Woody Ornamental Disease Management Research Reports

Boxwood, Crapemyrtle, Flowering Dogwood, Hydrangea, Ginkgo, Indian hawnthorn, Magnolia, Maple and Rose

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"Think. Work. Serve."

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BOXWOOD (*Buxus sinica* var. *insularis* x *B. sempervirens* 'Green Velvet')
Volutella blight; *Pseudonectria foliicola*

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Evaluation of fungicides for the control of Volutella blight of boxwood, 2020.

Boxwood 'Green Velvet' plants were potted in 1-gallon containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 29 Sep and 0.5 oz of 18-6-8 Nutricote controlled release fertilizer on 13 Oct. Six single-plant replications per treatment were arranged in a completely randomized design in a Biosafety Level 2 room at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated by hand as needed throughout the trial. Plants were inoculated by uniformly spraying foliage with conidia of *Pseudonectria foliicola* (1×10^6 conidia/ml) using a hand-held sprayer. Treatments were applied using a handheld sprayer until run off on a 14-day interval beginning on 6 Oct and ending on 17 Nov. Foliar disease severity, defoliation and phytotoxicity were determined on 6, 13, 20, and 27 Oct, 3, 10, 17 and 24 Nov using a scale of 0-100% foliage area affected and disease progress (area under disease progress curve [AUDPC] was calculated). Plant quality was evaluated on 24 Nov using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height and width were measured on 7 Oct and 24 Nov. The average temperature for Oct and Nov was a consistent room temperature at 72.0ºF. Analysis of variance was performed using the general linear model (GLM) procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Volutella blight disease pressure was low in this trial with non-treated, inoculated control plants showing 18.3% disease severity by 24 Nov. All of the treatments significantly reduced Volutella blight severity and AUDPC throughout the experiment compared to the non-treated, inoculated control. The treatments that most effectively reduced Volutella blight severity and the progression of disease were Orkestra Intrinsic alternated with Trinity and KleenGrow. Phytotoxicity was not observed in any of the treated boxwood plants. There were no differences in height increase and width increase between treated and non-treated boxwood plants. All non-treated, inoculated control plants (6 of 6) were not commercially acceptable (data not shown).

Treatment and rate (Application dates[z])	Volutella blight severity (%) (24 Nov 2020)	AUDPC	Height increase (in)	Width increase (in)
Daconil Weatherstik 22 fl oz/100 gal (1,2,3,4)	5.0 b[y]	50.2 b	0.72 a	0.19 a
KleenGrow 0.25 fl oz/1 gal (1,2,3,4)	2.5 bc	34.4 bc	0.46 a	0.33 a
Orkestra Intrinsic10 fl oz/100 gal (1,3) *alt* Trinity 8 fl oz/100 gal (2,4)	1.5 bc	23.9 bc	0.39 a	0.39 a
Non-treated, inoculated control	18.3 a	222.8 a	0.33 a	0.07 a
Non-treated, non-inoculated control	0.0 c	0.0 c	0.46 a	0.19 a
P-value	< .0001	< .0001	0.4183	0.4518

[z]Application dates: 1 = 6 Oct 2020; 2 = 20 Oct 2020; 3 = 3 Nov 2020; 4 = 17 Nov 2020.
[y]Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

BOXWOOD (*Buxus sinica* var. *insularis* × *B. sempervirens* 'Green Velvet')
Boxwood blight; *Calonectria pseudonaviculata*

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Evaluation of fungicides for the control of boxwood blight, 2020.

Boxwood 'Green Velvet' rooted cuttings were potted in 4 in square pots in Morton's no. 2 Grow Mix on 30 Jul 2019. Each pot was top dressed with 0.18 oz of 18-6-12 Osmocote Classic controlled release fertilizer. Six single-plant replications per treatment were arranged in a completely randomized design in a Biosafety Level 2 room at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were hand watered as needed. Fungicide treatments were applied according to application intervals as drench (75 ml solution/container) or spray (using hand-held sprayer until runoff) in a biosafety level-2 room and plants were relocated to the growth chamber 24 h after each fungicide application. *Calonectria pseudonaviculata* isolate FBGCp03, isolated from boxwood plants in TN in Sep 2019, was used for inoculation. Boxwood plants were inoculated with a conidial suspension (3.0×10^5 conidia/ fl oz) until run-off using a hand-held sprayer on 14 Nov 2019. Plants were placed in transparent plastic bags 6 h after inoculation and incubated in plant growth chambers at 77ºF under a 14-h photoperiod. After 24 h, the plants were removed from the bags and kept in the same growth chambers. Severity of boxwood blight and defoliation due to boxwood blight were recorded on 18, 25 Nov, 2, 9, 16, 23, 30 Dec 2019, 6 and 13 Jan 2020 using a scale of 0-100% foliage area affected. The area under disease progress curve (AUDPC) was calculated. Plant height and width were measured on 8 Nov 2019 and 15 Jan 2020. Analysis of variance was performed using the general linear models procedure using SAS statistical software and means were separated using Fisher's least significant difference test.

Boxwood blight disease pressure was moderate in this trial with non-treated control plants showing 30.8% disease severity and 21.7% defoliation by 13 Jan. The low rate of Broadform (2 fl oz/100 gal) (28-day application interval), KleenGrow alone (0.25 fl oz/1 gal) (14-day application interval), Daconil Weatherstik (22 fl oz/100 gal) plus KleenGrow (0.25 fl oz/1 gal) (14-day application interval), Daconil Weatherstik alone (22 fl oz/100 gal) (14-day application interval), Terraguard (6 fl oz/100 gal) (14-day application interval), the high rate of Broadform (4 fl oz/100 gal) (21-day application interval) and Medallion (1 fl oz/100 gal) (28-day application interval) were more effective in reducing disease severity in boxwood plants than Pageant Intrinsic (14-day application interval); but statistically similar in efficacy to the low rate of Broadform (2 fl oz/100 gal) (21-day application interval), the high rate of Broadform (4 fl oz/100 gal) (28-day application interval) and Pageant Intrinsic (28-day application interval). The low rate of Broadform (2 fl oz/100 gal) (28-day application interval), KleenGrow alone (0.25 fl oz/1 gal) (14-day application interval), Daconil Weatherstik (22 fl oz/100 gal) plus KleenGrow (0.25 fl oz/1 gal) (14-day application interval), Daconil Weatherstik alone (22 fl oz/100 gal) (14-day application interval), Terraguard (6 fl oz/100 gal) (14-day application interval), the high rate of Broadform (4 fl oz/100 gal) (21-day application interval), Medallion (1 fl oz/100 gal) (28-day application interval) and the low rate of Broadform (2 fl oz/100 gal) (21-day application interval) were more effective in reducing disease progress in boxwood plants than Pageant Intrinsic (14-day application interval) and the high rate of Broadform (4 fl oz/100 gal) (28-day application interval); but statistically similar in efficacy to Pageant Intrinsic (28-day application interval). Daconil Weatherstik (22 fl oz/100 gal) plus KleenGrow (0.25 fl oz/1 gal) (14-day application interval), KleenGrow alone (0.25 fl oz/1 gal) (14-day application interval) and Daconil Weatherstik alone (22 fl oz/100 gal) (14-day application interval) were more effective in reducing the defoliation percentage due to boxwood blight than Pageant Intrinsic (14-day application interval). Plant height and width increases were not significantly different among treated and non-treated control boxwood plants. Phytotoxicity was not observed in any of the treated boxwood plants.

Treatment and rate (Application dates[z])	Application interval	Application method	Boxwood blight			Plant height increase (in)
			Disease severity (%) (13 Jan)	AUDPC	Defoliation (%) (13 Jan)	
Broadform SC 2 fl oz/100 gal (1,3,5)	21 day	Drench	21.2 abc[y]	608.4 bcd	15.0 ab	0.47 a
Broadform SC 2 fl oz/100 gal (1,4,6)	28 day	Drench	13.7 c	508.1 cd	14.2 ab	0.51 a
Broadform SC 4 fl oz/100 gal (1,3,5)	21 day	Drench	18.3 c	582.8 bcd	14.2 ab	0.39 a
Broadform SC 4 fl oz/100 gal (1,4,6)	28 day	Drench	22.5 abc	712.3 abc	17.5 ab	0.87 a
Daconil Weatherstik 22 fl oz/100 gal (1,2,4)	14 day	Spray	16.3 c	434.0 cd	10.3 b	0.59 a
Daconil Weatherstik + KleenGrow 22 fl oz/100 gal + 0.25 fl oz/1 gal (1,2,4)	14 day	Spray	15.3 c	500.5 cd	8.7 b	0.98 a
KleenGrow 0.25 fl oz/1 gal (1,2,4)	14 day	Spray	13.7 c	454.4 cd	10.8 b	0.67 a
Medallion SC 1 fl oz/100 gal (1,4,6)	28 day	Drench	20.0 bc[y]	449.8 cd	14.2 ab	0.59 a
Pageant Intrinsic 12 oz/100 gal (1,2,4)	14 day	Drench	30.0 ab	887.8 ab	22.5 a	0.31 a
Pageant Intrinsic 12 oz/100 gal (1,4,6)	28 day	Drench	22.0 abc	625.3 a-d	17.5 ab	1.18 a
Terraguard SC 6 fl oz/100 gal (1,2,4)	14 day	Drench	14.5 c	365.8 d	12.5 ab	0.98 a
Non-treated, inoculated control			30.8 a	937.4 a	21.7 a	0.39 a
P-value			0.0163	0.0128	0.2769	0.4180

[z]Application dates: 1 = 11 Nov 2019; 2 = 25 Nov 2019; 3 = 2 Dec 2019; 4 = 9 Dec 2019; 5 = 23 Dec 2019; 6 = 6 Jan 2020.

[y]Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different ($P \leq 0.05$).

BOXWOOD (*Buxus sinica* var. *insularis* × *B. sempervirens* 'Green Velvet')
Phytophthora root rot; *Phytophthora nicotianae*

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Evaluation of fungicides, biofungicides, host plant inducers and fertilizer for the control of Phytophthora root rot of boxwood in field conditions, 2020.

The experiment was conducted at the Otis L. Floyd Nursery Research Center in McMinnville, TN in field plots with Waynesboro loam soil. The field was cultivated and leveled. Plots were measured and marked in a completely randomized design with four replications. On 3 Jun, the field was inoculated with *Phytophthora nicotianae* grown on rice grains for 10 days by placing a rice grain 5 cm below the soil surface every 30 cm in a row. Non-treated, non-inoculated and inoculated plots served as controls. Rooted cuttings of boxwood 'Green Velvet' were planted in the plots on 23 Jun. Each plot consisted of 5 plants spaced 60 cm apart with 2 m between rows. Plants were watered as needed using a drip irrigation system and fertilized with 10 g of 18-6-8 Nutricote controlled-release fertilizer on 30 Jun. Manual weeding was performed twice during the trial. All treatments were applied as soil drenches starting on 7 Jul and ending 15 Sep at different application intervals indicated in the table below. Plant height was recorded on 23 Jun and 29 Sep and the difference between the initial and final measurements were calculated and presented as height increase. Total fresh weight and root fresh weight were recorded for all plants on 29 Sep, and roots were assessed for Phytophthora root rot disease severity using a scale of 0-100% of roots affected. Average maximum temperatures for 3-30 Jun, 1-31 Jul, 1-30 Aug and 1-29 Sep were 29.8, 32.9, 32.1 and 27.4 ºC; average minimum temperatures were 17.6, 20.9, 19.36 and 15.2 ºC; and total rainfall amounts were 6.5, 7.7, 14.6 and 7.3 cm, respectively. Analysis of variance was performed using the general linear models (GLM) procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Phytophthora root rot disease pressure was moderate to high in this trial with non-treated, inoculated control plants showing 57.8% disease severity. Non-treated, non-inoculated control plants showed a minimal level of root rot (8%) due to the natural presence of soilborne pathogen inoculum in the field, which was identified as *P. nicotianae*. All of the treatments significantly reduced Phytophthora root rot severity compared to the non-treated, inoculated control. Subdue MAXX was significantly more effective in reducing disease severity in boxwood plants than all other treatments but not statistically different from Orkestra Intrinsic and the fertilizer ON-Gard. There were no significant differences among the treatments in height increase, total fresh weight and root fresh weight. Phytotoxicity was not observed in any of the treated boxwood plants.

Treatment and rate (application date[z])	Height increase (cm)	Total fresh weight (g)	Root fresh weight (g)	Phytophthora root rot severity (%)[y]
Non-treated, non-inoculated control	1.82 [x]	9.20	4.25	8.0 f[x]
Non-treated, inoculated control	1.47	7.45	2.95	57.8 a
Agri-Fos Plus L 0.6 ml/L (1)	1.70	8.97	3.72	34.5 b
Aliette 80 WDG 3.74 g/L (1, 4, 7, 10)	1.52	8.75	3.57	26.0 b-d
Areca WDG 5.99 g/L (1, 5, 9)	1.77	8.82	3.85	25.8 b-d
Empress Intrinsic 23.8SC 0.47 ml/L (1, 4, 7, 10)	1.40	9.40	4.17	28.8 b-d
ON-Gard 5-0-0 5.0 ml/L + RootShield Plus WP 0.6 g/L (1, 4, 7, 10)	1.40	7.05	2.72	33.3 bc
ON-Gard 5-0-0 5.0 ml/L (1, 4, 7, 10)	1.60	7.02	2.87	22.8 de
Orkestra Intrinsic 21.26SC 0.78 ml/L (1, 4, 7, 10)	1.52	10.10	4.65	24.0 de
Orvego SC 1.09 ml/L (1, 3, 5, 7, 9, 11)	1.72	7.30	3.05	29.8 b-d
Pageant Intrinsic 38WG 1.35 g/L (1, 4, 7, 10)	1.67	9.00	3.95	29.8 b-d
RootShield Plus WP 0.6 g/L (1, 7)	1.82	7.4	3.0	26.3 b-d
Segovis 1.67SC 0.25 ml/L (1, 4, 7, 10)	1.72	12.8	3.57	26.8 b-d
Stargus L 10 ml/L (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11)	1.55	7.67	3.60	25.3 cd
Subdue MAXX 22ME 0.16 ml/L (1, 11)	1.47	9.82	4.15	16.0 ef
P-value	0.212	0.386	0.125	<.0001

[z]Application dates: 1=7 Jul, 2=14 Jul, 3=21 Jul, 4=28 Jul, 5=4 Aug, 6=11 Aug, 7=18Aug, 8=25 Aug, 9=1 Sep, 10=8 Sep, 11=15 Sep.

[y]Disease severity was based on percentage of roots affected.

[a]Values are the means of twenty replicates; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$

CRAPEMYRTLE (*Lagerstroemia indica* 'Whit I' Raspberry Sundae™)
Cercospora leaf spot; *Cercospora lythracearum*

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Evaluation of fungicides for the control of Cercospora leaf spot of crapemyrtle, 2019.

Crapemyrtle 'Whit I' (*Lagerstroemia indica* Raspberry Sundae™) plants were potted in no. 3 nursery containers in Morton's no. 2 Grow Mix on 12 Apr and each pot was top-dressed with 1.23 oz of 18-6-12 Osmocote Classic controlled release fertilizer on 1 May. Five single-plant replications per treatment were arranged in a completely randomized design outdoor under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 3 minutes twice a day using light green coded SPOT-SPITTER® spray stakes (Primerus Products, LLC). The initial fungicide application was made when disease was first observed on leaves (0.5-1% disease severity). Fungicide treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi on 28 Jun, 12 and 26 Jul. Control plants were sprayed with water. The severity of Cercospora leaf spot was evaluated weekly from 8 Jul to 12 Aug using a scale of 0-100% foliage area affected, and the area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated on 26 Jul using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. Plant height and width were measured on 28 Jun and 12 Aug and the difference between initial and final values were reported as plant height and width increases. Average maximum temperatures for 28-30 Jun, 1-31 Jul, and 1-12 Aug were 93.0, 96.0, and 90.9ºF; average minimum temperatures were 59.0, 59.7 and 63.0ºF; and total rainfall was 0.10, 8.73 and 0.01 in., respectively. Analysis of variance was performed using the general linear model procedure using SAS statistical software and means were separated using Fisher's LSD test.

Cercospora leaf spot infections occurred naturally and disease pressure was moderate in this trial. The final disease severity mean value was 37% in the non-treated control plants. All fungicide treatments significantly reduced Cercospora leaf spot severity and disease progress compared to the non-treated control, and there were no differences among fungicide treatments. Plant height and width were not significantly different among treated and non-treated control plants on 12 Aug. There were also no differences in plant height and width increases between treated and non-treated plants (data not shown). Phytotoxicity was not observed in any of the treated crapemyrtle plants. Both rates of ManKocide left blue-colored chemical residue on the leaf surfaces. Non-treated control plants were not commercially acceptable due to the level of disease at the end of the experiment; however, all treated plants were commercially acceptable or better (data not shown).

Treatment and rate	Cercospora leaf spot		Plant width (in) (12 Aug)	Plant height (in) (12 Aug)
	Disease severity (%) (12 Aug)	AUDPC		
ManKocide DF 0.56 oz/1 gal	6.0 b[z]	150.2 b	18.9	43.9
ManKocide DF 1.13 oz/1 gal	5.5 b	134.8 b	21.5	38.0
Astun™ SC 15.00 fl oz/100 gal	6.5 b	181.7 b	20.8	41.9
Astun™ SC 17.50 fl oz/100 gal	5.0 b	117.9 b	20.2	42.8
Mural 45WG 7.00 oz/100 gal	5.5 b	145.3 b	21.7	43.6
Non-treated control	37.0 a	780.3 a	19.9	38.1
P-value	≤0.0001	≤0.0001	0.6492	0.8010

[z]Values are the means of five replications; treatments followed by the same letter within a column are not significantly different ($P \leq 0.05$).

CRAPEMYRTLE (*Lagerstroemia indica* Raspberry Sundae™ 'Whit I')
Cercospora leaf spot; *Cercospora lythracearum*

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Evaluation of fungicides for control of Cercospora leaf spot on crapemyrtle, 2020.

Crapemyrtle 'Whit I' (*Lagerstroemia indica* Raspberry Sundae™) plants were potted in no. 3 nursery containers filled with Morton's Nursery mix (55-65% processed pine bark, Canadian sphagnum peat, and sand) in 2017. Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 14 Jul and with 1.23 oz Nutricote Total 18-6-8 on 21 Jul. Six single-plant replications per treatment were arranged in a completely randomized design under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 5 minutes twice a day using an overhead irrigation system in Aug and Sep. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer at 40 psi with a TeeJet XR8002VS nozzle on a 7 or 14-day interval beginning on 4 Aug and ending on 1 Sep. Severity of Cercospora leaf spot resulting from natural infections, phytotoxicity and defoliation were recorded weekly starting 11 Aug until 15 Sep and were expressed as the percentage of foliage area affected. The area under the disease progress curve (AUDPC) was then calculated. Plant quality was evaluated on 15 Sep using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 3 Aug and 15 Sep and the difference between the initial and final measurements were calculated and presented as height increase. Average maximum temperatures for 4-31 Aug and 1-15 Sep were 94.4 ºF and 91.7ºF; average minimum temperatures were 62.8ºF and 46.0ºF; and total rainfall was 5.76 in and 2.86 in, respectively. Analysis of variance was performed using the general linear models (GLM) procedure with SAS statistical software and means were separated using Fisher's LSD test.

Cercospora leaf spot disease pressure was low to moderate in this trial with non-treated control crapemyrtle plants showing 35% disease severity by 15 Sep. All fungicide treatments significantly reduced Cercospora leaf spot and disease progress (AUDPC) compared to the non-treated control plants. LifeGard + Triathlon (7-day application interval) was significantly more effective in reducing disease severity than Mural (14-day application interval), LifeGard alone (7-day application interval), the low rate of Astun (13.5 fl oz/100 gal) (14-day application interval), Triathlon alone (7-day application interval), and the rotation program of LifeGard (twice with 7-day application interval) followed by LifeGard + Triathlon (twice with 7-day application interval). The high rate of Astun (17 fl oz/100 gal) (14-day application interval) and KleenGrow were significantly more effective in reducing disease severity compared to Mural (14-day application interval) and LifeGard alone (7-day application interval). LifeGard + Triathlon (7-day application interval) and KleenGrow were significantly more effective in reducing disease progress than Mural (14-day application interval), LifeGard alone (7-day application interval), the low rate of Astun (13.5 fl oz/100 gal) (14-day application interval), and Triathlon alone (7-day application interval). The high rate of Astun (17 fl oz/100 gal) (14-day application interval) and the rotation program of LifeGard (twice with 7-day application interval) followed by LifeGard + Triathlon (twice with 7-day application interval) were significantly more effective in reducing disease progress than LifeGard alone (7-day application interval). Phytotoxicity and defoliation were not observed in any of the treated plants. There were no significant differences in plant height increase between treated and non-treated plants. Most of the non-treated control plants (5 out of 6) were not commercially acceptable due to Cercospora leaf spot disease severity at the end of the experiment (data not shown).

Treatment and rate (application dates[*])	Cercospora leaf spot		Height increase (in)
	Mean severity (%) (15 Sep)	AUDPC	
Astun SC 13.5 fl oz/100 gal (1, 3, 5)	5.4 bc[**]	104.7 bc	3.5 a
Astun SC 17 fl oz/100 gal (1, 3, 5)	4.1 cd	81.4 cd	1.3 a
KleenGrow L 0.25 fl oz/1 gal (1, 3, 5)	3.3 cd	57.2 d	1.3 a
LifeGard WG 5 oz/100 gal (1, 2, 3, 4)	7.1 b	123.4 b	1.4 a
LifeGard WG 5 oz/100 gal (1, 2) LifeGard WG 5 oz/100 gal + Triathlon 3 qt/100 gal (3, 4)	5.4 bc	83.7 cd	1.2 a
LifeGard WG 5 oz/100 gal + Triathlon 2 qt/100 gal (1, 2, 3, 4)	2.7 d	51.3 d	4.0 a
Mural 45WG 7 oz/100 gal (1, 3, 5)	6.7 b	117.3 bc	1.1 a
Triathlon SC 3 qt/100 gal (1, 2, 3, 4)	5.3 bc	98.0 bc	0.6 a
Non-treated control	35.0 a	527.9 a	0.7 a
P-value	≤0.0001	≤0.0001	0.7065

[*]Application dates: 1= 4 Aug; 2= 11 Aug; 3= 18 Aug; 4= 25 Aug; 5= 1 Sep.

[**]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

CRAPEMYRTLE (*Lagerstroemia indica* x *L. fauriei* 'Hopi')
Powdery mildew; *Erysiphe lagerstroemia*

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Evaluation of fungicides for control of powdery mildew on crapemyrtle, 2020.

Crapemyrtle (*Lagerstroemia indica* x *L. fauriei* 'Hopi') plants were potted in 1-gallon nursery containers filled with Morton's Nursery mix (processed pine bark [55-65%], Canadian sphagnum peat, and sand) on 2 Mar. Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 8 Sep and 0.5 oz of 18-6-8 Nutricote controlled release fertilizer on 15 Sep. Six single-plant replications per treatment were arranged in a complete randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 4 minutes twice a day in Oct and Nov. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with a TeeJet XR8002VS nozzle on a 14-day interval on 1, 15, and 29 Oct. Severity of powdery mildew resulting from natural infection, defoliation and phytotoxicity were recorded on 7, 14, 21 and 28 Oct and 4 Nov and were expressed as the percentage of foliage area affected. The area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated on 4 Nov using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 1 Oct and 5 Nov. The maximum temperatures for 1-30 Oct and 1-5 Nov was 81.2ºF and 82.5ºF, respectively; average minimum temperatures for 1-30 Oct and 1-5 Nov was 61.1ºF and 59.4ºF, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew infection occurred naturally and disease pressure was moderate. Powdery mildew disease severity rating was 51.7% in the non-treated control plants by 4 Nov. All of the treatments significantly reduced final severity (4 Nov) and AUDPC compared to the non-treated control. There were no significant differences between the treatments in disease severity and disease progress (AUDPC). There were no significant differences in plant height increase between treated and non-treated crapemyrtle plants. Phytotoxicity and defoliation were not observed in any of the treated plants. All treated plants were commercially acceptable; however, non-treated control plants were not commercially acceptable due to disease severity (data not shown).

Treatment and rate	Application dates[z]	Powdery mildew		Height increase (in)
		Mean severity (%) (4 Nov)	AUDPC	
KleenGrow L 0.25 fl oz/1 gal	1, 2, 3	13.3 b[zz]	158.7 b	0.67 a
Mural 45WG 4 oz/100 gal	1, 2, 3	3.7 b	40.8 b	0.39 a
OHP1902 4 fl oz/100 gal	1, 2, 3	6.0 b[zz]	60.7 b	0.51 a
OHP1902 5 fl oz/100 gal	1, 2, 3	5.3 b	65.3 b	1.06 a
Terraguard SC 4 fl oz/100 gal + OHP1902 4 fl oz/100 gal	1, 2, 3	4.7 b	64.2 b	0.79 a
Terraguard SC 8 fl oz/100 gal	1, 2, 3	4.7 b	65.9 b	0.90 a
Non-treated control		51.7 a	722.8 a	1.18 a
P-value		<.0001	<.0001	0.5077

[z]Application dates: 1=1 Oct 2020; 2=15 Oct 2020; 3=29 Oct 2020.
[zz]Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

FLOWERING DOGWOOD (*Cornus florida* 'Cherokee Princess')
Powdery mildew; *Erysiphe pulchra*

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Evaluation of biorational products for the control of powdery mildew of dogwood, 2019.

Flowering dogwood (*Cornus florida*) cultivar 'Cherokee Princess' seedlings were potted in no. 1 nursery containers in Morton's no. 2 Grow Mix on 20 May. Each plant was top-dressed with 0.5 oz of 18-6-12 Osmocote Classic controlled release fertilizer on 28 Jun and 150 ml/pot of Miracle-Gro® All Purpose Plant Food 24-8-16 at a rate of 0.5 oz/1 gal on 28 May and 18 Jun. Ten single-plant replications per treatment were arranged in a completely randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Flowering dogwood plants were watered once per day using overhead irrigation system. The initial application was made when disease was first observed on leaves (0.5-1% leaf area affected). Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi. Control plants were sprayed with water. The severity of powdery mildew was evaluated on 9, 16 and 23 Jul using a scale of 0-100% foliage area affected, and the area under the disease progress curve (AUDPC) was calculated. Plant height and width were measured on 1 Jul and 23 Jul and the difference between initial and final height and width are reported. Average maximum temperature for 1-23 Jul was 83.9ºF and average minimum temperature was 66.6ºF. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew infection occurred naturally in the greenhouse and disease pressure was high; the final (23 Jul) mean disease severity rating was 88% in the non-treated control dogwood plants. All treatments significantly reduced powdery mildew severity and disease progress compared to the non-treated control. There were no significant differences in disease severity and disease progress among treatments. Plant height and width were not significantly different among treated and non-treated control dogwood plants on 23 Jul (data not shown). There were no significant differences in plant height increase between treated and non-treated plants. Cease, Milstop and Triact 70 treated plants had greater width increase compared to the non-treated control plants. Phytotoxicity and residue were not observed in any of the treated dogwood plants.

Treatment and rate	Application dates[z]	Final disease severity (%)[y]	AUDPC[y]	Plant height increase (in)	Plant width increase (in)
Non-treated control		88.0 a[x]	808.5 a	1.1 a	0.4 b
Cease 8 qts/100 gal	1,2,3	4.8 b	38.9 b	2.3 a	2.0 a
Milstop 1 tbsp/gal	1,2,3	1.6 b	10.9 b	2.2 a	1.7 a
Triact 70 1%	1,2,3	1.9 b	10.9 b	1.4 a	1.7 a
P-value		≤0.0001	≤0.0001	0.5495	0.0145

[z] Application dates for treatments were: 1=2 Jul; 2=9 Jul; 3=16 Jul.
[y] Disease severity and AUDPC were based on percentage of the foliage affected.
[x] Values are the means of ten replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

FLOWERING DOGWOOD (*Cornus florida* 'Cherokee Princess')
Powdery mildew; *Erysiphe pulchra*

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Evaluation of experimental fungicides for the control of powdery mildew of dogwood, 2019.

Flowering dogwood (*Cornus florida*) cultivar Cherokee Princess seedlings were potted in no. 1 nursery containers in Morton's no. 2 Grow Mix on 20 May. Each plant was top-dressed with 150 ml/pot of Miracle-Gro® All Purpose Plant Food 24-8-16 at a rate of 0.5 oz/gal on 28 May and 18 Jun and 0.5 oz of 18-6-12 Osmocote Classic controlled release fertilizer on 28 Jun. Six single-plant replications per treatment were arranged in a completely randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Flowering dogwood plants were watered once per day using an overhead irrigation system. Treatments were applied twice on a 14-day interval to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi. Control plants were sprayed with water. The severity of powdery mildew was evaluated on 9, 16 and 23 Jul using a scale of 0-100% foliage area affected, and the area under the disease progress curve (AUDPC) was calculated. Plant height and width were measured on 6 Jun and 23 Jul and the difference between initial and final values were reported as plant height and width increases. Average maximum temperatures for 6-30 Jun and 1-23 Jul were 81.2 and 83.9ºF, while average minimum temperatures were 64.6 and 66.6ºF, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew infection occurred naturally in the greenhouse and disease pressure was high. The final (23 Jul) mean disease severity rating was 90% in the non-treated control dogwood plants. All fungicide treatments significantly reduced powdery mildew severity and disease progress compared to the non-treated control. However, there were no significant differences in disease progress among fungicide treatments. The treatments that most effectively reduced powdery mildew severity were both rates of OHPF-1904 (3.1 and 4.7 fl oz/100 gal), Mural, and the high rate of OHPF-1902 (5.0 fl oz/100 gal). Plant height and width were not significantly different among treated and non-treated control plants on 23 Jul. There were also no differences in plant height and width increases between treated and non-treated plants (data not shown). Phytotoxicity and chemical residue were not observed in any of the fungicide treated dogwood plants.

Treatment and rate/100 gal	Application dates[z]	Final disease severity (%)	AUDPC[z]	Plant width (in) (23 Jul)	Plant height (in) (23 Jul)
Non-treated control		90.0 a[zz]	837.1 a	12.6	9.3
OHPF-1902 4.0 fl oz	1,2	6.7 b	47.5 b	13.4	11.3
OHPF-1902 5.0 fl oz	1,2	5.3 bc	41.7 b	14.7	11.1
OHPF-1904 3.1 fl oz	1,2	0.6 c	5.3 b	12.4	10.7
OHPF-1904 4.7 fl oz	1,2	0.3 c	4.4 b	9.8	9.3
Mural 45WG 5.0 oz	1,2	1.7 bc	20.4 b	15.6	10.6
P-value		≤0.0001	≤0.0001	0.2371	0.4368

[z] Application dates for treatments were: 1=2 Jul; 2=16 Jul.
[zz] Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

FLOWERING DOGWOOD (*Cornus florida* 'Cherokee Princess')
Powdery mildew; *Erysiphe pulchra*
Spot anthracnose; *Elsinoe corni*

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Evaluation of fungicides for the control of powdery mildew and spot anthracnose of dogwood, 2019.

Flowering dogwood (*Cornus florida*) 'Cherokee Princess' plants were potted in no. 7 nursery containers in %100 bark substrate. Six single-plant replications per treatment were arranged in a completely randomized design under 56% shade at Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 4 minutes twice a day in Jul and Aug using micro bubbler emitters installed on short stakes. The initial fungicide application was made when the two diseases were first observed on leaves. Treatments were applied to run-off using a backpack CO_2 -pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi on a 14-day interval beginning on 3 Jul and ending on 31 Jul. Postiva treatment was mixed with CapSil® at 6 fl oz/100 gal. The severities of powdery mildew and spot anthracnose, and phytotoxicity were evaluated on 3, 9, 16, 23, 30 Jul and 8 Aug using a scale of 0-100% foliage area affected. The area under the disease progress curve (AUDPC) was calculated according to the formula: $\sum([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations. Plant height was measured on 2 Jul and 8 Aug. Average maximum temperatures for 2-31 Jul, and 1-8 Aug were 96.0 and 90.9°F, average minimum temperatures were 49.7 and 63.0°F, and total rainfall amounts were 8.73 and 0.10 in, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's LSD test.

Powdery mildew and spot anthracnose infections occurred naturally in this trial. Powdery mildew disease pressure was moderate, and mean disease severity reached 33.3% by the end of the experiment in the non-treated control plants. Spot anthracnose disease pressure was low, with an average disease severity of 12.1% in the non-treated control plants. All fungicide treatments significantly reduced powdery mildew and spot anthracnose severity as well as disease progress compared to non-treated control plants. Mural and Concert II were more effective in reducing powdery mildew disease severity and AUDPC than all rates of Postiva (10, 14, 21 and 28 fl oz/100 gal) and Pageant, but Concert II was statistically similar in efficacy to Pageant Intrinsic. Mural, Concert II and Pageant Intrinsic were numerically more effective in reducing spot anthracnose disease severity than all rates of Postiva. Plant height was not significantly different among treated and non-treated control dogwood plants on 8 Aug (data not shown). There were also no differences in height increase between treated and non-treated plants (data not shown). Phytotoxicity and chemical residue were not observed in any of the treated dogwood plants.

Treatment and rate/100 gal	Powdery mildew[z]		Spot anthracnose[z]	
	% Mean severity (8 Aug)	AUDPC	% Mean severity (8 Aug)	AUDPC
Postiva SC 10 fl oz	13.3 b[zz]	282.2 b	2.5 b	50.2 b
Postiva SC 14 fl oz	13.3 b	251.7 bc	2.5 b	49.1 b
Postiva SC 21 fl oz	11.7 b	238.4 c	2.2 b	41.7 bc
Postiva SC 28 fl oz	11.3 b	229.4 c	2.1 b	38.9 bc
Mural 45WG 7 fl oz	0.7 d	20.2 e	0.5 c	4.5 d
Concert II 4.3SE 28 fl oz	2.9 cd	53.8 de	1.3 bc	22.4 cd
Pageant Intrinsic 38WG 12 oz	4.6 c	95.8 d	1.7 bc	25.9 cd
Non-treated control	33.3 a	566.4 a	12.1 a	175.2 a
P value	≤0.0001	≤0.0001	≤0.0001	≤0.0001

[z]Disease ratings and area under the disease progress curve (AUDPC) were based on percentage of foliage area affected.
[zz]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

FLOWERING DOGWOOD (*Cornus florida* 'Cherokee Princess')
Powdery mildew; *Erysiphe pulchra*

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Evaluation of biofungicides for the control of powdery mildew of dogwood, 2019.

Flowering dogwood (*Cornus florida*) cultivar 'Cherokee Princess' seedlings were potted in no. 1 nursery containers in Morton's no. 2 Grow Mix on 20 May. Each plant was top-dressed with 0.5 oz of 18-6-12 Osmocote Classic controlled release fertilizer on 28 Jun and 150 ml/pot of Miracle-Gro® All Purpose Plant Food 24-8-16 at a rate of 0.5 oz/1 gal on 28 May and 18 Jun. Ten single-plant replications per treatment were arranged in a completely randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Flowering dogwood plants were watered once per day using overhead irrigation system. The initial application was made when disease was first observed on leaves (0.5-1% disease severity). Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi. Control plants were sprayed with water. The severity of powdery mildew was evaluated on 9, 16 and 23 Jul using a scale of 0-100% foliage area affected, and the area under the disease progress curve (AUDPC) was calculated. Plant height and width were measured on 1 Jul and 23 Jul. Average maximum temperature for 1-23 Jul was 83.9ºF and average minimum temperature was 66.6ºF. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew infection occurred naturally in the greenhouse and disease pressure was high; the final (23 Jul) mean disease severity rating was 88% in the non-treated control dogwood plants. All treatments significantly reduced powdery mildew severity and disease progress compared to the non-treated control. But, there were no significant differences in disease progress among treatments. The treatments that most effectively reduced powdery mildew severity were the low and high rates of Serifel (16 and 48 oz/100 gal) and Cease. Plant height and width were not significantly different among treated and non-treated control dogwood plants on 23 Jul. There were also no differences in plant height increase between treated and non-treated plants (data not shown). Phytotoxicity and residue were not observed in any of the treated dogwood plants.

Treatment and rate/100 gal	Application dates[z]	Final disease severity (%)[y]	AUDPC[z]	Plant width (in) (23 Jul)	Plant height (in) (23 Jul)
Non-treated control		88.0 a[x]	808.5 a	8.1 a	11.3 a
Serifel 16 oz	1,2,3	5.6 c	50.8 b	8.7 a	12.2 a
Serifel 48 oz	1,2,3	3.3 c	23.6 b	8.1 a	9.4 a
Integral Pro 38.4 fl oz	1,2,3	10.8 b	58.6 b	7.8 a	9.7 a
Integral Pro 115.2 fl oz	1,2,3	10.3 b	79.5 b	9.5 a	12.4 a
Cease 8 qt	1,2,3	4.8 c	38.9 b	10.2 a	12.8 a
P-value		≤0.0001	≤0.0001	0.0811	0.1379

[z]Application dates for treatments were: 1=2 Jul; 2=9 Jul; 3=16 Jul.
[y]Disease severity and AUDPC were based on percentage of the foliage affected.
[x]Values are the means of ten replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

FLOWERING DOGWOOD (*Cornus florida* 'Cherokee Princess')
Powdery mildew; *Erysiphe pulchra*
Spot anthracnose; *Elsinoe corni*

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Evaluation of fungicides for control of powdery mildew and spot anthracnose of dogwood, 2020.

Flowering dogwood (*Cornus florida*) 'Cherokee Princess' plants were potted in 5-gallon containers filled with Morton's Nursery mix (processed pine bark [55-65%], Canadian sphagnum peat, and sand) and fertilized with Nutricote Total (18-6-8) controlled release fertilizer. Six single-plant replications per treatment were arranged in a randomized complete block design outdoors under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 4 minutes twice a day in Jun, Jul and Aug. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle on a 14-day interval beginning on 26 Jun and ending on 24 Jul. Severity of powdery mildew and spot anthracnose resulting from natural infection, phytotoxicity and defoliation were determined on 26 Jun, 3, 17, and 31 Jul and 14 Aug using a scale of 0-100% foliage area affected. The area under the disease progress curve (AUDPC) for each disease was calculated. Plant quality was evaluated on 14 Aug using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height and plant width were measured on 25 Jun and 13 Aug. The maximum temperatures for Jun, Jul and Aug were 98.2ºF, 102.9ºF and 103.2ºF; average minimum temperatures for Jun, Jul and Aug were 62.3ºF, 64.4ºF, 66.7ºF and total rainfall for Jun, Jul and Aug were 1.01, 3.03 and 1.62 in, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew and spot anthracnose infections occurred naturally in this trial. Powdery mildew and spot anthracnose disease pressures were low to moderate in this trial with non-treated control plants showing 21.3% and 30.8% disease severity by 14 Aug, respectively. All fungicide treatments significantly reduced powdery mildew severity and disease progress compared to non-treated control plants. Terraguard was the most effective in reducing spot anthracnose disease severity and spot anthracnose disease progress. Phytotoxicity was not observed in any of the treated plants. There were no significant differences in plant height increase between treated and non-treated controls. All plants were commercially acceptable.

Treatment and rate	Application dates[z]	Powdery mildew		Spot anthracnose		Plant height increase (in)
		Disease severity (%)	AUDPC	Disease severity (%)	AUDPC	
KleenGrow L 0.25 fl oz/1 gal	1,2,3	4.2 b[zz]	101.5 b	14.2 b	387.9 b	2.24 a
Pageant Intrinsic 38WG 18 oz/100 gal	1,2,3	7.5 b	205.3 b	12.9 bc	338.3 bc	1.49 a
Terraguard SC 8 fl oz/100 gal	1,2,3	6.3 b	133.6 b	10.4 c	276.5 c	4.01 a
Non-treated control		21.3 a	440.1 a	30.8 a	680.5 a	4.52 a
P-value		≤0.0001	≤0.0001	≤0.0001	≤0.0001	0.1438

[z]Application dates: 1=26 Jun 2020; 2=10 Jul 2020; 3=24 Jul 2020.
[zz]Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

FLOWERING DOGWOOD (*Cornus florida* 'Cherokee Princess')
Phytophthora root rot; *Phytophthora cinnamomi*

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Evaluation of fungicides and host plant defense inducers for the control of Phytophthora root rot of dogwood, 2020.

Flowering dogwood (*Cornus florida*) 'Cherokee Princess' seedlings were potted in 4-in nursery containers using pine bark medium on 20Feb. Six single-seedling replications per treatment were arranged in a completely randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were watered twice a day for 2 minutes using an overhead irrigation system. Plants were inoculated on 20 Apr using rice grains colonized by *Phytophthora cinnamomi* for 15 days. One rice grain was placed at the two opposite sides of the container in the root zone of each plant. Non-treated, inoculated and non-inoculated plants served as controls. Treatments were applied as a drench one week after inoculation on 27 Apr (1.7 fl oz/pot). Plants' root system was assessed on 26 Jul for root rot severity using a 1 to 5 scale based on percentage of the root with visible rot symptoms: 1=0% (healthy), 2=1-25%, 3=26-50%, 4=51-75%, and 5=76-100%. The median value of each range was used for data analysis. Root fresh weight was determined on 26 Jul. Average maximum temperatures for 20-30 Apr, 1-31 May,1-30 Jun and 1-26 Jul were 90.6ºF, 84.7ºF, 98.0ºF and 100.0ºF; average minimum temperatures were 68.6ºF, 66.8ºF, 69.5ºF and 70.0ºF, respectively. Analysis of variance was performed using the general linear models (GLM) procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Phytophthora root rot severity was moderate, reaching 35.8% in the non-treated, inoculated control dogwood plants in the final evaluation (26 Jul). All treatments significantly reduced Phytophthora root rot severity compared to the non-treated, inoculated control. Interface was more effective in reducing disease severity in dogwood plants than Pageant Intrinsic, but not statistically different in efficacy to all other treatments. Interface and Signature Xtra Stressgard treatments significantly increased root fresh weight compared to all other treatments. No symptoms of phytotoxicity were seen in the treated dogwood seedlings.

Treatment and rate (per 100 gal)	Phytophthora root rot severity (%)	Root fresh weight (oz)
Aliette 80 WDG 50 oz	13.3 bc	1.18 c
Empress Intrinsic 23.8SC 3 fl oz	13.3 bc	1.00 c
Interface 23.10SC 80 fl oz	7.5 c	2.03 a
Orkestra Intrinsic 21.26SC 10 fl oz	9.2 bc	0.97 c
Pageant Intrinsic 38WG 18 oz	15.0 b	0.96 c
Segovis 1.67SC 3 fl oz	12.5 bc	1.08 c
Signature Xtra Stessgard 60WDG 80 oz	9.2 bc	1.63 b
Subdue MAXX 22ME 2 fl oz	10.0 bc	1.14 c
Tartan 4.17SC 80 fl oz	13.3 bc	0.95 c
Non-treated, non-inoculated control	0.0 d	1.03 c
Non-treated, inoculated control	35.8 a	0.92 c
P-value	<0.0001	<0.0001

·Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

HYDRANGEA (*Hydrangea macrophylla* 'Nikko Blue')
Cercospora leaf spot; *Cercospora hydrangea*

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Evaluation of fungicides for control of Cercospora leaf spot on Hydrangea, 2019.

Hydrangea (*Hydrangea macrophylla*) 'Nikko Blue' plants were potted in no. 5 nursery containers filled with 100% pine bark substrate, which was amended with 0.48 lb of 19-5-9 Osmocote® Pro controlled release fertilizer, 0.06 lb of Micromax® micronutrient fertilizer, 0.04 lb iron sulfate and 0.01 lb Epsom salt per cubic feet of mix. Six single-plant replications per treatment were arranged in a completely randomized design outdoors under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 3 minutes twice a day in Jun and for 4 minutes twice a day in Jul and Aug using micro bubbler emitters installed on short stakes. Treatments were applied three times on a 14-day interval to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi beginning on 3 Jul and ending on 31 Jul. Severity of Cercospora leaf spot resulting from natural infections and phytotoxicity were determined on 3, 9, 16, 23, 30 Jul and 8 Aug and were expressed as percentage of foliage area affected. The area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated on 8 Aug using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. Plant height and width were measured on 2 Jul and 8 Aug and the difference between initial and final values was reported as height and width increase. Average maximum temperatures for 2-31 Jul, and 1-8 Aug were 96.0 and 90.9°F, average minimum temperatures were 49.7 and 63.0°F, and total rainfall amounts were 8.73 and 0.10 in, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's LSD test.

Cercospora leaf spot infection occurred naturally and disease pressure was moderate in this trial with non-treated control plants showing 34.2% disease severity by 8 Aug. All of the treatments significantly reduced disease severity and AUDPC compared to the non-treated control. Orkestra Intrinsic and Mural were more effective in reducing Cercospora leaf spot disease severity than the lower rates of Postiva (10 and 14 fl oz/100 gal) and Concert II, but statistically similar in efficacy to the higher rates of Postiva (21 and 28 fl oz/100 gal). When looking at AUDPC on fungicide-treated plants, there was a significant difference between Orkestra Intrinsic and Postiva 14 fl oz only. Plant height and width were not significantly different among treated and non-treated control plants on 8 Aug (data not shown). There were also no differences in height increase between treated and non-treated plants (data not shown). Phytotoxicity and chemical residue were not observed in any of the treated hydrangea plants. All non-treated control plants were not commercially acceptable due to Cercospora leaf spot disease severity at the end of the trial (data not shown).

		Cercospora leaf spot	
		Mean severity (%)	AUDPC
Treatment and rate/100 gal	Application dates[z]	(8 Aug)	
Postiva SC 10 fl oz + CapSil® 6 fl oz	1, 2, 3	4.4 b[y]	71.8 bc
Postiva SC 14 fl oz + CapSil® 6 fl oz	1, 2, 3	4.1 b	75.0 b
Postiva SC 21 fl oz + CapSil® 6 fl oz	1, 2, 3	2.3 bcd	45.9 bc
Postiva SC 28 fl oz + CapSil® 6 fl oz	1, 2, 3	2.1 bcd	55.7 bc
Mural 45WG 7 fl oz	1, 2, 3	1.7 cd	35.6 bc
Concert II 4.3SE 28 fl oz	1, 2, 3	3.5 bc	70.8 bc
Orkestra Intrinsic SC 6 fl oz	1, 2, 3	0.8 d	17.8 c
Non-treated control		34.2 a	649.5 a
P-value		≤0.0001	≤0.0001

[z]Application dates: 1=3 Jul; 2=17 Jul; 3=31 Jul.
[y]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

HYDRANGEA (*Hydrangea macrophylla* 'Endless Summer®')
Cercospora leaf spot; *Cercospora hydrangea*

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Evaluation of fungicides for control of Cercospora leaf spot on Hydrangea, 2020.

Hydrangea (*Hydrangea macrophylla*) 'Endless Summer®' plants were potted in no. 5 nursery containers filled with Morton's Nursery mix (processed pine bark [55-65%], Canadian sphagnum peat, and sand). Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 14 Jul and fertilized with Nutricote Total 18-6-8 on 21 Jul. Six single-plant replications per treatment were arranged in a completely randomized design under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 3 minutes twice a day using irrigation system with green Spot-Spitter spray stick (160° spray pattern). Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with a TeeJet XR8002VS nozzle on a 7 or 14-day interval beginning on 4 Aug and ending on 1 Sep. Severity of Cercospora leaf spot resulting from natural infection, phytotoxicity and defoliation were recorded on 11, 18 and 25 Aug and 1, 8 and 15 Sep and were expressed as the percentage of foliage area affected. The area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated on 15 Sep using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 3 Aug and 15 Sep. The maximum temperatures for 4-31 Aug and 1-15 Sep were 94.4 ºF and 91.7ºF, respectively; average minimum temperatures for 4-31 Aug and 1-15 Sep were 62.8ºF and 46.0ºF, respectively; and total rainfall was 5.76 in and 2.86 in, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Cercospora leaf spot disease pressure was moderate in this trial with non-treated control plants showing 53.3% disease severity by 15 Sep. All treatments significantly reduced Cercospora leaf spot disease severity and disease progress (AUDPC) compared to the non-treated control hydrangea plants. Mural (14-day application interval), Triathlon alone (3 qt/100 gal) (7-day application interval), the high rate of Astun (17 fl oz/100 gal) (14-day application interval), LifeGard (5 oz/100 gal) + Triathlon (2 qt/100 gal) (7-day application interval), LifeGard (5 oz/100 gal) (twice with 7-day application interval) followed with LifeGard (5 oz/100 gal) + Triathlon (3 qt/100 gal) (twice with 7-day application interval) program were more effective in reducing disease severity in hydrangea plants than LifeGard alone (7-day application interval); but statistically similar in efficacy to the low rate of Astun (13.5 fl oz/100 gal) (14-day application interval) and KleenGrow (0.25 fl oz/1 gal). Mural (14-day application interval), LifeGard (5 oz/100 gal) + Triathlon (2 qt/100 gal) (7-day application interval), LifeGard (5 oz/100 gal) (twice with 7-day application interval) followed with LifeGard (5 oz/100 gal) + Triathlon (3 qt/100 gal) (twice with 7-day application interval) program were more effective in reducing disease progress in hydrangea plants than LifeGard alone (7-day application interval), the low rate of Astun (13.5 fl oz/100 gal) (14-day application interval) and KleenGrow (0.25 fl oz/1 gal); but statistically similar in efficacy to Triathlon alone (3 qt/100 gal) (7-day application interval), and the high rate of Astun (17 fl oz/100 gal) (14-day application interval). Phytotoxicity and defoliation were not observed in any of the treated hydrangea plants. There were no significant differences in plant height increase between treated and non-treated plants. None of the control hydrangea plants (6 of 6 plants) were commercially acceptable due to Cercospora leaf spot disease severity at the end of the experiment, but all treated hydrangea plants were commercially acceptable (data not shown).

Treatment and rate (application dates*)	Cercospora leaf spot		Height increase (in)
	Mean severity (%) (15 Sep)	AUDPC	
Astun 13.5 fl oz/100 gal (1,3,5)	15.0 bc**	289.3 b	1.49 a
Astun 17 fl oz/100 gal (1,3,5)	14.2 c	248.5 bc	2.64 a
KleenGrow 0.25 fl oz/1 gal (1,3,5)	15.0 bc	248.5 bc	0.79 a
LifeGard WG 5 oz/100 gal (1,2,3,4)	18.3 b	291.7 b	2.17 a
LifeGard WG 5 oz/ 100 gal (1,2) LifeGard WG 5 oz/100 gal + Triathlon 3 qt/100 gal (3,4)	14.2 c	203.0 c	4.06 a
LifeGard WG 5 oz/100 gal + Triathlon 2 qt/100 gal (1,2,3,4)	14.2 c	206.5 c	2.05 a
Mural 45WG 7 oz/100 gal (1,3,5)	13.3 c	229.8 c	2.76 a
Triathlon 3 qt/100 gal (1,2,3,4)	13.3 c	256.7 bc	3.62 a
Non-treated control	53.3 a	753.1 a	3.35 a
P-value	≤0.0001	≤0.0001	0.2257

*Application dates: 1= 4 Aug 2020; 2= 11 Aug 2020; 3= 18 Aug 2020; 4= 25 Aug 2020; 5= 1 Sep 2020.
**Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

HYDRANGEA (*Hydrangea macrophylla* 'Nikko Blue')
Powdery mildew; *Erysiphe polygoni*

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Evaluation of fungicides for control of powdery mildew of Hydrangea, 2020.

Uniform big leaf hydrangea (*Hydrangea macrophylla*) 'Nikko Blue' plants were potted in 1-gallon nursery containers filled with Morton's Nursery mix (55-65% processed pine bark, Canadian sphagnum peat, and sand). Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 8 Sep and with 0.5 oz Nutricote Total 18-6-8 on 15 Sep. Six single-plant replications per treatment were arranged in a completely randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 4 minutes twice a day using an overhead irrigation system in Oct and Nov. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer at 40 psi with a TeeJet XR8002VS nozzle on a 14-day interval beginning on 1 Oct and ending on 29 Oct. Severity of powdery mildew resulting from natural infections, defoliation and phytotoxicity were recorded on 7, 14, 21 and 28 Oct and 4 Nov and were expressed as the percentage of foliage area affected. The area under the disease progress curve (AUDPC) was then calculated. Plant quality was evaluated on 4 Nov using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 1 Oct and 5 Nov and the difference between the initial and final measurements were calculated and presented as height increase. Average maximum temperatures for 1-30 Oct and 1-5 Nov were 81.2ºF and 82.5ºF; average minimum temperatures were 61.1ºF and 59.4ºF, respectively. Analysis of variance was performed using the general linear models (GLM) procedure with SAS statistical software and means were separated using Fisher's LSD test.

Powdery mildew infection occurred naturally in the trial and disease pressure was high, with severity reaching 75% in the non-treated control plants by Nov 4. All fungicide treatments significantly reduced powdery mildew severity and AUDPC throughout the experiment compared to the non-treated control. There were no significant differences between fungicide treatments in disease severity and disease progress (AUDPC). There were no significant differences in plant height increase between treated and non-treated hydrangea plants. Phytotoxicity and defoliation were not observed in any of the treated plants. All treated plants were commercially acceptable; however, non-treated control plants were not commercially acceptable due to disease severity (data not shown).

Treatment and rate (per 100 gal)	Application Dates[z]	Powdery mildew		Height increase (in)
		Mean severity (%) (4 Nov)	AUDPC	
Postiva (A20259G) SC 10 fl oz	1, 2, 3	8.3 b[zz]	127.2 b	0.5 a
Postiva (A20259G) SC 14 fl oz	1, 2, 3	2.2 b	36.2 b	0.4 a
Postiva (A20259G) SC 21 fl oz	1, 2, 3	6.7 b	100.9 b	0.6 a
Mural 45WG 7 oz	1, 2, 3	5.0 b	81.1 b	0.5 a
Non-treated control		75.0 a	1248.3 a	0.3 a
P-value		<.0001	<.0001	0.7950

[z]Application dates: 1= 1 Oct; 2= 15 Oct; 3= 29 Oct.
[zz]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

GINKGO (*Ginkgo biloba*)
Phytopythium root rot; *Phytopythium vexans*

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Evaluation of fungicides, biofungicides, host plant defense inducers and fertilizer for the control of Phytopythium root rot of ginkgo, 2020.

The experiment was conducted at the Otis L. Floyd Nursery Research Center in McMinnville, TN in field plots with Waynesboro loam soil. The field was cultivated on 17 May and leveled on 1 Jun. On 1 Jun, plots were measured and marked in a randomized complete block design with four replications. Seedlings of ginkgo plants were transplanted in the field plots on 10 Jun. Each plot consisted of 4 plants spaced 2 ft apart with 7 ft between rows. Plots were drench-inoculated with a *Phytopythium vexans* V8 medium slurry at a rate of 3.4 fl oz/sq. ft. on 2 Jun. Non-treated, non-inoculated and inoculated plots served as controls. Plants were watered as needed using a drip irrigation system and fertilized with 0.4 oz of 18-6-8 Nutricote controlled-release fertilizer on 16 Jun. Manual weeding was performed twice during the trial. All treatments were applied as soil drenches starting on 18 Jun and ending 27 Aug at different application intervals indicated in the table below. Plant height was measured on 10 Jun and 10 Sep and the difference between the initial and final measurements were calculated and presented as height increase. Total fresh weight and root fresh weight were recorded for all plants on 10 Sep, and roots were assessed for Phytopythium root rot disease severity using a scale of 0-100% of roots affected. Average maximum temperatures for 10-30 Jun, Jul, Aug and 1-10 Sep were 84.7, 81.2, 89.7 and 87.7ºF; average minimum temperatures were 62.8, 69.7, 66.9 and 64.1ºF; and total rainfall amounts were 2.35, 3.03, 5.76 and 0.5 in., respectively. One-way analysis of variance (ANOVA) was performed using the general linear models (GLM) procedure in SAS software v. 9.4 and when the effects were significant, the *post hoc* Fisher's LSD test was used for means comparisons.

Phytopythium root rot disease pressure was high in this trial. All treatments significantly reduced Phytopythium root rot severity compared to the non-treated, inoculated control ginkgo plants. Segovis, Subdue MAXX, Empress Intrinsic and Pageant Intrinsic were most effective in suppressing root rot severity than the rest of the treatments. There were no significant differences in plant height, plant fresh weight and root fresh weight among the treatments at the end of the trial. Phytotoxicity was not observed in any of the treated ginkgo plants.

Treatment and rate	Application dates[z]	Plant height increase (in)	Total fresh weight (oz)	Root fresh weight (oz)	Phytopythium root rot severity (%)[y]
Agri-Fos Plus L 8.25 fl oz/100 gal	1, 7	1.7 a	0.47 a	0.25 a	50.3 b
Aliette 80 WDG 50 oz/100 gal	1, 4, 7, 10	1.9 a	0.42 a	0.21 a	55.6 b
Empress Intrinsic 23.8SC 6 fl oz/100 gal	1, 4, 7, 10	2.0 a	0.60 a	0.30 a	34.7 c
Stargus L 128 fl oz/100 gal	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	2.0 a	0.51 a	0.28 a	52.3 b
ON-Gard 5-0-0 64 fl oz/100 gal	1, 4, 7, 10	1.9 a	0.52 a	0.27 a	54.2 b
Orkestra Intrinsic 21.26SC 10 fl oz/100 gal	1, 4, 7, 10	1.9 a	0.53 a	0.28 a	49.2 b
Pageant Intrinsic 38WG 18 oz/100 gal	1, 4, 7, 10	1.8 a	0.54 a	0.28 a	34.9 c
RootShield Plus WP 8 oz/100 gal	1, 7	1.7 a	0.43 a	0.22 a	49.3 b
Segovis 1.67SC 3.2 fl oz/100 gal	1, 4, 7, 10	1.9 a	0.47 a	0.24 a	31.6 c
Subdue MAXX 22ME 2 fl oz/100 gal	1, 11	1.9 a	0.50 a	0.25 a	33.2 c
Non-treated, inoculated		1.9 a	0.56 a	0.26 a	64.2 a
Non-treated, non-inoculated		1.9 a	0.48 a	0.25 a	1.9 d
P-value		0.0674	0.305	0.1466	<.0001

[z]Application dates: 1=18 Jun; 2=25 Jun; 3=2 Jul; 4=9 Jul; 5=16 Jul; 6=23 Jul; 7=30 Jul; 8=6 Aug; 9=13 Aug; 10=20 Aug; 11=27 Aug

[y]Disease severity was based on percentage of roots affected.

[x]Values are the means of sixteen plants; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

INDIAN HAWTHORN (*Rhaphiolepsis indica* 'Alba')
Entomosporium leaf spot; *Entomosporium mespili*

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Evaluation of fungicides for control of Entomosporium leaf spot on Indian hawthorn, 2020.

Indian hawthorn (*Raphiolepis indica*) 'Alba' plants were potted in 1-gallon nursery containers filled with Morton's Nursery mix (processed pine bark [55-65%], Canadian sphagnum peat, and sand). Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 23 Apr and 0.5 oz of 18-6-8 Nutricote controlled release fertilizer on 30 Apr. Five single-plant replications per treatment were arranged in a randomized complete block design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated for 1 minute twice a day using an overhead irrigation system. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle on a 14-day interval beginning on 2 Jun and ending on 14 Jul. Severity of Entomosporium leaf spot resulting from natural infection, phytotoxicity and defoliation were determined on 2, 9 and 23 Jun and 7, 21 and 28 Jul using a scale of 0-100% foliage area affected. The area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated on 28 Jul using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height and width were measured on 1 Jun and 31 Jul. Average maximum temperatures for Jun was 86.4ºF and for Jul was 85.6 ºF; average minimum temperatures for Jun was 65.6ºF and for Jul was 68.7 ºF. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Entomosporium leaf spot infection occurred naturally in this trial. Entomosporium leaf spot disease pressure was low to moderate with non-treated control plants showing 33% disease severity by 28 Jul. All treatments significantly reduced Entomosporium leaf spot disease severity, disease progress and defoliation compared to non-treated control. The treatments that most effectively reduced Entomosporium leaf spot severity were KleenGrow (0.25 fl oz/1 gal) and Pageant Intrinsic (10 oz/100 gal). The treatment that most effectively reduced Entomosporium leaf spot progression was KleenGrow (0.25 fl oz/1 gal). Phytotoxicity was not observed in any of the treated plants. There were no significant differences in plant height increase between treated and non-treated controls. All plants were commercially acceptable (data not shown).

Treatment and rate	Application dates[z]	Entomosporium leaf spot			Height increase (in)
		Disease severity (%) (28 Jul)	AUDPC	Defoliation (%) (28 Jul)	
Bayleton 50 5.5 oz/100 gal	1,2,3,4	12.0 b[zz]	459.6 b	1.4 b	0.87 a
KleenGrow 0.25 fl oz/1 gal	1,2,3,4	4.4 c	70.4 d	1.4 b	0.94 a
Pageant Intrinsic 38WG 10 oz/100 gal	1,2,3,4	5.5 c	238.0 c	1.6 b	1.57 a
Non-treated control		33.0 a	1034.6 a	4.5 a	0.63 a
P value		≤0.0001	≤0.0001	0.0033	0.2196

[z]Application dates: 1=2 Jun 2020; 2=16 Jun 2020; 3=30 Jun 2020; 4=14 Jul 2020.
[zz]Values are the means of five replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

MAGNOLIA (*Magnolia* x *soulangeana*)
Pseudomonas leaf spot; *Pseudomonas syringae*

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Evaluation of bactericides for control of Pseudomonas leaf spot on Magnolia, 2020.

Saucer magnolia (*Magnolia* x *soulangeana*) plants were potted in no. 3 nursery containers filled with Morton's Nursery mix (55-65% processed pine bark, Canadian sphagnum peat, and sand). Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 9 Jun and with 1.23 oz Nutricote Total 18-6-8 on 16 Jun. Six single-plant replications per treatment were arranged in a completely randomized design in a shade house (56% shade) at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were watered with an overhead irrigation system two times per day for 5 minutes in Jun, Jul and Aug. Plants were inoculated by uniformly spraying foliage till run-off with a bacterial suspension of *Pseudomonas syringae* (10^8 CFU/ml) using a hand-held sprayer on 25 Jun. Non-inoculated control plants were sprayed with sterilized water. All plants were covered with clear plastic for 24 h following inoculation. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer at 40 psi with TeeJet XR8002VS nozzle on a 7-day interval beginning on 23 Jun and ending on 21 Jul. Severity of Pseudomonas leaf spot and phytotoxicity were determined on 1, 8, 15, 22, 29 Jul and 7 Aug and were expressed as percentage of foliage area affected. The area under the disease progress curve (AUDPC) was then calculated. Plant quality was evaluated on 7 Aug using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 19 Jun and 7 Aug and the difference between the initial and final measurements were calculated and presented as height increase. Average maximum temperatures for 23-30 Jun, Jul and 1-7 Aug were 93.3ºF, 102.9ºF and 94.4ºF; average minimum temperatures were 74.3ºF, 78.8ºF and 62.8ºF; and total rainfall was 2.56 in, 3.03 in, and 5.76 in, respectively. Analysis of variance was performed using the general linear models (GLM) procedure with SAS statistical software and means were separated using Fisher's LSD test.

Pseudomonas leaf spot disease pressure was low to moderate in this trial with non-treated, inoculated control plants showing 38.3% disease severity by the end of the trial period (7 Aug). All treatments significantly reduced bacterial leaf spot severity and disease progress compared to the non-treated, inoculated control. Magnolia plants treated with CuPro 5000 had significantly less Pseudomonas leaf spot than those treated with the low rate of Postiva. There were no significant differences in height increase among all treated and the non-treated control magnolia plants. All of the non-treated control plants and treated plants were commercially acceptable (data not shown). Phytotoxicity was not observed in any of the treated magnolia plants.

Treatment and rate/100 gal	Application dates[z]	Pseudomonas leaf spot		Height increase (in)
		Mean severity (%) (7 Aug)	AUDPC	
Postiva (A20259G) SC 10 fl oz	1, 2, 3, 4, 5	15.8 b[y]	256.1 b	2.4 a
Postiva (A20259G) SC 14 fl oz	1, 2, 3, 4, 5	10.8 bc	181.4 bc	3.3 a
Postiva (A20259G) SC 21 fl oz	1, 2, 3, 4, 5	9.2 bc	189.0 bc	3.4 a
CuPro 5000 DF 24 oz	1, 2, 3, 4, 5	4.2 c	81.7 c	4.2 a
Non-treated control, inoculated control		38.3 a	586.8 a	3.2 a
Non-treated, non-inoculated control		8.2 c	69.4 c	3.0 a
P-value		≤0.0001	≤0.0001	0.4607

[z]Application dates: 1= 23 Jun; 2= 30 Jun; 3= 7 Jul; 4= 14 Jul; 5= 21 Jul.
[y]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

MAPLE (*Acer rubrum* 'October Glory')
Phytopythium root rot; *Phytopythium vexans*

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Evaluation of fungicides, biofungicides, host plant defense inducers and fertilizer for the control of Phytopythium root rot of red maple, 2020.

An experiment was carried out at the Otis L. Floyd Nursery Research Center in McMinnville, TN in field plots with Waynesboro loam soil. The field was cultivated on 17 May and leveled on 1 Jun. Treatments were arranged in a randomized block design with four replications on 1 Jun. Red maple seedlings were transplanted in the field plots on 10 Jun. Each plot consisted of 4 plants spaced 2 ft apart with 7 ft between rows. Plots were drench-inoculated with a *Phytopythium vexans* V8 medium slurry at a rate of 3.4 fl oz/sq. ft. on 2 Jun. Non-treated, non-inoculated and inoculated plots served as controls. Plants were watered as needed using a drip irrigation system and fertilized with 0.4 oz of 18-6-8 Nutricote controlled-release fertilizer on 16 Jun. Manual weeding was performed twice during the trial. All treatments were applied as soil drenches starting on 18 Jun and ending 27 Aug at different application intervals indicated in the table below. Plant height was measured on 10 Jun and 10 Sep and the difference between the initial and final measurements were calculated and presented as height increase. Total fresh weight and fresh root weight were recorded for all the plants on 10 Sep, and roots were assessed for Phytopythium root rot disease severity using a scale of 0-100% of roots affected. Average maximum temperatures for 10-30 Jun, Jul, Aug and 1-10 Sep were 84.7, 81.2, 89.7 and 87.7ºF; average minimum temperatures were 62.8, 69.7, 66.9 and 64.1ºF; and total rainfall amounts were 2.35, 3.03, 5.76 and 0.5 in., respectively. One-way analysis of variance (ANOVA) was performed using the general linear models (GLM) procedure in SAS software v. 9.4 and when the effects were significant, the *post hoc* Fisher's LSD test was used for means comparisons.

Phytopythium root rot disease pressure was high in this trial. Root rot severity was 57.5% in the non-treated, inoculated control, which was significantly reduced by all fungicides, biofungicides, host plant defense inducers and fertilizer. Pageant Intrinsic, Subdue MAXX and Segovis were most effective in suppressing root rot severity compared to Agri-Fos Plus, Aliette, On-Gard, Orkestra Intrinsic and Stargus. There were no significant differences in plant height, plant fresh weight and fresh root weight among the treatments at the end of the trial. Phytotoxicity was not observed in any of the treated red maple plants.

Treatment and rate	Application dates[z]	Plant height increase (in)	Total fresh weight (oz)	Fresh rRoot weight (oz)	Phytopythium root rot severity (%)[y]
Agri-Fos Plus L 8.25 fl oz/100 gal	1, 7	1.6 a	1.5 a	0.81 a	42.5 b[x]
Aliette 80 WDG 50 oz/100 gal	1, 4, 7, 10	1.8 a	1.1 a	0.63 a	43.1 b
Empress Intrinsic 23.8SC 6 fl oz/100 gal	1, 4, 7, 10	1.7 a	1.3 a	0.85 a	30.3 cd
Stargus L 128 fl oz/100 gal	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1.7 a	1.2 a	0.87 a	40.3 bc
ON-Gard 5-0-0 64 fl oz/100 gal	1, 4, 7, 10	1.8 a	1.1 a	0.84 a	41.9 b
Orkestra Intrinsic 21.26SC 10 fl oz/100 gal	1, 4, 7, 10	1.9 a	1.4 a	0.94 a	41.6 b
Pageant Intrinsic 38WG 18 oz/100 gal	1, 4, 7, 10	1.7 a	1.2 a	0.90 a	25.9 d
RootShield Plus® WP 8 oz/100 gal	1, 7	1.8 a	1.1 a	0.78 a	35.3 bcd
Segovis 1.67SC 3.2 fl oz/100 gal	1, 4, 7, 10	1.9 a	1.5 a	1.0 a	28.4 d
Subdue MAXX 22ME 2 fl oz/100 gal	1, 11	1.8 a	1.3 a	0.98 a	27.8 d
Non-treated, inoculated		1.7 a	1.2 a	0.82 a	57.5 a
Non-treated, non-inoculated		1.8 a	1.2 a	0.84 a	2.2 e
P-value		0.4417	0.2613	0.3584	<.0001

[z]Application dates: 1=18 Jun; 2=25 Jun; 3=2 Jul; 4=9 Jul; 5=16 Jul; 6=23 Jul; 7=30 Jul; 8=6 Aug; 9=13 Aug; 10=20 Aug; 11=27 Aug

›Disease severity was based on percentage of roots affected.
‹Values are the means of sixteen plants; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

ROSE (*Rosa* sp. 'Queen Elizabeth' and 'Louis Philippe')
Black spot; *Diplocarpon rosae*

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Evaluation of drench application of fungicides for the control of black spot of rose, 2019.

Rose 'Queen Elizabeth' and 'Louis Philippe' plants were potted in no. 5 nursery containers filled with 100% pine bark substrate amended with 0.48 lb of 19-5-9 Osmocote® Pro controlled release fertilizer, 0.06 lbof Micromax® micronutrient fertilizer, 0.04 lb iron sulfate and 0.01 lb Epsom salt per cubic feet of mix. Plants received an additional 2.5 oz of 19-5-9 Osmocote® Pro and 0.5 oz/gal 24-8-16 Miracle-Gro® water-soluble fertilizer (10 fl oz/plant) on 19 Jun. Four single-plant replications per treatment were arranged in a randomized complete block design as a separate trial for each cultivar under 45% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Rose plants were watered twice a day for 5 minutes using an overhead irrigation system. Fungicides were applied as a drench application on 2, 16 and 30 Jul, and 13 Aug for a total of 4 applications on a 14-day schedule. The severity of black spot and phytotoxicity were evaluated on 9, 16, 23 and 30 Jul, 6, 13 and 20 Aug using a scale of 0-100% foliage affected. Area under the disease progress curve (AUDPC) values were calculated. Plant height and width were measured on 20 Jun and 21 Aug. Flower number was also determined on 21 Aug. Average maximum temperatures for 2-31 Jul and 1-21 Aug were 96.0 and 90.9°F, average minimum temperatures were 59.7 and 63.0°F, and total rainfall amounts were 8.73 and 0.20 in, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Black spot infection occurred naturally and disease pressure was high on 'Queen Elizabeth' plants with non-treated control plants showing 53.8% foliar disease severity; disease pressure was low on 'Louise Philippe' plants with non-treated control plants showing 18.1% foliar disease severity by 20 Aug. All of the treatments significantly reduced final severity (20 Aug) and AUDPC compared to the non-treated control in both trials. Three different rates (7, 14 and 28 fl oz/100 gal) of F6123-1 were more effective in reducing disease severity in 'Queen Elizabeth' trial than Orkestra Intrinsic. There were no significant differences in disease progress (AUDPC) between all rates of F6123-1 1.04 SC and Orkestra Intrinsic for 'Queen Elizabeth' trial. There were no significant differences in disease severity and disease progress (AUDPC) between all rates of F6123-1 1.04 SC and Orkestra Intrinsic for 'Louise Philippe' trial. There were no significant differences in plant height, plant width and flower counts between treated and non-treated plants at the end of 'Queen Elizabeth' trial. Plant height was greater in fungicide treated plants compared to the non-treated control plants in 'Louise Philippe' trial. There were no significant differences in plant width and flower counts between treated and non-treated plants at the end of 'Louis Philippe' trial.

Treatment and rate/100 gal	Cultivar	Disease severity (%)[z] (20 Aug)	AUDPC[z]	Plant height (in) (21 Aug)	Plant width (in) (21 Aug)	Flower count (#) (21 Aug)
F6123-1 1.04 SC 3 fl oz	Queen Elizabeth	11.3 bc[zz]	314.1 b	64.5 a	28.1 a	17.8 a
F6123-1 1.04 SC 7 fl	Queen Elizabeth	5.6 cd	136.5 b	61.0 a	29.1 a	17.0 a
F6123-1 1.04 SC 14 fl oz	Queen Elizabeth	5.0 cd	139.1 b	51.9 a	30.7 a	14.3 a
F6123-1 1.04 SC 28 fl oz	Queen Elizabeth	1.3 d	34.6 b	61.2 a	30.3 a	18.5 a
Orkestra Intrinsic 10 fl oz	Queen Elizabeth	13.8 b	353.1 b	64.7 a	30.3 a	17.8 a
Non-treated control	Queen Elizabeth	53.8 a	1161.6 a	60.2 a	30.0 a	15.8 a
P-value		≤0.0001	≤0.0001	0.4851	0.9351	0.7226

[z]Disease severity ratings and area under the disease progress curve (AUDPC) were based on percentage foliage affected.
[zz]Values are the means of four replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

Treatment and rate/100 gal	Cultivar	Disease severity (%)[z] (20 Aug)	AUDPC[z]	Plant height (in) (21 Aug)	Plant width (in) (21 Aug)	Flower count (#) (21 Aug)
F6123-1 1.04 SC 3 fl oz	Louis Philippe	3.8 b[zz]	66.5 b	32.9 a	30.4 a	47.3 a
F6123-1 1.04 SC 7 fl	Louis Philippe	2.4 b	47.7 b	32.0 a	30.2 a	54.5 a
F6123-1 1.04 SC 14 fl oz	Louis Philippe	2.3 b	38.5 b	26.9 ab	25.4 a	47.8 a
F6123-1 1.04 SC 28 fl oz	Louis Philippe	1.5 b	39.8 b	28.1 ab	32.2 a	49.5 a
Orkestra Intrinsic 10 fl oz	Louis Philippe	4.4 b	83.6 b	32.3 a	32.9 a	48.5 a
Non-treated control	Louis Philippe	18.1 a	347.4 a	21.3 b	29.5 a	41.0 a
P-value		≤0.0001	≤0.0001	0.0584	0.3681	0.8347

[z]Disease severity ratings and area under the disease progress curve (AUDPC) were based on percentage foliage affected.
[zz]Values are the means of four replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.0584$.

ROSE (*Rosa* sp. 'Queen Elizabeth' and 'Louis Philippe')
Black spot; *Diplocarpon rosae*

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Evaluation of foliar application of fungicides for the control of black spot of rose, 2019.

Rose 'Queen Elizabeth' and 'Louis Philippe' plants were potted in no. 5 nursery containers filled with 100% pine bark substrate amended with 0.48 lb of 19-5-9 Osmocote® Pro controlled release fertilizer, 0.06 lb of Micromax® micronutrient fertilizer, 0.04 lbiron sulfate and 0.01 lb Epsom salt per cubic feet of mix. Plants received an additional 2.5 oz of 19-5-9 Osmocote® Pro and 0.5 oz/gal 24-8-16 Miracle-Gro® water-soluble fertilizer (10 fl oz/plant) on 19 Jun. Four single-plant replications per treatment were arranged in a randomized complete block design as a separate trial for each cultivar under 45% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Rose plants were watered twice a day for 5 minutes using an overhead irrigation system. Spray applications of fungicides were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 40 psi. The experimental product F6123-1 was applied on 2, 16 and 30 Jul, and 13 Aug for a total of 4 applications, while Banner Maxx was applied on 2, 16 and 30 Jul for a total of 3 applications. The severity of black spot and phytotoxicity were evaluated on 9, 16, 23 and 30 Jul, 6, 13 and 20 Aug using a scale of 0-100% foliage affected. Area under the disease progress curve (AUDPC) values were also calculated. Plant height and width were measured on 20 Jun and 21 Aug. The number of flowers on each plant was also determined on 21 Aug. Average maximum temperatures for 2-31 Jul and 1-21 Aug were 96.0 and 90.9°F, average minimum temperatures were 59.7 and 63.0°F, and total rainfall amounts were 8.73 and 0.20 in, respectively. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's LSD test.

Black spot infection occurred naturally in both trials. Disease pressure was high on 'Queen Elizabeth' plants with non-treated control plants showing 61.3% disease severity, while it was low on 'Louise Philippe' plants with non-treated control plants showing 15.6% disease severity by 20 Aug. All fungicide treatments significantly reduced final severity (20 Aug) and AUDPC compared to the non-treated control in both trials. In 'Queen Elizabeth' trial, no differences in both disease severity and disease progress (AUDPC) were observed among fungicide treatments. In 'Louis Philippe' trial however, the two higher rates (14 and 28 fl oz/100 gal) of F6123-1 1.04 SC were more effective in reducing disease severity than Banner Maxx. Three different rates (7, 14 and 28 fl oz/100 gal) of F6123-1 1.04 SC were more effective in reducing disease progress (AUDPC) in 'Louis Philippe' trial than Banner Maxx. There were no significant differences in plant height, plant width and flower counts between treated and non-treated plants at the end of 'Queen Elizabeth' and 'Louis Philippe' trials.

Treatment and rate/100 gal	Cultivar	Disease severity (%) (20 Aug)	AUDPC	Plant height (in) (21 Aug)	Plant width (in) (21 Aug)	Flower count (#) (21 Aug)
F6123-1 1.04 SC 3 fl oz	Queen Elizabeth	5.0 b[z]	96.3 b	35.2 a	23.6 a	0.8 a
F6123-1 1.04 SC 7 fl	Queen Elizabeth	7.5 b	149.2 b	33.7 a	22.0 a	1.3 a
F6123-1 1.04 SC 14 fl oz	Queen Elizabeth	2.0 b	45.2 b	36.2 a	20.8 a	1.3 a
F6123-1 1.04 SC 28 fl oz	Queen Elizabeth	1.4 b	44.2 b	34.4 a	22.1 a	0.5 a
Banner Maxx 8 fl oz	Queen Elizabeth	8.1 b	165.4 b	39.5 a	23.0 a	2.8 a
Non-treated control	Queen Elizabeth	61.3 a	1419.3 a	41.5 a	23.3 a	1.5 a
P-value		≤0.0001	≤0.0001	0.0847	0.7715	0.1687

[z]Values are the means of four replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

Treatment and rate/100 gal	Cultivar	Disease severity (%) (20 Aug)	AUDPC	Plant height (in) (21 Aug)	Plant width (in) (21 Aug)	Flower count (#) (21 Aug)
F6123-1 1.04 SC 3 fl oz	Louis Philippe	3.1 bc[z]	50.8 bc	31.7 a	34.4 a	60.8 a
F6123-1 1.04 SC 7 fl	Louis Philippe	2.4 bc	35.4 c	36.2 a	34.7 a	64.3 a
F6123-1 1.04 SC 14 fl oz	Louis Philippe	2.0 c	28.0 c	29.3 a	30.0 a	55.8 a
F6123-1 1.04 SC 28 fl oz	Louis Philippe	1.3 c	24.9 c	31.4 a	28.7 a	59.8 a
Banner Maxx 8 fl oz	Louis Philippe	4.4 b	73.5 b	28.5 a	30.5 a	52.8 a
Non-treated control	Louis Philippe	15.6 a	266.0 a	27.5 a	29.8 a	49.3 a
P-value		≤0.0001	≤0.0001	0.1254	0.6018	0.4166

[z]Values are the means of four replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

ROSE (*Rosa* sp. 'Miniature')
Cercospora leaf spot; *Cercospora rosicola*
Black leaf spot; *Diplocarpon rosae*
Powdery mildew; *Podosphaera pannosa*

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Evaluation of different rates of Postiva for the control of Cercospora leaf spot, black leaf spot and powdery mildew of rose, 2020.

Rose 'Miniature-Pink' plants potted in #1 containers were purchased from Dewar Nurseries (Apopka, FL) on 12 Jun. Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 25 Jun and 0.5 oz of 18-6-8 Nutricote controlled release fertilizer on 2 Jul. Six single-plant replications per treatment were arranged in a completely randomized design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated using overhead irrigation system for 4 minutes twice a day in Jun, Jul and Aug. Treatments were mixed with CapSil® at 4 fl oz/100 gal and applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle on a 14-day interval beginning on 9 Jul and ending on 6 Aug. Severity of Cercospora leaf spot, black leaf spot, powdery mildew, defoliation and phytotoxicity were determined on 16, 23 and 30 Jul, 6, 13 and 20 Aug using a scale of 0-100% foliage area affected. The area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated on 20 Aug using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 9 Jul and 20 Aug. Average maximum temperatures for 9-31 Jul and 1-20 Aug were 85.6ºF and 84.0ºF, respectfully; average minimum temperatures were 68.7ºF and 67.8ºF, respectfully. Analysis of variance was performed using the general linear model procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Cercospora leaf spot, black leaf spot and powdery mildew occurred naturally and disease severities were low by the end of this trial with non-treated control plants showing 17.1%, 21.7% and 3.8% disease severity by 20 Aug, respectively. All rates of Postiva significantly reduced Cercospora leaf spot, black leaf spot and powdery mildew disease severities and AUDPC compared to the non-treated control. Plants treated with the mid and high rates of Postiva had significantly less Cercospora leaf spot compared to the low rate of Postiva and non-treated control plants. Plants treated with the high rate of Postiva had significantly less black leaf spot compared to the low and mid rates of Postiva and non-treated control plants. There were no significant differences in powdery mildew disease severity and disease progress among all treated rose plants. There were no significant differences in height increase among all treated and the non-treated control rose plants. All of the non-treated control plants were not commercially acceptable (data not shown). Phytotoxicity and defoliation were not observed in any of the treated rose plants.

Treatment and rate/100 gal	Application dates[*]	Cercospora leaf spot Mean severity (%) (20 Aug)	AUDPC	Height increase (in)
Postiva (A20259G) SC 10 fl oz	1,2,3	5.8 b[**]	155.8 b	5.04 a
Postiva (A20259G) SC 20 fl oz	1,2,3	3.8 c	93.6 c	2.48 a
Postiva (A20259G) SC 28 fl oz	1,2,3	2.8 c	87.8 c	5.63 a
Non-treated control	-	17.1 a	430.8 a	3.46 a
P-value	-	≤0.0001	≤0.0001	0.1098

[*]Application dates: 1 = 9 Jul; 2 = 23 Jul; 3 = 6 Aug.

[**]Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

Treatment and rate/100 gal	Application dates[*]	Black leaf spot Mean severity (%) (20 Aug)	Black leaf spot AUDPC	Powdery mildew Mean severity (%) (20 Aug)	Powdery mildew AUDPC
Postiva (A20259G) SC 10 fl oz	1,2,3	7.5 b[**]	197.2 b	0.5 b	5.3 b
Postiva (A20259G) SC 20 fl oz	1,2,3	5.4 c	144.9 c	0.3 b	0.9 c
Postiva (A20259G) SC 28 fl oz	1,2,3	2.9 d	81.4 d	0.0 b	0.0 c
Non-treated control	-	21.7 a	435.2 a	3.8 a	37.6 a
P-value	-	≤0.0001	≤0.0001	≤0.0001	≤0.0001

[*]Application dates: 1 = 9 Jul 2020; 2 = 23 Jul 2020; 3 = 6 Aug 2020.

[**]Values are the means of six replications and means were separated using Fisher's least significant difference test; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

ROSE (*Rosa* sp. 'Louis Philippe')
Black spot; *Diplocarpon rosae*

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Evaluation of fungicides for the control of black spot of rose, 2020.

Rose 'Louis Philippe' plants were potted in 5-gallon containers filled with Morton's Nursery mix (55-65% processed pine bark, Canadian sphagnum peat, and sand). Each plant was fertilized with 0.5 oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 9 Jun and 0.5 oz of 18-6-8 Nutricote controlled release fertilizer on 12 Jun. Six single-plant replications per treatment were arranged in a completely randomized design in a shade house at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated using an overhead irrigation system for 2 minutes twice a day in Jun, Jul and Aug. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer at 40 psi with TeeJet XR8002VS nozzle on a 14-day interval beginning on 23 Jun and ending on 21 Jul. Severity of black spot, defoliation and phytotoxicity were determined on 30 Jun and 7, 14, 21, and 28 Jul and 4 Aug using a scale of 0-100% foliage area affected. The area under the disease progress curve (AUDPC) was then calculated. Plant quality was evaluated on 4 Aug using a scale of 1-5 where 1 is dead, 3 is commercially acceptable and 5 is a perfect plant. Plant height was measured on 19 Jun and 7 Aug and the difference between the initial and final measurements were calculated and presented as height increase. Average maximum temperatures for Jun, Jul, and Aug were 93.3ºF, 102.9 ºF and 94.4ºF; average minimum temperatures were 74.3ºF, 78.8ºF and 62.8ºF; and total rainfall was 2.56 in, 3.03 in, and 5.76 in, respectively. Analysis of variance was performed using the general linear models (GLM) procedure with SAS statistical software and means were separated using Fisher's LSD test.

Black spot disease pressure was low in this trial with non-treated control plants showing 20.8% disease severity by 4 Aug. All treatments reduced mean disease severity compared to the non-treated control. All three rates of Postiva and Mural were more effective in reducing disease severity than KleenGrow. All three rates of Postiva and Mural also reduced disease progress compared to the non-treated control but not KleenGrow. There was minimal defoliation in plants treated with the mid-rate of Postiva, Mural, and KleenGrow and also in control plants. There were no significant differences in height increase among treated and non-treated control rose plants. All plants in the trial, including the non-treated control plants, were commercially acceptable (data not shown). Phytotoxicity was not observed in any of the treated rose plants.

Treatment and rate	Application dates[z]	Black leaf spot			Height increase (in)
		Mean severity (%) (4 Aug)	AUDPC	Defoliation (%) (4 Aug)	
Postiva (A20259G) SC 10 fl oz/100 gal	1, 2, 3	3.3 c[y]	85.8 bc	0.0 a	6.6 a
Postiva (A20259G) SC 14 fl oz/100 gal	1, 2, 3	4.5 c	92.2 bc	0.8 a	6.8 a
Postiva (A20259G) SC 21 fl oz/100 gal	1, 2, 3	3.0 c	30.3 c	0.0 a	6.5 a
Mural 45 WG 7 oz/100 gal	1, 2, 3	5.2 c	117.3 b	0.8 a	3.5 a
KleenGrow L 0.25 fl oz/1 gal	1, 2, 3	9.2 b	219.9 a	1.7 a	7.7 a
Non-treated control		20.8 a	256.1 a	1.7 a	5.2 a
P-value		≤0.0001	≤0.0001	0.4797	0.6759

[z]Application dates: 1 = 23 Jun; 2 = 7 Jul; 3 = 21 Jul.
[y]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

For more information on this report or to receive copies of this or similar publications, please contact:

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