Woody Ornamental Disease Management Research Reports

Boxwood, Crabapple, Daylily, Flowering Dogwood, Hydrangea, Lilac, Maple and Rose

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

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Evaluation of fungicides and antitranspirant for the control of boxwood blight, 2022.

Boxwood 'Green Velvet' plants were potted in 4 sq. inch nursery containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 0.036 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.625 oz of 18-6-8 Nutricote controlled release fertilizer on 18 July and 2 Aug, respectively. Plants were placed in a BSL2 (Biosafety Level 2) greenhouse facility at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with six single-plant replications. Preventative treatments as indicated in the table below were applied on 30 Aug using a hand-held manual pump sprayer. On 31 Aug, boxwood plants were inoculated using a hand-held manual pump sprayer with a conidial suspension (2.0×10^6 conidia/ fl oz) of *Calonectria pseudonaviculata* (FBG1513) until run-off of the suspension from the foliage. Transparent plastic bags were placed over plants overnight and were removed the following morning. Plants were hand watered once a week with 3.4 fl oz of water. Plants were curatively treated similarly, but following inoculation on 15 Sep, 29 Sep, and 13 Oct for a total of three curative applications on a 14-day schedule. Boxwood blight disease severity (the percentage of the entire plant showing symptoms such as leaf lesions or stem streaking), defoliation and phytotoxicity were determined on 6, 14, 21, and 27 Sep, 5, 12, and 19 Oct using a scale of 0-100%. The area under 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 29 Aug and 19 Oct. Height increase was calculated by subtracting initial height from final height. The temperature in the BSL2 room was a constant 72.0ºF. One-way analysis of variance was performed using the general linear models procedure using SAS 9.4 statistical software and means were separated using Fisher's LSD test.

Boxwood blight disease pressure was moderate by the end of the trial with non-treated, inoculated control plants showing 51.6% disease severity and 8.3% defoliation by 19 Oct. All treatments significantly reduced disease severity and disease progress throughout the trial. Plants treated with curative application of the low rate of Postiva (14 fl oz) had the lowest disease severity, which was similar to the non-treated, non-inoculated control plants. The non-treated, inoculated control plants had the highest disease progress. The lowest disease progress was observed for preventive and curative applications of the low rate of Postiva (14 fl oz), the high rate of Postiva (24 fl oz) *alt* Vapor Gard, preventive and curative applications of Daconil Weatherstik *alt* KleenGrow, and preventive and curative applications of Daconil Weatherstik *alt* Vapor Gard whereas the non-treated, non-inoculated control and non-inoculated, Vapor Gard treated plants remained asymptomatic. Defoliation was significantly lower in the plants with preventive and curative applications of Vapor Gard on inoculated plants at 2.0%, preventive and curative applications of the high rate of Postiva (24 fl oz) *alt* Vapor Gard at 2.5%, and preventive applications of F6123-1 at 3.3% compared to the non-treated, inoculated control. Defoliation was highest for preventive application of Actigard at 14.1%, preventive application of F6123-1 *alt* Vapor Gard at 14.1%, preventive and curative applications of KleenGrow *alt* Vapor Gard at 10.8%, which were significantly higher than non-treated, inoculated control at 8.3%. There were no significant differences between treated and non-treated control plants in plant height increase. Phytotoxicity was not observed in any of the treated boxwood plants.

Treatment and rate/100 gal	Application schedule*	Boxwood blight: Disease severity (%) (19 Oct)	Boxwood blight: AUDPC	Defoliation (%) (19 Oct)	Height increase (in)
Actigard 50WG 27 oz	1	28.3 cd**	471.0 bc	14.1 a	0.3 a
Actigard 50WG 27 oz	1, 3, 4, 5	40.0 b	452.0 cd	5.4 d-h	0.1 a
Actigard 50WG 27 oz *alt* Vapor Gard 253.2 fl oz	1, 2	16.6 e-i	383.8 ef	9.1 bc	0.1 a
Actigard 50WG 27 oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	33.3 bc	469.5 bc	9.5 bc	0.2 a
Daconil Weatherstik 22 fl oz	1, 3, 4, 5	24.1 de	323.7 f-i	8.3 b-e	0.2 a
Daconil Weatherstik 22 fl oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	16.6 e-i	220.2 k-n	8.7 bcd	0.3 a
Daconil Weatherstik 22 fl oz *alt* KleenGrow 25 fl oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	15.0 f-j	316.7 g-j	3.7 gh	0.06 a
Daconil Weatherstik 22 fl oz *alt* KleenGrow 25 fl oz	1, 3, 4, 5	8.7 ij	194.5 lm	7.5 b-f	0.1 a
F6123-1 14 fl oz	1	20.8 d-g	322.2 f-i	3.3 ghi	0.1 a
F6123-1 14 fl oz	3, 4, 5	19.1 e-h	333.9 e-i	5.0 e-h	0.2 a
F6123-1 14 fl oz *alt* Vapor Gard 253.2 fl oz	1, 2	22.5 def	392.2 de	14.1 a	0.1 a
F6123-1 14 fl oz *alt* Vapor Gard 253.2 fl oz	3, 4, 5	13.7 g-j	272.1 ijk	4.1 fgh	0.2 a
F6123-1 14 fl oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	16.6 e-i	257.2 jkl	10.8 ab	0.03 a
KleenGrow 25 fl oz	1, 3, 4, 5	9.1 ij	243.5 kl	7.9 b-e	0.1 a
KleenGrow 25 fl oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	15.0 f-j	337.5 e-h	10.8 ab	0.5 a
Postiva 14 fl oz	3, 4, 5	7.5 jk	196.5 lm	3.7 gh	0.06 a
Postiva 24 fl oz	3, 4, 5	20.8 d-g	527.9 b	8.3 b-e	0.4 a
Postiva 14 fl oz *alt* Vapor Gard 253.2 fl oz	3, 4, 5	15.0 f-j	364.3 efg	4.2 fgh	0 a
Postiva 14 fl oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	10.8 ij	196.8 lm	6.6 c-g	0.1 a
Postiva 24 fl oz *alt* Vapor Gard 253.2 fl oz	3, 4, 5	16.0 e-i	338.5 e-h	5.0 e-h	0.1 a
Postiva 24 fl oz *alt* Vapor Gard 253.2 fl oz	1, 3, 4, 5	12.5 hij	160.4 m	2.5 hi	0.06 a
Vapor Gard 253.2 fl oz	2	20.0 e-h	274.1 ijk	4.1 fgh	0.06 a
Vapor Gard 253.2 fl oz	2, 3, 4, 5	24.1 de	277.0 h-k	2.0 hi	0.1 a
Vapor Gard 253.2 fl oz	3, 4, 5	23.3 de	463.7 c	6.6 c-g	0.4 a
Vapor Gard 253.2 fl oz, non-inoculated	2, 3, 4, 5	0.0 k	0.0 o	0.0 i	0.5 a
Non-treated, inoculated control	-	51.6 a	702.9 a	8.3 b-e	0.1 a
Non-treated, non-inoculated control	-	0.0 k	0.0 o	0.0 i	0.1 a
P-value	-	<0.0001	<0.0001	<0.0001	0.371

*Application schedule: 1 = 30 Aug morning; 2 = 30 Aug afternoon; 3 = 15 Sep; 4 = 29 Sep; 5 = 13 Oct.

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

CRABAPPLE (*Malus mandshurica* 'Manchurian')
Southern blight; *Athelia rolfsii*

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Evaluation of fungicides for the control of Southern blight on crabapple, 2022.

Crabapple (*Malus mandshurica*) 'Manchurian' plants were potted in 5-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 13.5 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 1 oz of 18-6-8 Nutricote controlled release fertilizer on 15 Jun. The experiment was conducted in full sun at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with six single-plant replications per treatment. Plants were irrigated using overhead irrigation for 15 min twice a day in 24-30 Jun, Jul, Aug, Sep, and Oct. Treatments were applied as a sprench to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi, except for Orkestra which was applied as a drench, on a 14-day interval beginning on 27 Jun and ending on 11 Jul. *Athelia rolfsii* was used for inoculation on 24 Jun. Inoculum was grown on PDA (potato dextrose agar) for 15 days. After the 15-day period, eight sclerotia per crabapple were buried around the crown of the plant. On 24 Oct, crabapple plants were weighed for their root and total plant weight as well as evaluated at the crown and root for disease. Plants were then incubated for 7 days and re-evaluated for disease severity on the crown and root area on 31 Oct. The initial and final plant heights were measured on 22 Jun and 24 Oct and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 24-30 Jun, Jul, Aug, Sep, and Oct were 89.1, 90.5, 86.7, 82.0, and 71.5ºF, respectively; average minimum temperatures were 66.7, 70.4, 67.3, 57.3, and 43.2ºF, respectively. Total rainfall was 0.3, 6.1, 3.9, 4.4, and 2.0in., respectively. One-way analysis of variance was performed using the general linear model procedure with SAS 9.4 and means were separated using Fisher's Least Significant Difference test.

Southern blight disease pressure was low to moderate in the non-treated, inoculated control plants showing 11.7% and 45.0% crown and root disease severity by 31 Oct, respectively. All treated plants had lower disease severity in both the crown and root areas compared to the non-treated, inoculated control plants. Astun + Seido, Terraguard, Orkestra, KleenGrow, SP2478 and KleenGrow + Orkestra treatments provided the best control of crown rot severity numerically. Astun + Seido, Terraguard, and KleenGrow provided the best control of root rot severity numerically. Plants treated with Astun, Orkestra, SP2478 and KleenGrow + Orkestra and non-treated, non-inoculated control plants had the greatest total fresh weight numerically. The non-treated, non-inoculated control plants as well as plants treated with Astun, Terraguard, Orkestra, KleenGrow, SP2478 and KleenGrow + Orkestra had the greatest root fresh weight numerically. There were no differences in plant height increase among any of the treated and non-treated control plants. Phytotoxicity was not observed in any of the treated crabapple plants.

		Southern blight				
Treatment/100 gal	Application dates*	Crown rot severity (%) (31 Oct)	Root rot severity (%) (31 Oct)	Total fresh weight (oz)	Root fresh weight (oz)	Height increase (in)
Astun + Seido 13.5 fl oz + 5 oz	1, 2	3.3 bc	7.5 bc	145.4 c	141.4 c	1.2 a
Astun 17 fl oz	1, 2	5.8 b**	19.6 b	265.4 ab	235.9 a	3.4 a
KleenGrow + Orkestra 12.5 fl oz + 10 fl oz	1, 2	3.8 bc	18.8 b	277.7 a	248.8 a	0.8 a
KleenGrow 25 fl oz	1, 2	2.1 bc	11.3 bc	224.8 b	208.3 ab	3.3 a
Orkestra 10 fl oz	1, 2	3.8 bc	24.6 b	243.5 ab	224.4 ab	0.9 a
SP2478 3 fl oz	1, 2	2.9 bc	18.3 b	281.5 a	251.9 a	2.5 a
Terraguard 8 fl oz	1, 2	2.9 bc	11.3 bc	226.7 b	207.7 ab	1.0 a
Non-treated, inoculated control	-	11.7 a	45.0 a	228.8 b	179.9 bc	4.5 a
Non-treated, non-inoculated control	-	0.0 c	0.0 c	244.3 ab	232.1 a	2.2 a
P-value		0.002	0.0006	< 0.0001	0.0003	0.3

*Application dates: 1 = 27 Jun; 2 = 11 Jul.
**Values are the means of six replications; treatments followed by the same lowercase letters within a column are not significantly different at $P \leq 0.05$.

DAYLILY (*Hemerocallis lilioasphodelus* 'Stella d'Oro')
Southern blight; *Athelia rolfsii*

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Evaluation of fungicides for the control of Southern blight on daylily, 2022.

Daylily (*Hemerocallis lilioasphodelus*) 'Stella d'Oro' plants were potted in 1-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 3.4 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.2 oz of 18-6-8 Nutricote controlled release fertilizer on 15 Jun. The experiment was conducted in full sun at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with five single-plant replications per treatment. Plants were irrigated using overhead irrigation for 15 min twice a day in Jun, Jul, Aug, Sep, Oct, and Nov. Treatments were applied as a sprench to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi, except for Orkestra which was applied as a drench, on a 14-day interval beginning on 27 Jun and ending on 11 Jul. *Athelia rolfsii* was used for inoculation on 24 Jun. Inoculum was grown on PDA (potato dextrose agar) for 15 days. After the 15-day period, eight sclerotia per daylily were buried around the crown of the plant. On 24 Oct, daylily plants were weighed for their root and total plant weight as well as evaluated at the crown and root for disease. Plants were then incubated for 7 days and re-evaluated for disease severity on the crown and root area. The initial and final plant heights were measured on 22 Jun and 24 Oct and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 24-30 Jun, Jul, Aug, Sep, and Oct were 89.1, 90.5, 86.7, 82.0, and 71.5ºF, respectively; average minimum temperatures were 66.7, 70.4, 67.3, 57.3, and 43.2ºF, respectively. Total rainfall was 0.3, 6.1, 3.9, 4.4, and 2.0 in., respectively. One-way analysis of variance was performed using the general linear model procedure with SAS 9.4 and means were separated using Fisher's Least Significant Difference test.

Southern blight disease pressure was low in the non-treated, inoculated control plants showing 12.0% and 14.0% crown and root disease severity by 31 Oct, respectively. All treated plants had lower disease severity in both the crown and root areas compared to the non-treated, inoculated control plants. Astun + Seido and Terraguard provided the best control of crown disease severity numerically. Terraguard provided the best control of root disease severity numerically. Plants treated with Orkestra, SP2478, KleenGrow + Orkestra and non-treated, inoculated control plants had the greatest total fresh weight numerically. SP2478 and the non-treated, inoculated control plants had the greatest root fresh weight numerically. There were no significant differences in plant height increase among any of the treated and non-treated control daylily plants. Phytotoxicity was not observed in any of the treated daylily plants.

		Southern blight				
Treatment/100 gal	Application dates*	Crown rot severity (%) (31 Oct)	Root rot severity (%) (31 Oct)	Total fresh weight (oz)	Root fresh weight (oz)	Height increase (in)
Astun + Seido 13.5 fl oz + 5 oz	1, 2	3.5 cd**	7.0 b	37.8 bc	19.1 e	1.5 a
Astun 17 fl oz	1, 2	7.5 b	5.5 b	39.0 bc	29.2 cd	3.4 a
KleenGrow + Orkestra 12.5 fl oz + 10 fl oz	1, 2	7.5 b	7.0 b	44.0 ab	31.3 bc	2.9 a
KleenGrow 25 fl oz	1, 2	6.5 bc	7.5 b	32.2 c	23.3 de	1.6 a
Orkestra 10 fl oz	1, 2	4.5 bc	6.0 b	40.1 abc	29.8 cd	3.5 a
SP2478 3 fl oz	1, 2	4.5 bc	7.0 b	47.9 a	40.9 a	1.7 a
Terraguard 8 fl oz	1, 2	3.5 cd	5.0 bc	34.2 c	21.7 e	2.7 a
Non-treated, inoculated control	-	12.0 a	14.0 a	44.3 ab	38.3 ab	2.8 a
Non-treated, non-inoculated control	-	0.0 d	0.0 c	36.9 bc	24.7 cde	2.0 a
P-value	-	< 0.0001	0.004	0.008	< 0.0001	0.2

*Application dates: 1 = 27 Jun; 2 = 11 Jul.
**Values are the means of five 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, 2022.

Dogwood (*Cornus florida*) 'Cherokee Princess' plants were potted in 1-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 3.4 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.2 oz of 18-6-8 Nutricote controlled release fertilizer on 21 Jul. The experiment was conducted in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with six single-plant replications per treatment. Plants were irrigated using overhead irrigation for 2 min twice a day in Aug and Sep. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 14-day interval beginning on 1 Aug and ending on 29 Aug. Plants were evaluated for powdery mildew disease severity, spot anthracnose disease severity, defoliation and phytotoxicity on 2, 9, 16, 23, and 30 Aug, and 6 and 13 Sep 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 disease severity rating at each evaluation time and $(t_i - t_{i-1})$ is the number of days between evaluations. The initial and final plant heights were measured on 1 Aug and 13 Sep and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for Aug and 1-13 Sep were 84.0 and 82.8ºF; average minimum temperatures were 67.6 and 66.1ºF, respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 and means were separated using Fisher's LSD test.

Powdery mildew and spot anthracnose occurred naturally in this trial. Powdery mildew and spot anthracnose pressures were low with non-treated control dogwood plants showing 13.3 and 12.1% disease severity by 13 Sep, respectively. All treated plants had significantly less disease severity and disease progress compared to the non-treated control plants in both powdery mildew and spot anthracnose. Defoliation was low among treated and non-treated plants. There were no significant differences in plant height increase among any of the treated and non-treated control plants. Phytotoxicity was not observed in any of the treated dogwood plants.

		Powdery mildew		Spot anthracnose			
Treatment and rate/100 gal	Application dates*	Disease Severity (%) (13 Sep)	AUDPC	Disease Severity (%) (13 Sep)	AUDPC	Defoliation (%)	Height increase (in)
Seido (OHP1902) + Capsil (preventative) 4 fl oz + 4 fl oz	1, 2, 3	4.6 b**	36.2 b	2.9 b	59.8 b	0.4 a	7.0 a
Seido (OHP1902) + Capsil (preventative) 5 fl oz + 4 fl oz	1, 2, 3	2.9 b	21.9 b	0.8 b	35.0 b	0.8 a	6.6 a
Seido (OHP1902) + Capsil (curative) 5 fl oz + 4 fl oz	1, 2, 3	3.3 b	11.7 b	2.5 b	42.3 b	0.0 a	6.3 a
Heritage 50 WG (preventative) 4 oz	1, 2, 3	3.3 b	11.7 b	2.1 b	42.3 b	0.0 a	6.0 a
KleenGrow (preventative) 25 fl oz	1, 2, 3	4.2 b	37.9 b	2.5 b	51.0 b	0.0 a	10.0 a
Pipron (preventative) 4 fl oz	1, 2, 3	4.6 b	48.1 b	2.1 b	61.3 b	0.0 a	8.9 a
KleenGrow + Heritage (preventative) 12.5 fl oz + 4 oz	1, 2, 3	2.1 b	10.2 b	0.8 b	35.0 b	0.0 a	4.1 a
Non-treated control	-	13.3 a	326.4 a	12.1 a	233.9 a	0.4 a	9.0 a
P-value	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.6	0.7

*Application dates: 1 = 1 Aug; 2 = 15 Aug; 3 =30 Aug.

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

HYDRANGEA (*Hydrangea macrophylla* 'Nikko Blue')
Powdery mildew; *Erysiphe polygoni*
Cercospora leaf spot; *Cercospora hydrangea*

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Evaluation of fungicides for the control of powdery mildew and Cercospora leaf spot of hydrangea, 2022.

Hydrangea (*H. macrophylla*) 'Nikko Blue' plants were potted in 1-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 3.4 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.2 oz of 18-6-8 Nutricote controlled release fertilizer on 20 Jun. Six single-plant replications per treatment were arranged in a completely randomized design in a shadehouse under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated using overhead irrigation for 15 minutes twice a day in Jun, Jul, Aug, Sep, and Oct. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 2-week, 4-week, or 6-week interval beginning on 28 Jun and ending on 20 Sep. Powdery mildew disease severity, Cercospora leaf spot disease severity, defoliation and phytotoxicity were determined on 30 Jun, 7, 14, 21 and 28 Jul, 4, 11, 18 and 25 Aug, 1, 8, 15, 22, and 29 Sep, and 6 Oct 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 27 Jun and 6 Oct. Height increase was calculated by subtracting the initial height from the final height. Maximum temperatures for 28-30 Jun, Jul, Aug, Sep and 1-6 Oct were 88.0, 90.5, 86.7, 82.0 and 80.2ºF; minimum temperatures were 64, 70.4, 67.3, 57.3 and 49.8ºF; and total rainfall was 0.1, 6.1, 3.9, 4.4 and 0 in, respectively. Data was subjected to one-way analysis of variance using the general linear model procedure with SAS 9.4 and means were separated using Fisher's least significant difference test.

Powdery mildew and Cercospora leaf spot occurred naturally in this trial. Non-treated control plants showed 45.0 and 51.7% powdery mildew and Cercospora leaf spot disease severity by 6 Oct, respectively. All treatments significantly reduced powdery mildew and Cercospora leaf spot disease severity and disease progress compared to the non-treated control plants. The high rate of Postiva (28 fl oz) applied with the 2-week interval provided the best reduction of powdery mildew disease progress numerically. The high rate of Postiva (28 fl oz) applied with the 6-week interval provided the best reduction of Cercospora leaf spot disease progress numerically. All treatments reduced defoliation compared to the non-treated control that had 17.5% defoliation. Plants treated with Postiva (14 fl oz; 2-week), Postiva (28 fl oz; 2- and 6-week), Mural (7 oz; 2- and 6-week), and the non-treated control plants had the greatest numeric height increase. Phytotoxicity was not observed in any of the treated hydrangea plants.

Treatment and rate/100 gal	Application Dates*	Powdery Mildew: Mean severity (%) (6 Oct)	Powdery Mildew: AUDPC	Cercospora leaf spot: Mean severity (%) (6 Oct)	Cercospora leaf spot: AUDPC	Defoliation	Height increase (in)
Postiva + Capsil 14 fl oz + 4 fl oz	1, 2, 3, 4, 5, 6, 7	14.2 b**	708.6 bc	15.8 bc	770.5 bc	3.8 b	2.1 ab
Postiva + Capsil 20 fl oz + 4 fl oz	1, 2, 3, 4, 5, 6, 7	9.6 b	519.6 bc	14.2 bc	679.3 bc	4.6 b	0.5 d
Postiva + Capsil 28 fl oz + 4 fl oz	1, 2, 3, 4, 5, 6, 7	8.8 b	429.9 c	12.1 bc	606.5 bc	3.8 b	1.9 abc
Postiva + Capsil 14 fl oz + 4 fl oz	1, 3, 5, 7	14.2 b	634.8 bc	20.8 bc	884.3 bc	5.8 b	1.1 bcd
Postiva + Capsil 20 fl oz + 4 fl oz	1, 3, 5, 7	16.7 b	826.2 b	12.1 bc	568.9 bc	4.2 b	0.9 cd
Postiva + Capsil 28 fl oz + 4 fl oz	1, 3, 5, 7	10.0 b	558.5 bc	12.5 bc	662.0 bc	4.3 b	1.1 bcd
Postiva + Capsil 14 fl oz + 4 fl oz	1, 4, 7	9.6 b	519.8 bc	19.6 bc	859.9 bc	5.2 b	0.9 cd
Postiva + Capsil 20 fl oz + 4 fl oz	1, 4, 7	14.2 b	581.9 bc	13.3 bc	588.9 bc	5.8 b	1.2 bcd
Postiva + Capsil 28 fl oz + 4 fl oz	1, 4, 7	10.8 b	591.7 bc	6.7 c	313.6 c	5.4 b	2.5 a
Mural 45 WG + Capsil 7 oz + 4 fl oz	1, 2, 3, 4, 5, 6, 7	11.7 b	610.1 bc	21.3 b	974.9 b	5.8 b	1.4 a-d
Mural 45 WG + Capsil 7 oz + 4 fl oz	1, 3, 5, 7	11.7 b	641.0 bc	22.5 b	907.8 b	5.8 b	0.5 d
Mural 45 WG + Capsil 7 oz + 4 fl oz	1, 4, 7	12.1 b	563.8 bc	17.5 bc	769.3 bc	5.0 b	1.7 abc
Non-treated control	-	45.0 a	2006.6 a	51.7 a	1951.0 a	17.5 a	1.7 abc
P-value	-	<0.0001	<0.0001	<0.0001	0.0005	<0.0001	0.02

*Application dates: 1 = 28 Jun; 2 = 12 Jul; 3 = 26 Jul; 4 = 9 Aug; 5 = 23 Aug; 6 = 6 Sep; 7 = 20 Sep.

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

HYDRANGEA (*Hydrangea quercifolia* 'Queen of Hearts')
Fusarium crown and root rot; *Fusarium oxysporum*

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Evaluation of fungicides for the control of Fusarium crown and root rot of hydrangea, 2022.

Oakleaf hydrangea 'Queen of Hearts' plants were potted in 1-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 3.4 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.2 oz of 18-6-8 Nutricote controlled release fertilizer on 5 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 for 3 min twice a day in Aug and Sep. All plants except the non-treated, non-inoculated control plants were inoculated with 5.1 fl oz *Fusarium oxysporum* conidial suspension (approximately $1.6x10^8$ conidia/fl oz) by drench on 10 Aug. Treatments were applied as a sprench using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 14-day interval beginning on 12 Aug and ending on 26 Aug. Root and crown disease severities were evaluated on a scale of 0-100% on 9 Sep. The total and root fresh weights obtained on 9 Sep. Plant heights were measured on 9 Aug and 9 Sep. Height increase was obtained by taking the initial measurement from the final measurement. Average maximum temperatures for Aug and Sep were 84.0 and 82.8ºF; average minimum temperatures were 67.6 and 64.3ºF, respectively. One-way 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.

Fusarium crown and root rot disease pressure was moderate with non-treated, inoculated control plants showing 59.2 and 28.3% disease severity of the root and crown of the plants by 9 Sep, respectively. All treated plants had significantly less Fusarium crown and root rot compared to the non-treated, inoculated control plants. All treatments were similar in their control of Fusarium root rot disease severity. Astun, Empress, KleenGrow, and KleenGrow + Empress provided the best control of Fusarium crown rot disease severity numerically. Total fresh weight, root fresh weight and plant height increase had no significant differences among treatment or control plants. Phytotoxicity was not observed in any of the treated hydrangea plants.

Treatment/100 gal	Application dates*	Fusarium root rot severity (%)	Fusarium crown rot severity (%)	Total fresh weight (oz)	Root fresh weight (oz)	Height increase (in)
Astun 17 fl oz	1, 2	30.8 b**	5.4 bcd	51.3 a	10.4 a	1.1 a
Astun + Seido 13.5 fl oz + 5 oz	1, 2	36.7 b	10.8 b	54.1 a	15.6 a	1.4 a
Terraguard 8 fl oz	1, 2	35.0 b	8.8 bc	46.6 a	10.7 a	2.0 a
Empress 3 fl oz	1, 2	35.8 b	6.3 bcd	52.9 a	14.7 a	3.1 a
KleenGrow 25 fl oz	1, 2	35.8 b	4.6 bcd	49.7 a	17.0 a	1.8 a
KleenGrow + Empress 12.5 fl oz + 3 fl oz	1, 2	34.2 b	2.5 cd	53.0 a	11.5 a	2.2 a
Non-treated, inoculated control	-	59.2 a	28.3 a	51.4 a	11.3 a	1.4 a
Non-treated, non-inoculated control	-	0.0 c	0.0 d	50.4 a	12.8 a	1.4 a
P - value		< 0.0001	< 0.0001	1.0	0.9	0.7

*Application dates: 1 = 12 Aug; 2 = 26 Aug.
**Values are the means of six single plant replications; treatments followed by the same lowercase letters within a column are not significantly different at $P \leq 0.05$.

HYDRANGEA (*Hydrangea arborescens* 'Annabelle')
Rust; *Pucciniastrum hydrangeae*

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Evaluation of fungicides for the control of rust of hydrangea, 2022.

Hydrangea arborescens 'Annabelle' plants were potted in 5-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 13.5 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 1.0 oz of 18-6-8 Nutricote controlled release fertilizer on 15 Sep. The experiment was conducted in a shade house under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with six single-plant replications. Plants were irrigated using overhead irrigation for 15 min twice a day in Sep and Oct. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 14-day interval beginning on 19 Sep and ending on 17 Oct. Rust disease severity, defoliation and phytotoxicity were determined on 19 and 26 Sep, 3, 10, 17, 24, and 31 Oct 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 disease severity rating at each evaluation time and $(t_i - t_{i-1})$ is the number of days between evaluations. The initial and final plant heights were measured on 15 Sep and 31 Oct and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 15-30 Sep and Oct were 82.5 and 71.5ºF; average minimum temperatures were 54.4 and 43.2ºF; and total rainfall was 0.3 and 2.0 in, respectively. One-way analysis of variance was performed using the general linear model procedure with SAS 9.4 and means were separated using Fisher's Least Significant Difference test.

Rust disease occurred naturally in this trial. Rust disease pressure was high with non-treated control plants showing 72.5% disease severity by 31 Oct. All treated plants had significantly less rust mean disease severity percentage and disease progress compared to the non-treated control plants. Mural and KleenGrow + Mural had the best control of disease severity and lowest disease progression. The non-treated control plants and plants treated with KleenGrow had the highest defoliation percentage. There were no significant differences in plant height increase among any of the treated and non-treated control plants. Phytotoxicity was not observed in any of the treated hydrangea plants.

		Rust			
Treatment and rate/100 gal	Application dates*	Disease severity (%) (31 Oct)	AUDPC	Defoliation (%)	Height increase (in)
Mural 45WG 7.0 oz	1, 2, 3	25.8 c	453.5 c	7.5 b	2.3 a
KleenGrow 25 fl oz	1, 2, 3	60.8 b	943.5 b	30.8 a	2.8 a
KleenGrow + Mural 45WG 12.5 fl oz + 7 oz	1, 2, 3	22.5 c	523.5 c	8.3 b	1.8 a
Non-treated control	-	72.5 a	1,598.3 a	35.0 a	1.1 a
P - value	-	< 0.0001	< 0.0001	< 0.0001	0.4

*Application dates: 1 = 19 Sep; 2 = 3 Oct; 3 = 17 Oct.
**Values are the means of six single plant replications; treatments followed by the same lowercase letters within a column are not significantly different at $P \leq 0.05$.

HYDRANGEA (*Hydrangea macrophylla* 'Nikko Blue')
Powdery mildew; *Erysiphe polygoni*
Cercospora leaf spot*; Cercospora hydrangea*

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Evaluation of fungicides for the control of powdery mildew and Cercospora leaf spot of hydrangea, 2022.

Hydrangea (*Hydrangea macrophylla*) 'Nikko Blue' plants were potted in 1-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 3.4 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.2 oz of 18-6-8 Nutricote controlled release fertilizer on 5 Jul. The experiment was conducted in a shadehouse under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with six single-plant replications per treatment. Plants were irrigated using overhead irrigation for 15 min twice a day in Jul and Aug. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 7 and 14-day interval beginning on 13 Jul and ending on 10 Aug. Plants were evaluated for powdery mildew disease severity, Cercospora leaf spot disease severity, defoliation and phytotoxicity on 15, 22, 29 Jul, 5, 12, 19, and 26 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 disease severity rating at each evaluation time and $(t_i - t_{i-1})$ is the number of days between evaluations. The initial and final plant heights were measured on 11 Jul and 26 Aug and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 13-31 Jul and 1-26 Aug were 92.9 and 86.5ºF; average minimum temperatures were 73.9 and 67.5ºF; and total rainfall was 2.7 in and 3.8 in, respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 and means were separated using Fisher's LSD test.

Powdery mildew and Cercospora leaf spot occurred naturally in this trial. Powdery mildew and Cercospora leaf spot disease pressures were low to moderate with non-treated control plants showing 38.3 and 37.5% disease severity by 26 Aug, respectively. All treated plants had significantly less disease severity and disease progress compared to the non-treated control plants. Preventative treatments of Seido (4 fl oz and 5 fl oz), Heritage, KleenGrow, Kleengrow + Mural, and SP2704 provided the best control of powdery mildew disease severity, while the preventative treatments of Seido (4 fl oz and 5 fl oz), Heritage, KleenGrow, SP2704, and SP2700 provided the lowest disease progress for powdery mildew. Preventative treatments of Seido (5 fl oz), Heritage, KleenGrow, KleenGrow + Heritage, Mural, Kleengrow + Mural, SP2478, and SP2704 provided the best control of Cercospora leaf spot disease severity, while the preventative treatments of Seido (5 fl oz), Heritage, KleenGrow, KleenGrow + Heritage, Mural, KleenGrow + Mural, SP478, SP2704, and SP 2700 provided the lowest Cercospora leaf spot disease progress. Defoliation was low among treated and non-treated plants. Plants preventatively treated with Seido (5 fl oz), Heritage, KleenGrow, KleenGrow + Heritage, KleenGrow + Mural, SP2478, SP2704 and SP2700 had the least defoliation. Plants preventatively treated with Seido (4 fl oz), Mural, SP2478, and plants curatively treated with Seido (5 fl oz) had the greatest height increase among treated and non-treated plants. Phytotoxicity was not observed in any of the treated hydrangea plants.

Treatment and rate/100 gal	Application dates*	Powdery mildew		Cercospora leaf spot		Defoliation (%)	Height (in)
		Disease Severity (%) (26 Aug)	AUDPC	Disease Severity (%) (26 Aug)	AUDPC		
Seido (OHP 1902) + Capsil (preventative) 4 fl oz + 4 fl oz	1, 3, 5	0.0 f**	0.0 f	21.7 bc	392.0 bc	2.3 abcd	1.5 ab
Seido (OHP 1902) + Capsil (preventative) 5 fl oz + 4 fl oz	1, 3, 5	0.0 f	0.0 f	16.7 bcd	288.5 bcd	0.9 de	1.1 bcd
Seido (OHP 1902) + Capsil (curative) 5 fl oz + 4 fl oz	1, 3, 5	7.5 cde	221.1 bc	22.5 b	436.0 b	3.1 ab	1.5 abc
Heritage 50 WG (preventative) 4 oz	1, 3, 5	1.3 ef	22.5 f	14.2 bcd	287.3 bcd	0.8 de	1.0 bcd
KleenGrow (preventative) 25 fl oz	1, 3, 5	3.8 def	33.3 ef	12.5 cd	328.1 bcd	0.0 e	0.5 cd
KleenGrow + Heritage (preventative) 12.5 fl oz + 4 oz	1, 3, 5	8.8 bcd	133.6 cd	11.3 d	201.0 d	0.4 e	0.3 d
Mural 45 WG (preventative) 7.0 oz	1, 3, 5	13.3 bc	243.3 b	15.8 bcd	278.0 cd	2.8 abc	2.2 a
KleenGrow + Mural 45 WG (preventative) 12.5 fl oz + 7 oz	1, 3, 5	5.8 def	122.2 cde	20.0 bcd	312.1 bcd	1.0 de	0.8 bcd
SP2478 (preventative) 3 fl oz	1, 2, 3, 4, 5	14.6 b	207.4 bc	18.3 bcd	329.8 bcd	1.6 bcde	1.5 ab
SP2704 (preventative) 128 fl oz	1, 2, 3, 4, 5	5.0 def	79.6 def	17.1 bcd	339.8 bcd	1.6 bcde	1.1 bcd
SP2700 (preventative) 8 oz	1, 2, 3, 4, 5	9.2 bcd	74.1 def	23.3 b	327.8 bcd	1.3 cde	0.8 bcd
Non-treated control	-	38.3 a	590.0 a	37.5 a	720.4 a	3.8 a	0.9 bcd
P-value	-	<0.0001	<0.0001	0.0003	<0.0001	0.0007	0.01

*Application dates: 1 = 13 Jul; 2 = 20 Jul; 3 = 27 Jul; 4 = 3 Aug; 5 = 10 Aug.

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

LILAC (*Syringa reticulata* 'Ivory Silk')
Bacterial blight; *Pseudomonas syringae* pv. *syringae*

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Evaluation of treatments for control of bacterial blight on lilac, 2022.

Lilac (*Syringa reticulata*) 'Ivory Silk' plants were potted in 5-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Plants were fertilized with 13.5 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 10 May and with 1 oz Nutricote total on 3 Jun. Four 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 using emitters for 2 minutes twice a day in Jun and Jul with irrigation stakes. All plants except for the non-treated, non-inoculated control plants were inoculated with *Pseudomonas syringea* pv. *syringae* (approximately $3x10^8$ cfu/0.03 fl oz) on 17 Jun with a backpack CO_2-pressurized sprayer with a TeeJet XR8002VS nozzle at 30 psi. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with a TeeJet XR8002VS nozzle at 30 psi beginning on 10 Jun and ending on 1 Jul. Bacterial blight disease severity, defoliation, and phytotoxicity were evaluated on 10, 17 and 24 Jun and 1, 8 and 15 Jul and were expressed as the percentage of 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 bacterial blight rating at each evaluation time and $(t_i - t_{i-1})$ is the number of days between evaluations. Plant height was measured on 9 Jun and 15 Jul. The average maximum temperature for 10-30 Jun. and 1-15 Jul. were 89.4 and 90.3ºF; average minimum temperature was 65.1 and 69.1ºF; and total rainfall amounts were 1.7 and 0.5 in., respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 and means were separated using Fisher's LSD test.

Pseudomonas bacterial blight disease pressure was high in this trial with non-treated, inoculated plants showing 63.8% disease severity by 15 Jul. All treatments significantly reduced disease severity compared to non-treated, inoculated plants. All plants except those treated with BW159 (128 fl oz), MBI-121 (128 fl oz), Postiva, TDA-NC-1 (total six applications), and KleenGrow + Camelot were similar to the non-treated, non-inoculated control plants in disease progress. There were no significant differences in height increase or defoliation percentage among treated and non-treated plants. Phytotoxicity was not observed in any of the treated lilac plants.

		Pseudomonas bacterial blight			
Treatment and rate/100 gal	Application dates *	Mean severity (%) (15 Jul)	AUDPC	Height (in.) increase	Defoliation (%) (15 Jul)
BW159 + Capsil 128 fl oz + 4 fl oz	1, 3, 5	19.4 bc**	288.3 b	2.3 a	0.0 a
BW159 + Capsil 64 fl oz + 4 fl oz	1, 3, 5	20.0 bc	251.1 bc	3.5 a	0.0 a
BW165E + Capsil 64 oz + 4 fl oz	1, 4, 6	23.8 b	261.6 bc	1.1 a	0.0 a
Camelot O 128 fl oz	2, 4, 6	13.8 bc	211.8 bc	3.5 a	0.0 a
KleenGrow 25 fl oz	4, 6	12.5 bc	147.9 bc	3.9 a	0.0 a
KleenGrow + Camelot O 12.5 fl oz + 128 fl oz	4, 6	25.0 b	336.9 b	2.8 a	0.0 a
MBI-121 128 fl oz	1, 4, 6	25.0 b	321.1 b	1.9 a	2.5 a
MBI-121 64 fl oz	1, 3, 6	17.5 bc	191.6 bc	3.1 a	0.0 a
Postiva 10 fl oz	2, 4, 6	24.4 b	285.7 b	2.1 a	0.0 a
Proud 3 128 fl oz	1, 3, 4, 5, 6	21.3 bc	231.0 bc	3.1 a	0.0 a
SP2704 128 fl oz	1, 4, 6	18.8 bc	248.5 bc	1.7 a	0.0 a
Stargus 128 fl oz	1, 4, 6	16.3 bc	224.9 bc	3.3 a	0.0 a
TDA-NC-1 20.1 oz	1, 2, 3, 4, 5, 6	21.3 bc	274.8 b	4.8 a	0.0 a
TDA-NC-1 20.1 oz	1, 3, 5	11.9 bc	200.8 bc	4.1 a	0.0 a
Tril-21 64 fl oz	1, 3, 5	12.5 bc	166.3 bc	3.3 a	0.0 a
Tril-21 64 fl oz	4, 6	11.3 bc	154.9 bc	2.8 a	0.0 a
Non-treated, inoculated control	N/A	63.8 a	859.3 a	3.3 a	3.8 a
Non-treated, non-inoculated control	N/A	1.9 c	27.6 c	4.5 a	0.0 a
P-value	-	0.0006	0.0001	1.00	0.1

*Application dates: 1=14 Jun; 2=17 Jun; 3=20 Jun; 4=24 Jun; 5=27 Jun; 6=1 Jul.

**Values are the means of four single plant replications; treatments followed by the same lowercase letters within a column are not significantly different at $P \leq 0.05$.

RED MAPLE (*Acer rubrum* 'October Glory')
Rhizoctonia root rot; *Rhizoctonia solani*

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Evaluation of fungicides for the control of Rhizoctonia root rot on red maple, 2022.

An experiment was carried out in a shadehouse under 56% shade at the Otis L. Floyd Nursery Research Center, McMinnville, TN. Eight-months old rooted red maple plants (*A. rubrum*) were planted in 1-gal size nursery containers filled with nursery mix (Morton's Nursery Mix: Canadian sphagnum peat [55–65%]) on 30 Mar. On 15 Apr, each plant was fertilized with 0.5 oz of 18-6-8 Nutricote controlled-release granular fertilizer. Plants were watered twice per day for 3 min. On 7 Jun, the experiment was laid out in a completely randomized design with six single-plant replications. *Rhizoctonia solani* slurry was drenched at the rate of 3.5 fl oz/plant on 8 Jun. Ten-day old cultures of *R. solani* grown on PDA medium were homogenized in the sterile distilled water and slurry was prepared at the rate of 1 petri plate/L. Non-treated, non-inoculated and non-treated, inoculated plants served as controls. Two applications of fungicide treatments; the first on 10 Jun and the second on 24 Jun, were made as sprench with the exception of fungicide SP2478, which was applied as drench. The initial and final plant height and width were measured on 8 Jun and 8 Jul and the height and width increase were calculated by subtracting the initial from the final measurement. Plant fresh weight and root fresh weight were recorded for all plants on 8 Jul, and roots were assessed for Rhizoctonia root rot disease severity using a scale of 0-100% of roots damaged. *Rhizoctonia* pathogen recovery was calculated by culturing ten root pieces (~ 1 cm) on *Rhizoctonia* semi-selective medium. Average maximum temperatures for 8-30 Jun and 1-8 Jul were 94.0 and 92.8ºF; average minimum temperatures were 53.0 and 70.6ºF; and total rainfall amounts were 4.9 and 1.3 in, respectively. One-way analysis of variance (ANOVA) was performed using the general linear models (GLM) procedure in SAS 9.4 and when the effects were significant, the *post hoc* Fisher's LSD test was used for means comparisons.

Rhizoctonia root rot disease pressure was medium to high in this trial. All fungicide treatments significantly reduced Rhizoctonia root rot severity and pathogen recovery compared to the non-treated, inoculated control. Non-treated, non-inoculated control had no root rot disease. Pageant and Pageant + KleenGrow were the most effective fungicides in controlling Rhizoctonia root rot. There were no significant differences in plant height increase, plant width increase, plant fresh weight and root fresh weight among the treatments at the end of the trial. Plants from all treatments were marketable at the end of the trial. Phytotoxicity was not observed in any of the treated red maple plants.

Treatment and rate/100 gal	Application dates[z]	Plant height increase (in)	Width increase (in)	Total fresh weight (oz)	Root fresh weight (oz)	Rhizoctonia root rot disease severity (%)[y]	*Rhizoctonia* pathogen recovery (%)
Astun + Seido 13.5 fl oz + 5 oz	1, 2	1.6 a	1.7 a	4.7 a	2.7 a	15.8 b	50.0 b
Astun 17 fl oz	1, 2	2.1 a[x]	2.3 a	4.9 a	2.7 a	17.5 b	43.3 b
KleenGrow 25 fl oz	1, 2	2.0 a	1.1 a	5.4 a	3.0 a	15.8 b	55.0 b
Pageant + KleenGrow 18 oz + 12.5 fl oz	1, 2	1.4 a	1.0 a	4.9 a	2.7 a	4.2 c	16.7 c
Pageant 18 oz	1, 2	1.5 a	1.2 a	5.5 a	3.1 a	5.8 c	16.7 c
SP2478 3 fl oz	1, 2	1.7 a	0.6 a	5.3 a	3.0 a	19.2 b	46.7 b
Terraguard 8 fl oz	1, 2	1.4 a	1.3 a	5.1 a	2.9 a	22.5 b	51.7 b
Non-treated, inoculated		1.5 a	0.9 a	5.3 a	3.1 a	63.3 a	88.3 a
Non-treated, non-inoculated		1.8 a	0.9 a	5.6 a	3.1 a	0.0 c	0.0 c
P-value		0.2463	0.3391	0.9028	0.8913	<.0001	<.0001

[z]Application dates: 1 = 10 Jun; 2 = 24 Jun.
[y]Disease severity was based on percentage of roots affected.
[x]Values are the means of six plants; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

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

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Evaluation of fungicides for the control of black spot of rose, 2022.

Rose 'Queen Elizabeth' plants were potted in 5-gallon containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 13.5 fl oz of 24-8-16 Miracle-Gro®. All Purpose Plant Food and 1.0 oz of 18-6-8 Nutricote controlled release fertilizer on 28 Jun. The experiment was conducted in a shade house under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with four single-plant replications. Plants were irrigated using overhead irrigation for 15 minutes twice a day in Jul and Aug. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 14-day interval beginning on 5 Jul and ending on 2 Aug. Black spot severity, defoliation and phytotoxicity were determined on 5, 12, 19, and 26 Jul, and 2, 9 and 16 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 5 Jul and 16 Aug. Height increase was calculated by subtracting initial height from final height. Average maximum temperatures for 5-31 Jul and 1-16 Aug were 93.5 and 89.5ºF; average minimum temperatures were 74.0 and 71.5ºF; and total rainfall amount were 6.8 and 3.1 in., respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 and means were separated using Fisher's LSD test.

Black spot disease developed naturally in this trial. Black spot disease pressure was low to moderate with non-treated control plants showing 31.3% disease severity by 16 Aug. All treated plants had significantly less black spot disease severity and disease progression compared to the non-treated control plants. There was no difference both in disease severity and disease progression among fungicides. All treated plants had reduced defoliation compared to the non-treated control plants. Phytotoxicity was not observed in any of the treated rose plants.

		Black leaf spot			
Treatment and rate/100 gal	Application dates*	Disease severity (%) (16 Aug)	AUDPC	Defoliation (%)	Height increase (in)
Astun 17 fl oz	1, 2, 3	7.5 b**	121.6 b	0.0 b	1.9 a
Astun + Seido 13.5 fl oz + 5 fl oz	1, 2, 3	8.8 b	162.8 b	0.0 b	0.4 a
Mural 45WG 6 oz	1, 2, 3	4.4 b	52.9 b	0.0 b	1.9 a
KleenGrow 25 fl oz	1, 2, 3	8.8 b	141.8 b	0.0 b	3.5 a
KleenGrow + Mural 45WG 12.5 fl oz + 6 oz	1, 2, 3	10.0 b	157.1 b	0.0 b	1.2 a
Non-treated control	-	31.3 a	528.5 a	4.4 a	2.4 a
P-value	-	0.004	0.0007	0.03	0.3

*Application dates: 1 = 5 Jul; 2 = 19 Jul; 3 = 2 Aug.
**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. 'Queen Elizabeth')
Black spot; *Diplocarpon rosae*

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Evaluation of fungicides for the control of black spot on rose, 2022.

Rose (*Rosa* sp.) 'Queen Elizabeth' plants were potted in 5-gal containers filled with Morton's Nursery mix (processed pine bark (55-65%), Canadian sphagnum peat, and sand). Each plant was fertilized with 13.5 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 1.0 oz of 18-6-8 Nutricote controlled release fertilizer on 1 Jul. The experiment was conducted in a shadehouse under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments were arranged in a completely randomized design with five single-plant replications per treatment. Plants were irrigated by overhead irrigation for 15 min twice a day in Jul, Aug, and Sep. Treatments were applied to run-off using a backpack CO_2-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 2- and 4-week interval beginning on 5 Jul and ending on 30 Aug. Plants were evaluated for black spot disease severity, defoliation and phytotoxicity on 8, 15, 22, and 29 Jul, and 5, 12, 19, and 26 Aug, and 2, 9, and 16 Sep 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 disease severity rating at each evaluation time and $(t_i - t_{i-1})$ is the number of days between evaluations. The initial and final plant height was measured on 5 Jul and 13 Sep and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 5-31 Jul, Aug and 1-16 Sep were 90.5, 86.7, and 82.5ºF; average minimum temperatures were 70.6, 67.3, and 59.9ºF; and total rainfall was 5.3, 3.9, and 4.1, respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 and means were separated using Fisher's LSD test.

Black spot disease occurred naturally in this trial. Black spot disease pressure was high with non-treated control plants showing 77.0% disease severity by 16 Sep. All treated plants had significantly less black spot disease severity and disease progress compared to the non-treated control plants. All Postiva treatments and the 2-week interval Mural treatment provided the most significant decrease in disease severity. Defoliation was moderate among non-treated plants showing 28.0% defoliation. The treated plants had less defoliation compared to the non-treated control. There were no significant differences in plant height increase among any of the treated and non-treated control plants. Phytotoxicity was not observed in any of the treated rose plants.

		Black spot			
Treatment and rate/100 gal	Application dates*	Disease severity (%) (16 Sep)	AUDPC	Defoliation (%)	Height increase (in)
Postiva + Capsil 14 fl oz + 4 fl oz	1, 2, 3, 4, 5	14.0 bc**	293.7 b	1.0 b	2.1 a
Postiva + Capsil 20 fl oz + 4 fl oz	1, 2, 3, 4, 5	18.5 bc	457.5 b	1.0 b	6.3 a
Postiva + Capsil 28 fl oz + 4 fl oz	1, 2, 3, 4, 5	7.0 c	187.6 b	0.0 b	9.6 a
Postiva + Capsil 14 fl oz + 4 fl oz	1, 3, 5	10.0 c	213.2 b	0.5 b	20.2 a
Postiva + Capsil 20 fl oz + 4 fl oz	1, 3, 5	21.0 bc	431.2 b	2.0 b	8.0 a
Postiva + Capsil 28 fl oz + 4 fl oz	1, 3, 5	19.5 bc	536.2 b	5.5 b	8.2 a
Mural + Capsil 4 fl oz + 4 fl oz	1, 2, 3, 4, 5	16.5 bc	369.3 b	0.5 b	6.6 a
Mural + Capsil 7 fl oz + 4 fl oz	1, 3, 5	26.0 b	659.4 b	1.0 b	8.2 a
Non-treated control	-	77.0 a	1911.0 a	28.0 a	5.7 a
P - value	-	< 0.0001	< 0.0001	< 0.0001	0.7

*Application dates: 1 = 5 Jul; 2 = 19 Jul; 3 = 2 Aug; 4 = 16 Aug; 5 = 30 Aug.

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

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Report is available on-line at: http://www.tnstate.edu/agriculture/nrc/

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