<0.0001

[z]Application dates: 1= 11 Jul; 2= 19 Jul; 3= 25 Jul; 4= 1 Aug; 5= 10 Aug; 6=16 Aug; 7= 23 Aug; 8= 30 Aug.
[y]Disease ratings and area under the disease progress curve (AUDPC) were based on the percent foliar disease.
[x]Area under the disease progress curve values were calculated according to the formula: $\Sigma ([(x_i+x_i-1)/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.
[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

Treatment and rate/A (application timing[z])	Total yield (t/A)[y]	Marketable yield (t/A)[y]	% marketable fruit[x]	% fruit with phytophthora[x]
Luna Experience 400SC 6.0 fl oz + Activator 90SL 0.125 % v/v (1,3,5,7) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (2,4,6,8)	21.4 bc[w]	17.3 b	81.1 bc	16.2
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt Aprovia TOP 8.5 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	23.4 abc	20.9 ab	90.2 a	6.6
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt Aprovia TOP 10.5 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	18.0 c	15.9 b	88.2 ab	8.6
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt A20259E 11.0 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	29.3 a	23.5 a	81.2 bc	9.8
Bravo Weather Stik 6SC 32.0 fl oz/A (1,7,8) alt A20259E 13.7 fl oz + Activator 90SL 0.125 % v/v (2,4) alt Quintec 2.08SC 4.0 fl oz + Activator 90SL 0.125 % v/v (3,5) alt Inspire Super 2.82EW 20.0 fl oz + Activator 90SL 0.125 % v/v (6)	19.7 c	15.6 b	78.8 c	14.7
Quintec 2.08SC 6.0 fl oz + Activator 90SL 0.25 % v/v (1-8)	23.3 abc	19.6 ab	84.4 abc	11.6
Non-treated control	27.3 ab	24.7 a	91.0 a	5.9
P value	0.0250	0.0150	0.0419	0.2358

[z]Application dates 1= 11 Jul; 2= 19 Jul; 3= 25 Jul; 4= 1 Aug; 5= 10 Aug; 6=16 Aug; 7= 23 Aug; 8= 30 Aug.
[y]Marketable yield and total yield (ton/A) values were calculated based on 4356 plants/A.
[x]Values are based on the percentage weight of fruit per plant.
[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

SQUASH (*Cucurbita maxima* 'Autumn Delight')
Phytophthora blight; *Phytophthora capsici*

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Evaluation of Orondis for the control of Phytophthora blight of winter squash, 2016.

The experiment was conducted at the Ohio Agricultural Research and Development Center's North Central Agricultural Research Station in Fremont, OH on Colwood loamy fine sandy soil. On 18 Apr the test field was plowed and potassium (240 lb/A K_2O), phosphorous (52 lb/A P_2O_5), nitrogen (126 lb/A NH_4NO_3), and boron (10 lb/A) were incorporated. The field was disked on 19 Apr and raised beds were prepared on 5 ft centers on 25 April. 'Autumn Delight' squash seeds were sown on 16 May into 72-cell plug trays containing Metro-Mix 360 seedling mix. Raised beds were reshaped on 19 May. The herbicides Dual II Magnum (1.0 pt/A), Command 3ME (0.5 pt/A), Roundup PowerMax (22.0 fl oz/A), Choice® (8.0 fl oz) and InterLock (6.0 fl oz/A) were applied and incorporated into the test field on 1 Jun. Squash seedlings were transplanted on 2 Jun. Starter fertilizer (N-P-K 10-34-0; 0.7 qt/50 gal) was applied in the transplant water. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 13 plants spaced 2 ft apart with 5 ft between rows. Treated rows were alternated with non-treated border rows. Orondis Gold 200 (4.8 fl oz/A) + Ridomil Gold SL (8 fl oz/A) and Ridomil Gold SL (8 fl oz/A) treatments were drenched at transplanting by pouring 8 fl oz of diluted product around the base of each plant. The insecticides Asana (5.8 fl oz/A), Assail 30SG (5.3, 4.0, 4.0 fl oz/A), Warrior II with Zeon Technology (1.9 fl oz/A), Arctic 3.2EC (6.0 fl oz/A) and Coragen®Insect Control (5.0 fl oz/A), were applied on 3 Jun; 15 Jun, 14 Jul and 29 Aug; 20 and 28 Jun; 5 Jul and 5 Aug; and 20 Jul, respectively. Treatments were applied using a tractor-mounted CO_2-pressurized sprayer (55 psi, 43.2 gal/A, 3 mph) beginning 20 Jun and ending 4 Aug for a total of seven applications. The field was cultivated on 16 Jun and hand weeded and hoed on 20 Jun. Plants were overhead irrigated with 1.0 in. water on 21 and 29 Jun and 7 Jul. Inoculum of *Phytophthora capsici* was produced by placing a 0.4 in. disc, cut with a #4 cork borer, of an actively growing colony of *P. capsici* produced on V8 medium into a 0.4 in. diam hole cut through the rind of a mature zucchini fruit. The rind was replaced after inoculation. Fruits were incubated at room temperature with a 12 hr photoperiod for 5 days. Squash plants were exposed to the *P. capsici*-infected zucchini fruit on 6 Jul by placing one fruit at the beginning, middle and end of each treated and non-treated control row. On 20 and 27 Jul and 3 Aug, the number of healthy plants, plants with Phytophthora blight on fruits, plants wilted due Phytophthora blight and plants killed by Phytophthora blight were counted. Fruit were not harvested because most plants were killed by Phytophthora blight. Average maximum temperatures for 2-30 Jun, Jul and 1-3 Aug were 82.6, 85.9, and 87.4°F; average minimum temperatures were 59.9, 64.9 and 62.1°F; and rainfall amounts were 1.7, 1.5 and 0.0 in., respectively. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Phytophthora blight was severe in this trial, killing 98% of non-treated control plants by 3 Aug, 4 weeks after inoculation. Disease incidence (wilted + dead plants) on 3 Aug was significantly less in plots treated with Orondis Gold (oxathiapiprolin + mefafanoxam) drench followed by foliar applications of Presidio 4SC alternated with Zampro; Orondis Gold drench followed by foliar applications of Revus + Kocide 3000 alternated with Presidio 4SC; and foliar applications of Orondis Ultra (oxathipiprolin + mandipropamid) alternated with Ranman 400SC or Presidio, compared to non-treated control plots. Season long disease progress (AUDPC) was also reduced significantly compared to the non-treated control by these programs, as well as by Orondis Gold drench followed by foliar applications of Revus + Kocide 3000 + Activator 90SL alternated with Ridomil Gold Copper 65WP; and Ridomil Gold SL drench followed by foliar applications of Orondis Ultra alternated with Zampro.

Treatment and rate/A (application timing[z])	% Dead (3 Aug)[y]	% Wilted + dead (3 Aug)[x]	AUDPC[w]	
			% dead	% wilted + dead
Orondis Gold 200 4.8 fl oz + Ridomil Gold SL 8 fl oz drench[v]	100.0 a[u]	100.0 a	1266.4 a	1346.6 a
Orondis Gold 200 4.8 fl oz + Ridomil Gold SL 8 fl oz drench[v] fb Revus 2.09SC 8 fl oz + Kocide 3000 1 lb + Activator 90SL 0.25% v/v (1,3,5,7) alt Ridomil Gold Copper 65WP 2 lb (2,4,6)	79.4 cde	90.6 abc	617.4 fg	1013.6 de
Orondis Gold 200 4.8 fl oz + Ridomil Gold SL 8 fl oz drench[v] fb Presidio 4SC 4 fl oz (1,3,5,7) alt Zampro 14 fl oz (2,4,6)	70.6 e	79.9 cd	701.9 ef	994.7 e
Orondis Gold 200 4.8 fl oz + Ridomil Gold SL 8 fl oz drench[v] fb Revus 2.09SC 8 fl oz + Kocide 3000 1 lb (1,3,5,7) alt Presidio 4SC 4 fl oz (2,4,6)	50.8 f	70.5 d	490.8 g	726.4 f
Orondis Ultra A 4.8 fl oz + Orondis Ultra B (Revus) 8 fl oz (1,4) alt Zampro 14 fl oz (2,3,5)	86.5 abc	92.3 abc	1023.1 bc	1177.9 a-e
Orondis Ultra A 4.8 fl oz + Orondis Ultra B (Revus) 8 fl oz (1,4) alt Ranman 400SC 2.75 fl oz (2,3,5,6)	78.8 cde	82.7 cd	834.6 cde	1050.0 cde
Orondis Ultra A 4.8 fl oz + Orondis Ultra B (Revus) 8 fl oz (1,4) alt Presidio 4SC 4 fl oz (2,3,5,6)	71.7 de	84.8 bcd	779.3 def	1028.4 cde
Ridomil Gold SL 8 fl oz drench[v] fb Orondis Ultra A 4.8 fl oz + Orondis Ultra B (Revus) 8 fl oz (1,4) alt Zampro 14 fl oz (2,3,5)	78.8 cde	88.7 abc	921.5 bcd	1124.8 cde
Ridomil Gold SL 8 fl oz drench[v] fb Orondis Ultra A 4.8 fl oz + Orondis Ultra B (Revus) 8 fl oz (1,4) alt Ranman 400SC 2.75 fl oz (2,3,5,6)	86.5 abc	90.4 abc	888.5 cde	1198.1 a-d
Ridomil Gold SL 8 fl oz drench[v] fb Orondis Ultra A 4.8 fl oz + Orondis Ultra B (Revus) 8 fl oz (1,4) alt Presidio 4SC 4 fl oz (2,3,5,6)	84.6 bcd	94.2 abc	827.9 cde	1157.7 b-e
Ridomil Gold SL 8 fl oz drench[v] fb Orondis Opti 4.8 fl oz (1,4) alt Presidio 4SC 4 fl oz (2,3,5,6)	96.2 ab	98.1 ab	922.1 bcd	1213.5 abc
Non-treated Control	98.1 ab	100.0 a	1113.5 ab	1320.7 ab
P value	<0.0001	0.0100	<0.0001	<0.0001

[z]Application dates: 1= 20 Jun; 2= 28 Jun; 3= 7 Jul; 4= 14 Jul; 5= 21 Jul; 6= 28 Jul; 7= 4 Aug.

[y]Percent dead plants was calculated according to the formula: (# plants killed by Phytophthora blight ÷ total # plants)×100.

[x]Percent wilted plus dead plants were calculated according to the formula: (# plants wilted + dead by Phytophthora blight ÷ total # plants)×100.

[w]Area under the disease progress curve values were calculated according to the formula: Σ ($[(x_i+x_{i-1})/2](t_i-t_{i-1})$) where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.

[v]Drench application at transplanting date: 1= 2 Jun.

[u]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.

SQUASH (*Cucurbita maxima* 'Autumn Delight F1')
Powdery mildew; *Podosphaera xanthii*

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Bioassay for sensitivity of *Podosphaera xanthii* to fungicides in OH, 2016.

The experiment was conducted in a greenhouse located at The Ohio State University - Ohio Agricultural Research and Development Center (OARDC) in Wooster, OH. Squash 'Autumn Delight F1' FarMore-treated seeds were sown on 17 Aug into 50-cell trays containing Baccto Professional Grower Potting Mix. Plants were transplanted to individual 4 in. pots filled with the same potting mix on 1 Sep. The experiment was set up in a randomized complete block design with four replications. Each replication consisted of one plant. Plants were hand watered daily, and fertilized (N-P-K 20-20-20; 0.53 oz/gal water) every week from germination through the end of the experiment. When the second true leaf was fully expanded, fungicide treatments were applied to the top surface of both the first and second true leaves by using a hand held sprayer at a rate of 54 gal/A. Non-treated control plants were sprayed with water. Each leaf received approximately 0.08 fl oz. of spray on 4 Sep. Treated seedlings were transported to cucurbit fields at the OARDC Snyder Farm in Wooster, OH, the OSU Waterman Agricultural and Natural Resources Laboratory in Columbus, OH, and the OARDC Western Agricultural Research Station in South Charleston, OH on 5 Sep. At each location, test plants were placed on the edge of a pumpkin field with powdery mildew and exposed naturally to *P. xanthii* inoculum for 7 hours. After exposure the seedlings were returned to the Wooster greenhouse. The severity of powdery mildew was evaluated on the upper surface of the first two true leaves at 5, 7, and 10 days after field exposure on 10, 12, and 15 Sep. Disease severity per leaf was estimated using a visual guide illustrating powdery mildew at 0.5, 1, 2, 4, 8, 16, 32, 64, and 80 percent severity. The greenhouse maximum temperature for 5-15 Sep was 89.3°F and the minimum temperature was 75.2°F. Analysis of variance was performed on the angular transformed (arcsine [$\sqrt{(\text{severity}/100)}$]) powdery mildew percent severity and percent control data using the GLIMMIX procedure, and transformed means were separated by Fisher's least significant difference test with SAS software. Powdery mildew severity data were analyzed independently for each location. Percent control data were analyzed independently for each treatment. Transformed means were back-transformed by squaring the sine of the means.

Powdery mildew severity was high in pumpkin fields next to which treated and non-treated control plants were placed in all of the locations. Based on disease severity of treated leaves 10 days after exposure to *P. xanthii* inoculum, all fungicide treatments, except Bravo Weather Stik at Wooster, performed significantly better than the non-treated control. Bravo Weather Stik provided no (0%) control at Wooster and less than 36% control at the other two locations. No differences in percent control between locations were observed for plants treated with Inspire Super, Procure, Quintec, and Rally; these products provided >92% control at all locations. The efficacy of Fontelis, Merivon Xemium, and Torino was always significantly lower (<75% control) at South Charleston than at Wooster and Columbus (>94% control). Aprovia Top provided >92% control at all locations. Powdery mildew control was <65% at all locations in plants treated with Pristine. At South Charleston, powdery mildew severity was lowest in Procure- and Quintec-treated plants (<1.0%), while disease severity in plants treated with Aprovia Top, Inspire Super, and Rally was lower than 7.0%. All of these fungicides provided greater than 90% control at this location. At Wooster, disease severity in plants treated with Aprovia Top, Procure, Quintec, or Torino was less than 1.0%, which represents control >99%. Inspire Super, Merivon, and Rally provided >95% control of powdery mildew at this location. At Columbus, all treatments, except Bravo Weather Stick and Pristine controlled >95% of the disease.

Powdery mildew severity (percent) on squash 'Autumn Delight F1' leaves 10 days after exposure to inoculum and percent control by each fungicide at locations in southwest (South Charleston), northern (Wooster) and central (Columbus) OH.

	Powdery mildew severity (%)[y]									
	South Charleston[t]			Wooster[v]			Columbus[u]			
Treatment and rate/A[z]	% PM (% control)			% PM (% control)			% PM (% control)			P-value[p]
Aprovia Top EC 14.5 fl oz	6.9[x]	f[w]	(92.7 B)[s r]	0.0[x]	ef[w]	(100.0 A)[s r]	0.0[x]	f[w]	(100.0 A)[s r]	0.0021
Bravo Weather Stik 6SC 48 fl oz	82.8	b	(11.6 B)	78.8	a	(0.0 C)	36.2	b	(33.9 A)	0.0002
Fontelis 1.67SC 14.0 fl oz	25.0	e	(73.3 C)	4.4	c	(94.5 B)	0.1	ef	(99.8 A)	<0.0001
Inspire Super EW 18.0 fl oz	4.0	fg	(95.7 A)	2.0	d	(97.5 A)	0.5	ef	(99.2 A)	0.4270
Merivon Xemium 2.09SC 5.0 fl oz	41.8	d	(55.3 B)	2.8	cd	(96.5 A)	0.7	d-f	(98.8 A)	<0.0001
Pristine WG 15.0 oz	58.8	c	(37.3 B)	34.1	b	(56.7 AB)	19.3	c	(64.5 A)	0.0480
Procure 480SC 6.0 fl oz	0.7	gh	(99.3 A)	0.0	ef	(100.0 A)	0.1	ef	(99.9 A)	0.6635
Quintec 2.08SC 6.0 fl oz	0.0	h	(100.0 A)	0.0	f	(100.0 A)	0.0	f	(100.0 A)	0.1251
Rally 40WSP 3.5 oz	6.9	f	(92.6 A)	3.9	c	(95.1 A)	2.6	d	(95.4 A)	0.8513
Torino 0.85SC 3.4 fl oz	41.8	d	(55.3 B)	0.4	e	(99.5 A)	0.9	de	(98.5 A)	<0.0001
Non-treated control	93.9	a		78.8	a		56.3	a		
P-value[q]	<0.0001			<0.0001			<0.0001			

[z] Rate per acre of formulated product.

[y] Disease ratings 10 days after exposure to powdery mildew inoculum, based on a scale of 0-100% foliage affected using a visual guide that illustrates powdery mildew at 0.5, 1, 2, 4, 8, 16, 32, 64, and 80 percent.

[x] Values are the back-transformed means of leaf 1 and 2, upper surface only, of four replicate plants, 10 days after field exposure.

[w] Means followed by the same lower case letter within a column are not significantly different at P<0.05. Means were separated using Fisher's least significant difference test on angular transformed data.

[v] Ohio Agricultural Research and Development Center Snyder Farm, Wooster, OH.

[u] OSU Waterman Agricultural and Natural Resources Laboratory, Columbus, OH.

[t] Ohio Agricultural Research and Development Center Western Agricultural Research Station, South Charleston, OH.

[s] Percentage control values were calculated for each plot according to the formula: [(SC – ST)/SC]*100 where SC is the severity on the non-treated control and ST is the severity on the treatment.

[r] Means followed by the same upper case letter within a row are not significantly different at P<0.05. Means were separated using Fisher's least significant difference test on angular transformed data. Values are the back-transformed means.

[q] P-values for treatment effect within each location.

[p] P-values for location effect for each treatment.

CANTALOUPE (*Cucumis melo* 'Athena')
Alternaria leaf spot; *Alternaria cucumerina*

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Evaluation of fungicides for the control of Alternaria leaf spot of cantaloupe, 2016.

The experiment was conducted at the Ohio Agricultural Research and Development Center's North Central Agricultural Research Station in Fremont, OH on Colwood loamy fine sandy soil. On 18 Apr the test field was plowed and potassium (240 lb/A K2O), phosphorous (52 lb/A P2O5), nitrogen (126 lb/A NH4NO3), and boron (10 lb/A) were incorporated. On 19 Apr the field was disked and on 25 April raised beds were prepared on 8 ft centers. 'Athena' cantaloupe seeds were sown on 16 May into 72-cell plug trays containing Metro-Mix 360 seedling mix. Black plastic mulch was laid on 19 May. Cantaloupe seedlings were transplanted on 3 Jun. Starter fertilizer (N-P-K 10-34-0; 0.7 qt/50 gal) was applied in the transplant water. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of 13 plants spaced 3 ft apart with 8 ft between rows. Treated rows were alternated with non-treated border rows. The insecticides Asana (5.8 fl oz/A), Assail 30SG (5.3, 4.0, 5.0 fl oz/A), Warrior II with Zeon Technology (1.9 fl oz/A), Arctic 3.2EC (6.0 fl oz/A), Coragen®Insect Control (5.0 fl oz/A), Baythroid XL (2 fl oz/A) were applied on 3 Jun; 15 Jun, 13 Jul and 22 Aug; 20 and 27 Jun, 26 Jul; 5 Jul and 5 Aug; and 9 Aug, respectively. Treatments were applied using a tractor-mounted CO_2-pressurized sprayer (55 psi, 43.2 gal/A, 3 mph) beginning 7 Jul and ending 25 Aug for a total of eight applications. The field was cultivated on 9 Jun and 5 and 20 Jul and hand weeded and hoed on 20 Jun and 6 and 20 Jul. Plants were overhead irrigated with 1.0 in. water on 28 Jun and 14 and 29 Jul. Plants across the entire field were naturally infected with Alternaria leaf spot. The severity of Alternaria leaf spot on foliage was evaluated on 3, 10, 17, 24 and 31 Aug and 7 Sep using a scale of 0-100% foliage affected, and the Area Under the Disease Progress Curve (AUDPC) was calculated. Melon fruits from all plants in each treatment row were harvested, counted and weighed on 2, 4, 5, 8, 10, 12, 15, 17, 18, 22, 24, and 25 Aug. Average maximum temperatures for 3-30 Jun, Jul, Aug and 1-7 Sep were 82.5, 85.9, 85.7 and 83.0°F; average minimum temperatures were 59.9, 64.9, 64.9 and 57.9°F; and rainfall amounts were 1.7, 1.5, 2.5 and 0.0 in., respectively. Analysis of variance was performed using the GLIMMIX procedure and means were separated by Fisher's least significant difference test with SAS software.

Alternaria leaf spot pressure was moderate in this trial. All of the fungicide programs tested significantly reduced final disease severity, rated on 7 Sep, as well as season long disease progress (AUDPC) compared to the non-treated control. There were no differences in foliar disease severity or AUDPC among plants treated with any of the fungicide programs. Total and marketable yields did not differ between treated and non-treated plots.

Treatment and rate/A (application timing[z])	Alternaria leaf spot		Total yield (t/A)[w]	Marketable yield (t/A)[w]
	Severity (%)[y] 7 Sep	AUDPC[yx]		
Bravo Weather Stik 6SC 24 fl oz (1,3,5) alt Merivon 4.18SC 5.5 fl oz (2,4,6)	20.5 b[v]	298.8 b	30.3	26.8
Bravo Weather Stik 6SC 24 fl oz (1,3,5) alt Aprovia Top 8.5 fl oz (2,4,6)	22.0 b	295.3 b	31.0	27.3
Bravo Weather Stik 6SC 24 fl oz (1,3,5) alt Aprovia Top 10.5 fl oz (2,4,6)	21.0 b	293.6 b	29.2	26.3
Bravo Weather Stik 6SC 24 fl oz (1,3,5) alt A20259E 11 fl oz (2,4,6)	22.5 b	300.1 b	28.5	24.8
Bravo Weather Stik 6SC 24 fl oz (1,3,5) alt A20259E 13.7 fl oz (2,4,6)	20.0 b	275.2 b	29.5	25.9
Koverall 75WG 1.5 lb (1,3,4,6,7) alt Topguard EQ 8.0 fl oz (2,5,8)	17.0 b	220.5 b	23.8	21.5
Bravo Weather Stik 6SC 24 fl oz (1,3,4,6,7) alt Topguard EQ 8.0 fl oz (2,5,8)	16.8 b	235.4 b	30.8	27.3
Non-treated control	43.5 a	653.2 a	28.2	25.1
P value	<0.0001	<0.0001	0.4092	0.5946

[z]Application dates: 1= 7 Jul; 2= 13 Jul; 3= 21 Jul; 4= 28 Jul; 5= 4 Aug; 6= 11 Aug; 7= 18 Aug; 8= 25 Aug.
[y]Disease ratings and area under the disease progress curve (AUDPC) were based on the percent foliar disease.
[x]Area under the disease progress curve (AUDPC) values were calculated according to the formula: $\Sigma\ ([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.
[w]Marketable yield and total yield (t/A) values were calculated based on 1815 plants/A.
[v]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$. Means were separated using Fisher's least significant difference test.

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