# Woody Ornamental Disease Management Research Reports

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

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*"Think. Work. Serve."*

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

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**Evaluation of fungicides and biorational products for the control of boxwood blight, 2023.**

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 3.4 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food and 0.3 fl oz of 18-6-8 Nutricote controlled release fertilizer on 2 Jul. Plants were placed in a BSL2 (Biosafety Level 2) area 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 treatment as indicated in the table below was applied on 22 Aug using a hand-held manual pump sprayer. On 24 Aug, boxwood plants were inoculated using a hand-held manual pump sprayer with a conidial suspension ($2.0 \times 10^6$ conidia/ fl oz) of *Calonectria pseudonaviculata* until run-off of the suspension from the foliage. Transparent plastic bags were placed over plants at dusk, left overnight, and were removed the following morning. Plants were hand watered once a week with 3.4 fl oz of water. The handheld sprayer was used until run-off to treat plants curatively 4 hours after inoculation (24 Aug), 4 days after inoculation (28 Aug), and then on a 7- or 14-day interval (7-day interval: 4, 11, 18, and 25 Sep, and 2 and 9 Oct; and 14 days interval after inoculation on 7, 21 Sep, and 5 and 19 Oct) using the method described above. 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 24 and 31 Aug; 7, 14, 21, and 28 Sep, and 5, 12, 19, and 26 Oct using a scale of 0-100%. The area under disease progress curve (AUDPC) was calculated according to the formula: $\sum$ ([(xi +xi-1)/2] (ti -ti-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 21 Aug and 26 Oct. Height increase was calculated by subtracting initial height from final height. The temperature in the BSL2 room was a constant 72.0º F. One-way analysis of variance was performed using the general linear model 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 55.8% disease severity and 6.6% defoliation by 19 Oct. All treatments significantly reduced boxwood blight disease severity and disease progress throughout the trial. Plants treated with curative application of Daconil Weatherstik, Daconil Weatherstik *alt* ZeroTol, and ZeroTol 2.0 and KleenGrow had the lowest disease severity and progress. The non-treated, inoculated control plants had the highest disease severity and disease progress whereas the non-treated, non-inoculated control plants remained asymptomatic. Defoliation was significantly lower in the plants treated with curative applications of Daconil Weatherstik *alt* ZeroTol 2.0, Daconil Weatherstick and ZeroTol 2.0 compared to the non-treated, inoculated control. 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 type[z] | Application dates[y] | Boxwood blight: Disease severity (%) (26 Oct) | Boxwood blight: AUDPC | Defoliation (%) (26 Oct) | Height increase (in) |
|---|---|---|---|---|---|---|
| Guarda 128 fl oz | Preventative | 1, 3, 6, 9, 12 | 15.8 b[x] | 282.9 b[**] | 5.4 a[**] | 0.3 a |
| Daconil Weatherstik *alt* Guarda 22 fl oz *alt* 128 fl oz | Curative | 5, 8, 11, 13 | 12.0 c | 246.4 bc | 3.3 b | 0.3 a |
| Daconil Weatherstik *alt* KleenGrow 22 fl oz *alt* 25 fl oz | Curative | 5, 8, 11, 13 | 12.0 c | 228.9 c | 3.3 b | 0.1 a |
| KleenGrow 25 fl oz | Curative | 5, 8, 11, 13 | 11.2 cd | 211.4 cd | 3.3 b | 0.0 a |
| ZeroTol 2.0 128 fl oz | Curative | 2, 3, 4, 6, 7, 9, 10, 12 | 9.1 cd | 172.0 de | 2.9 bc | 0.1 a |
| Daconil Weatherstik 22 fl oz | Curative | 3, 6, 9, 12 | 8.3 d | 157.0 e | 2.5 bc | 0.1 a |
| Daconil Weatherstik *alt* ZeroTol 2.0 22 fl oz *alt* 128 fl oz | Curative | 3, 6, 9, 12 | 8.3 d | 163.3 de | 1.6 c | 0.3 a |
| Non-treated, inoculated control | | - | 55.8 a | 920.2 a | 6.6 a | 0.4 a |
| Non-treated, non-inoculated control | | - | 0.0 e | 0.0 f | 0.0 d | 0.0 a |
| *P*-value | | - | <0.0001 | <0.0001 | <0.0001 | 0.5024 |

[z]Application type: Preventative application was done before inoculation with *Calonectria pseudonaviculata ((*$2.0 \times 10^6$ conidia/ fl oz) and curative applications were done after inoculation.
[y]Application dates: 1 = 22 Aug; 2 = 24 Aug; 3 = 28 Aug; 4 = 4 Sept; 5 = 7 Sept; 6 = 11 Sept; 7 = 18 Sept; 8 = 21 Sept; 9 = 25 Sept; 10 = 2 Oct; 11 = 5 Oct; 12 = 9 Oct; 13 = Oct 19.
[x]Values are the means of six single plant replications; treatments followed by the same lowercase letters within a column are not significantly different at $P \leq 0.05$.

CRABAPPLE (*Malus mandshurica* 'Robinson')
Fire blight; *Erwinia amylovora*

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**Evaluation of chemical treatments for control of fire blight on crabapple 2023.**

Flowering crabapple (*Malus mandshurica*) 'Robinson' 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 22 May. Six single-plant replications per treatment were arranged in a completely randomized design in full sun at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated using overhead irrigation for 30 minutes twice a day in Jun and Jul. Treatments were applied to run-off using a backpack $CO_2$-pressurized sprayer with a TeeJet XR8002VS nozzle at 30 psi beginning on 20 Jun and ending on 19 Jul. Shoot blight symptom was assessed on terminal shoots by counting all shoot and shoot strikes on 25 Jul. The shepherd's crook severity and phytotoxicity were visually assessed on 20 and 27 Jun and 11 and 25 Jul using a 0-100% scale. 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 $x_i$ was the shepherd's crook severity rating at each evaluation time and $(t_i - t_{i-1})$ was the number of days between evaluations. Plant height and width were measured on 19 Jun and 26 Jul. The average maximum temperatures for 20 to 30 Jun and 1 to 27 Jul were 92 and 91ºF; average minimum temperatures 62 and 58ºF; and total rainfall amounts were 2.97 and 0.00 in., respectively. One-way analysis of variance (ANOVA) was performed using the general linear models (GLM) procedure for plant height increase, width increase, and AUDPC in SAS software 9.4. When the effects were significant, the post hoc Fisher's LSD test was used for means comparisons. The final shoot blight incidence and shepherd's crook severity percentages were analyzed using mixed model (PROC GLIMMIX) fitted in beta distribution in SAS 9.4.

Fire blight symptoms developed naturally. The disease pressure was low in the non-treated control plants, showing 23.9% mean shoot blight incidence and 12.1% shepherd's crook severity on 25 Jul. All treatments had statistically similar efficacy, reducing the incidence of shoot blight, the mean shepherd's crook severity and disease progress compared to the non-treated control plants. The high rate of Postiva (20 fl oz) and the high rate of KleenGrow had lower shepherd's crook disease progress than the low rate of Postiva (14 fl oz). There were no significant differences in plant height and width increase among the treated and non-treated control crabapple plants. Phytotoxicity was not observed in any of the treated plants.

| Treatment and rate/100 gal | Application dates* | Incidence of shoot blight (%) (25 Jul) | Shepherd's crook | | Height increase (in.) | Width increase (in.) |
|---|---|---|---|---|---|---|
| | | | Mean severity (%) (25 Jul) | AUDPC | | |
| Postiva 14 fl oz | 1,2,3 | 16.1 b** | 6.70 b | 188.1 b | 12.1 a | 14.5 a |
| Postiva 20 fl oz | 1,2,3 | 16.5 b | 5.80 b | 121.0 c | 12.6 a | 15.5 a |
| KleenGrow 25 fl oz | 1,2,3 | 15.0 b | 5.80 b | 148.7 bc | 12.1 a | 14.9 a |
| KleenGrow 50 fl oz | 1,2,3 | 16.6 b | 5.40 b | 125.4 c | 12.5 a | 15.5 a |
| Camelot O 128 fl oz | 1,2,3 | 16.3 b | 6.30 b | 141.4 bc | 12.1 a | 15.1 a |
| BlightBan 7 fl oz | 1,2,3 | 15.2 b | 6.30 b | 163.3 bc | 12.1 a | 14.7 a |
| Non-treated control | - | 23.9 a | 12.1 a | 287.2 a | 11.6 a | 15.2 a |
| *P*-value | | 0.001 | <.0001 | <.0001 | <.0001 | 0.9750 |

*Application dates: 1= 20 Jun; 2= 5 Jul; 3 = 19 Jul

**Values are the means of six single plant replications; treatments followed by the same 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, 2023.**

One-year-old daylily (*Hemerocallis lilioasphodelus*) 'Stella d'Oro' plants were potted in 1-gal containers filled with Morton's Nursery mix, comprised of 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 14 Jul. Six single-plant replications per treatment were arranged in a completely randomized design in full sun at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were irrigated using overhead irrigation for 30 minutes twice a day in Jul and Aug. Astun and Terraguard treatments were applied as a sprench to run-off using a backpack $CO_2$-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi. Orkestra treatment was applied as a 6.8 fl oz drench. All treatments were applied on a 14-day interval beginning on 17 Jul and ending on 31 Jul. Inoculum of *Athelia rolfsii* was grown on PDA (potato dextrose agar) for 15 days. After the 15-day period, four sclerotia per daylily were buried around the crown of the plant on 17 Jul. Daylily plants were weighed for their root and total plant weight as well as evaluated at the crown and root for disease on 21 Aug. Root and crown rot were evaluated for disease severity using visual observation on a scale of 0 to 100% of root or crown affected by pathogen. Plant heights were measured on 17 Jul and 21 Aug. For the months of Jul and Aug, average maximum temperatures were 94.0°F and 95.0°F, average minimum temperatures were 61.0°F and 58.0°F, and total rainfall was 0.7 in. and 7.2 in., respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 statistical software and means were separated using Fisher's LSD test.

Southern blight disease pressure was low in the non-treated, inoculated control plants showing 24.2% and 26.7% crown rot and root rot severity, respectively, by 21 Aug. All treated plants had lower disease severity in both the crown and root areas compared to the non-treated, inoculated control plants. Terraguard, Orkestra, and Astun at 13.5 fl oz provided the best control of root and crown rot severity, although Astun at 17.0 fl oz was not statistically different from some of these treatments. There were no significant differences in total weight, root weight, 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 and rate/100 gal | Application dates* | Root rot severity (%) | Crown rot severity (%) | Total weight (oz) | Root weight (oz) | Height increase (in) |
| Astun 17.0 fl oz | 1,2 | 15.4 b** | 11.7 b | 44.6 a | 42.9 a | 1.1 a |
| Astun 13.5 fl oz | 1,2 | 12.5 bc | 9.6 bc | 32.9 a | 32.4 a | 1.2 a |
| Terraguard 8.0 fl oz | 1, 2 | 3.8 c | 5.4 bc | 31.4 a | 30.8 a | 1.1 a |
| Orkestra 10.0 fl oz | 1,2 | 4.8 c | 5.0 c | 36.9 a | 36.0 a | 0.9 a |
| Non-treated, inoculated control | - | 26.7 a | 24.2 a | 33.5 a | 32.9 a | 0.9 a |
| Non-treated, non-inoculated control | - | 0.0 d | 0.0 d | 45.7 a | 37.0 a | 1.1 a |
| *P*-value | | <0.0001 | <0.0001 | 0.1565 | 0.6674 | 0.9925 |

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

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, 2023.**

Dogwood 'Cherokee Princess' 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 12 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 six single-plant replications. Plants were irrigated using overhead irrigation for 15 min 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 at 30 psi on a 14-day interval beginning on 28 Jun and ending on 26 Jul. Powdery mildew disease severity, spot anthracnose disease severity and phytotoxicity were determined on 28 Jun, 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 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 23 Jun and 17 Aug and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 28-30 Jun, 1-31 Jul, and 1-16 Aug were 88.3, 87.4, and 85.9ºF; average minimum temperatures were 63.3, 67.4, and 67.4ºF; and total rainfall was 0.9, 4.2 and 5.9 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.

Spot anthracnose and powdery mildew occurred naturally in this trial. Spot anthracnose and powdery mildew disease pressure was low to moderate with non-treated control plants having 40.0 and 30.0% disease pressure by 16 Aug, respectively. All treatments had significantly less spot anthracnose and powdery mildew disease pressure and progress compared to the non-treated control plants. All treatments were similar in spot anthracnose and powdery mildew disease severity and progress. Plants treated with KleenGrow (25 fl oz) had the greatest increase in height which was significantly higher than the non-treated control plants. Phytotoxicity was not observed in any of the treated dogwood plants.

| | | Spot anthracnose | | Powdery mildew | | |
|---|---|---|---|---|---|---|
| Treatment and rate/100 gal | Application dates* | Mean severity (16 Aug) (%) | AUDPC | Mean severity (16 Aug) (%) | AUDPC | Height increase (in) |
| Mural 7.0 oz | 1, 2, 3 | 7.9 b** | 167.7 b | 4.6 b | 80.2 b | 2.0 ab |
| KleenGrow 25 fl oz | 1, 2, 3 | 8.8 b | 188.1 b | 5.0 b | 107.9 b | 3.6 a |
| KleenGrow 50 fl oz | 1, 2, 3 | 10.4 b | 231.9 b | 7.1 b | 121.0 b | 2.4 ab |
| Non-treated control | - | 40.0 a | 854.6 a | 30.0 a | 653.3 a | 1.2 b |
| P-value | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0415 |

*Application dates: 1 = 28 Jun; 2 = 12 Jul; 3 = 26 Jul.
**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')
Anthracnose; *Colletotrichum gloeosporioides*

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**Evaluation of fungicides for the control of anthracnose of hydrangea, 2023.**

Hydrangea '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 22 Aug. 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, Oct, and Nov. 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 21 Sep and ending on 19 Oct. Anthracnose disease severity, defoliation and phytotoxicity were determined on 21 and 28 Sep, 5, 12, 19, and 26 Oct, and 2 Nov 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 21 Sep and 2 Nov and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 21-30 Sep, Oct, and 1-2 Nov were 82.5, 75.4 and 48.5ºF; average minimum temperatures were 56.6, 50.2 and 23.5ºF; and total rainfall was 0.03, 0.5, and 0.0 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.

Anthracnose disease occurred naturally in this trial with the non-treated control plants having 45.0% disease severity by 2 Nov. All treated plants had significantly less mean disease severity, disease progress, and defoliation compared to the non-treated control plants. All treated plants were similar in final mean severity percentage, AUDPC and defoliation percentage. Plants treated with KleenGrow (both rates) and KleenGrow + Mural had the greatest increase in height. Phytotoxicity was not observed in any of the treated hydrangea plants.

| Treatment and rate/100 gal | Application dates* | Final mean anthracnose severity (%) | AUDPC | Defoliation (%) | Height increase (in) |
|---|---|---|---|---|---|
| KleenGrow 25 fl oz | 1, 2, 3 | 26.0 b | 378.0 b | 11.5 b | 10.3 a |
| KleenGrow 50 fl oz | 1, 2, 3 | 23.0 b | 507.5 b | 10.0 b | 7.1 ab |
| Mural 7.0 oz | 1, 2, 3 | 17.0 b | 367.5 b | 11.0 b | 5.7 bc |
| KleenGrow + Mural 25 fl oz + 7 oz | 1, 2, 3 | 18.0 b | 378.0 b | 10.5 b | 7.9 ab |
| Non-treated control | - | 45.0 a | 778.8 a | 18.0 a | 2.8 c |
| *P*-value | | 0.0005 | 0.0021 | 0.0004 | 0.0048 |

*Application dates: 1 = 21 Sep; 2 = 5 Oct; 3 = 19 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; *Golovinomyhces orontii*
Cercospora leaf spot; *Cercospora hydrangea*

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**Evaluation of fungicides for the control of powdery mildew and Cercospora leaf spot of hydrangea, 2023.**

Hydrangea '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 21 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 six single-plant replications. Plants were irrigated using overhead irrigation for 15 min 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 at 30 psi on a 14-day interval beginning on 28 Jun and ending on 26 Jul. Powdery mildew disease severity, Cercospora leaf spot disease severity and phytotoxicity were determined on 28 Jun, 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 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 23 Jun and 16 Aug and height increase was calculated by subtracting the initial height from the final height. Average maximum temperatures for 28-30 Jun, Jul, and 1-16 Aug were 88.3, 87.4, and 85.9ºF; average minimum temperatures were 63.3, 67.4, and 67.4ºF; and total rainfall was 0.9, 4.2 and 5.9 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 pressure was low in this trial with non-treated control plants showing 25.0 and 25.8 by 16 Aug, respectively. All treated plants had significantly less disease pressure and disease progress in both powdery mildew and Cercospora leaf spot compared to the non-treated control plants. All treatments were similar in disease severity and AUDPC for Cercospora leaf spot and powdery mildew. Mural and KleenGrow (25 fl oz) provided the best control of disease severity of powdery mildew based on the final visual rating on 16 Aug. All treatments were similar in powdery mildew AUDPC. There were no significant differences in plant height increase among treated and non-treated control plants. Phytotoxicity was not observed in any of the treated hydrangea plants.

| | | Cercospora leaf spot | | Powdery mildew | | |
|---|---|---|---|---|---|---|
| Treatment and rate/100 gal | Application dates* | Final mean severity (16 Aug) (%) | AUDPC | Final mean severity (16 Aug) (%) | AUDPC | Height increase (in) |
| Mural 7.0 oz | 1, 2, 3 | 10.8 b | 186.7 b | 5.4 c | 89.0 b | 5.6 a |
| KleenGrow 25 fl oz | 1, 2, 3 | 7.5 b | 140.0 b | 5.0 c | 125.4 b | 4.7 a |
| KleenGrow 50 fl oz | 1, 2, 3 | 9.2 b | 157.5 b | 9.2 b | 179.4 b | 3.8 a |
| Non-treated control | - | 25.8 a | 558.5 a | 25.0 a | 544.0 a | 5.6 a |
| *P*-value | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.3467 |

*Application dates: 1 = 28 Jun; 2 = 12 Jul; 3 = 26 Jul.
**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, 2023.**

Three-year-old hydrangea '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 22 Aug. The experiment was conducted 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 throughout Sep, Oct, and Nov. 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. Treatments began on 21 Sep and ended on 19 Oct. Rust disease severity, defoliation, and phytotoxicity were determined on 21 and 28 Sep; 5, 12, 19, and 26 Oct; and 2 Nov 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 21 Sep and 2 Nov, respectively. Height increase was calculated by subtracting the initial height from the final height. For the dates of 21-30 Sep, 1-31 Oct, and 1-2 Nov, average maximum temperatures were 82.5°F, 75.4°F and 48.5ºF; average minimum temperatures were 56.6°F, 50.2°F and 23.5°F ; and total rainfall was 0.03 in., 0.5 in., and 0.0 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.

Rust disease occurred naturally in this trial with the non-treated control plants having 46.0% disease severity by 2 Nov. All treated plants had significantly less rust mean disease severity percentage and disease progress compared to the non-treated control plants. Postiva + CapSil (14 fl oz + 4 fl oz) had the lowest numerical defoliation percentage while Postiva + Capsil (20 fl oz + 4 fl oz), Mural + CapSil (both rates), and KleenGrow + Mural + CapSil were statistically similar. 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.

| Treatment and rate/100 gal | Application dates* | Final mean rust disease severity (%) | AUDPC | Defoliation (%) | Height increase (in.) |
|---|---|---|---|---|---|
| Postiva + CapSil 14 fl oz + 4 fl oz | 1, 2, 3 | 17.5 bc** | 358.8 bc | 8.5 c | 4.9 a |
| Postiva + CapSil 20 fl oz + 4 fl oz | 1, 2, 3 | 23.5 bc | 533.8 b | 12.0 abc | 5.1 a |
| Mural + CapSil 4 oz + 4 fl oz | 1, 2, 3 | 25.5 b | 558.3 b | 11.5 bc | 4.0 a |
| Mural + CapSil 7 oz + 4 fl oz | 1, 2, 3 | 15.0 bc | 238.0 c | 9.0 bc | 5.8 a |
| KleenGrow 25 fl oz | 1, 2, 3 | 24.0 b | 577.5 b | 14.0 ab | 5.2 a |
| KleenGrow + Mural + CapSil 25 fl oz + 7 oz + 4 fl oz | 1, 2, 3 | 13.5 c | 197.8 c | 9.0 bc | 4.9 a |
| Non-treated control | - | 46.0 a | 855.8 a | 18.0 a | 2.8 a |
| *P*-value | | 0.0022 | 0.0014 | 0.0241 | 0.1204 |

*Application dates: 1 = 21 Sep; 2 = 5 Oct; 3 = 19 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 quercifolia* 'Munchkin')
Fusarium root and crown rot; *Fusarium oxysporum*

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**Evaluation of fungicides for the control of Fusarium root and crown rot on oakleaf hydrangea, 2023.**

Oakleaf hydrangea (*Hydrangea quercifolia*) 'Munchkin' 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 14 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 15 minutes twice a day in Jul and Aug. All plants except for 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 17 Jul. Treatments were applied as a sprench to run-off using a backpack $CO_2$-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 14-day interval beginning on 17 Jul 4 hr after inoculation and ending on 14 Aug. On 28 Aug, oakleaf hydrangea plants were weighed for their root and total plant weight as well as evaluated at the crown and root for disease using a scale of 0-100% root or crown area affected. Plant heights were measured on 14 Jul and 28 Aug. Average maximum temperatures for Jul and Aug were 84.6 and 85.3ºF; average minimum temperatures were 67.6 and 65.0ºF, respectively. One-way analysis of variance was performed using the general linear model's procedure with SAS 9.4 statistical software and means were separated using Fisher's LSD test.

Fusarium disease pressure was medium to high in the non-treated, inoculated control plants showing 43.3 and 60.0% crown and root rot severity by 28 Aug, respectively. All treated plants had lower disease severity in both the crown and root areas compared to the non-treated, inoculated control plants. All treated plants and the non-treated, inoculated control had similar total and root weights. The non-treated, non-inoculated control were significantly heavier than all treated and non-treated, inoculated control 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 oakleaf hydrangea plants.

| | | Fusarium | | | | |
|---|---|---|---|---|---|---|
| Treatment and rate/100 gal | Application dates* | Root rot severity (28 Aug) (%) | Crown rot severity (28 Aug) (%) | Total weight (oz) | Root weight (oz) | Height increase (in) |
| Astun 15.0 fl oz | 1, 2, 3 | 17.5 b | 17.5 b | 5.2 b | 3.4 b | 6.4 a |
| Terraguard 8.0 fl oz | 1, 2, 3 | 9.2 b | 6.3 b | 5.0 b | 2.0 b | 10.0 a |
| Empress 3.0 fl oz | 1, 2, 3 | 16.3 b | 10.4 b | 5.0 b | 2.8 b | 8.3 a |
| Non-treated, inoculated control | - | 60.0 a | 43.3 a | 5.0 b | 3.4 b | 6.9 a |
| Non-treated, non-inoculated control | - | 0.0 c | 0.0 c | 8.4 a | 5.9 a | 10.2 a |
| *P*-value | - | <0.0001 | <0.0001 | 0.0187 | 0.0072 | 0.4265 |

*Application dates: 1 = 17 Jul; 2 = 31 Jul; 3 = 14 Aug.
**Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

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

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**Evaluation of chemical treatments for control of bacterial blight on lilac, 2023.**

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 and 1 oz Nutricote total on 10 May. Five 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 irrigation emitters for 2 minutes twice a day in Jun and Jul. All plants except for the non-treated, non-inoculated control plants were inoculated with *Pseudomonas syringea* pv. *syringae* (approximately $10^8$ CFU/ml) on 12 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 9 Jun and ending on 26 Jun. Bacterial blight disease severity, defoliation, and phytotoxicity, and were expressed as the percentage of foliage area affected. Evaluations occurred on 19, 26 Jun; and 3, 10, 17, and 24 Jul. 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 24 Jul. For the dates 9-30 Jun and 1-24 Jul, the average maximum temperatures were 83.0°F and 87.0°F; average minimum temperature was 61.0°F and 67.0°F; and total rainfall amounts were 4.4 in. and 0.2in., 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.

Bacterial blight disease pressure was high in this trial, with non-treated, inoculated plants showing 64.0% disease severity by 24 Jul. All treated plants had significantly less bacterial blight mean disease severity percentage and disease progress compared to the non-treated, inoculated control plants. Plants treated with Camelot O had significantly lower mean bacterial blight, showing 9.0% compared to the high rate of Postiva, Proud 3, Stargus, Tril 21 (applied 19 Jun and 26 Jun) and non-treated, inoculated control plants. There were no significant differences in height and width increases or defoliation percentage among treated and non-treated plants. Phytotoxicity was not observed in any of the treated lilac plants.

| Treatment and rate/100 gal | Application dates * | Pseudomonas bacterial blight: Mean disease severity (%) (24 Jul) | Pseudomonas bacterial blight: AUDPC | Height increase (in) | Width increase (in) | Defoliation (%) (24 Jul) |
|---|---|---|---|---|---|---|
| Camelot O 128 fl oz | 2, 4, 6 | 9.0 e | 271.5 b | 12.6 a | 12.2 a | 0.0 a |
| KleenGrow 25 fl oz | 4, 6 | 10.0 de | 193.2 b | 12.4 a | 12.2 a | 0.0 a |
| KleenGrow + Camelot O 12.5 fl oz + 128 fl oz | 4, 6 | 10.5 cde | 245.2 b | 11.4 a | 12.3 a | 0.0 a |
| Postiva 10 fl oz | 2, 4, 6 | 10.0 de | 190.7 b | 11.2 a | 12.3 a | 0.0 a |
| Postiva 14 fl oz | 2, 3, 5 | 11.0 cde | 226.7 b | 13.0 a | 12.5 a | 0.0 a |
| Postiva 20 fl oz | 2, 4, 6 | 14.0 b | 308.0 b | 11.2 a | 12.7 a | 0.0 a |
| Proud 3 128 fl oz | 1, 3, 4, 5, 6 | 13.0 bc | 259.2 b | 11.4 a | 12.1 a | 0.0 a |
| Stargus 128 fl oz | 1, 4, 6 | 12.0 bcd | 238.0 b | 10.4 a | 12.0 a | 0.0 a |
| Tril-21 64 fl oz | 1, 3, 5 | 11.5 bcd | 218.7 b | 11.6 a | 12.1 a | 0.0 a |
| Tril-21 64 fl oz | 4, 6 | 11.0 cde | 247.2 b | 12.0 a | 12.1 a | 0.0 a |
| Non-treated, inoculated control | - | 64.0 a | 1474.0 a | 12.2 a | 12.0 a | 3.8 a |
| Non-treated, non-inoculated control | - | 0.5 f | 14.4 c | 11.8 a | 12.1 a | 0.0 a |
| *P*-value | - | <.0001 | <.0001 | 0.8782 | 0.9987 | 0.1 |

*Application dates: 1=9 Jun; 2=12 Jun; 3=15 Jun; 4=19 Jun; 5=22 Jun; 6=26 Jun.

**Values are the means of five 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 of maple, 2023.**

One-year-old maple 'October Glory' 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 21 Jul. The experiment was conducted in full sun at the Otis L. Floyd Nursery Research Center in McMinnville, TN. To prepare *Rhizoctonia solani* inoculum, 10-day-old cultures grown on PDA medium were chopped and placed in a beaker containing 34 fl oz sterile distilled water (one Petri plate), homogenized using a blender mixer until a homogenous consistency was achieved and the slurry was used to drench at a rate of 3.5 fl oz per plant on 24 Jul. Treatments were arranged in a completely randomized design with six single-plant replications. Plants were irrigated using overhead irrigation for 30 min twice a day in Jul, Aug, and Sep. Treatments were applied as a sprench to run-off using a backpack $CO_2$-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi on a 14-day interval beginning 24 Jul and ending 21 Aug. Rhizoctonia root rot disease severity was assessed on 18 Sep using a scale of 0-100% root area affected. Plant total and root weights were measured on 18 Sep. For the dates of 24-31 Jul, 1-31 Aug, and 1-18 Sep, average maximum temperatures were 89.9°F, 86.6°F, and 82.9ºF; average minimum temperatures were 66.8°F, 67.0°F, and 62.9ºF; and total rainfall was 0.7 in., 7.2 in., and 0.7 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 LSD test.

Rhizoctonia root rot severity was moderate at 57.5% root area affected in the non-treated, inoculated control by 18 Sep. All treated plants had less mean disease severity compared to the non-treated, inoculated control plants by the end of the trial. Plants treated with KleenGrow (12 fl oz) and Pageant provided the best control of Rhizoctonia root rot disease severity, although the two KleenGrow treatments were statistically similar. Plants treated with Pageant and the non-treated, non-inoculated control plants had the greatest total plant and root weight, although Pageant was not statistically different than any other treatment for these variables. There were no significant differences in plant height increase. Phytotoxicity was not observed in any of the treated maple plants.

| Treatment and rate/100 gal | Application dates* | Final mean severity (%) | Total weight (oz) | Root weight (oz) | Height increase (in.) |
|---|---|---|---|---|---|
| KleenGrow 12 fl oz | 1, 2, 3 | 18.3 bc** | 57.1 b | 49.6 b | 6.2 a |
| KleenGrow 25 fl oz | 1, 2, 3 | 25.0 b | 62.6 b | 54.3 b | 5.6 a |
| Pageant 18 oz | 1, 2, 3 | 12.5 c | 69.8 ab | 63.1 ab | 9.1 a |
| Non-treated, inoculated control | - | 57.5 a | 49.3 b | 44.7 b | 7.0 a |
| Non-treated, non-inoculated control | - | 0.0 d | 93.7 a | 85.8 a | 8.1 a |
| *P*-value | - | <0.0001 | 0.0257 | 0.0265 | 0.7956 |

*Application dates: 1 = 24 Jul; 2 = 7 Aug; 3 = 21 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 $P \leq 0.05$.

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

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**Chemical control of root rot caused by *Rhizoctonia solani* on red maple, 2023.**

This experiment was conducted in a shade house (56% shade) at the Otis L. Floyd Nursery Research Center, McMinnville, TN. Rooted cuttings of red maple 'October Glory' were planted in 2-gallon nursery containers filled with Morton's Nursery Mix (processed pine bark [55-65%], Canadian sphagnum peat, and sand) on 15 Mar. Plants were fertilized with 0.5 fl oz of 24-8-16 Miracle-Gro® All Purpose Plant Food on 5 Apr and 0.4 oz Nutricote total controlled release fertilizer (18–6–8) on 10 Apr. Plants were irrigated by irrigation emitters twice a day for two minutes. On 13 Jun, plants were arranged in a completely randomized design with six single-plant replications. Plants were inoculated with a slurry of *Rhizoctonia solani* as a container substrate drench at the rate of 10 fl oz/plant on 16 Jun. To prepare *Rhizoctonia solani* inoculum, 10-day-old cultures grown on PDA medium were chopped and placed in a beaker containing 34 fl oz sterile distilled water (one Petri plate) and then homogenized using a blender mixer until a homogenous consistency was achieved, then *R. solani* slurry was used to drench at a rate of 3.5 fl oz per plant. Non-treated, non-inoculated and non-treated, inoculated plants served as controls. Treatments were applied starting on 13 Jun and ending 7 Jul at different application intervals indicated in the table below. All treatments were applied as a substrate drench except RD00AS-1 and Postiva (both low and high rates), which were drenched at transplant and then sprenched. Sprench treatments were applied using a backpack $CO_2$-pressurized sprayer with TeeJet XR8002VS nozzle at 30 psi. The initial and final plant height and width were measured on 13 Jun and 28 Jul. Height and width increase were calculated by subtracting the initial from the final measurement. Plant total fresh weight and root fresh weight were recorded for all plants, and roots were evaluated for root rot severity in the scale of 0% to 100% on 28 Jul. For the dates of 13-30 Jun and 1-28 Jul, average maximum temperatures were 92°F and 87.4°F; average minimum temperatures were 51°F and 67.4°F; and total rainfall amounts were 3.82 in. and 4.22 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* Tukey test was used for means comparisons.

Rhizoctonia root rot disease was high in this trial with non-treated, inoculated plants showing 66.7% disease severity by 28 Jul. All treatments except for the curative application of Tril-21 significantly reduced Rhizoctonia root rot disease severity compared to the non-treated, inoculated plants. Non-treated, non-inoculated control had no root rot disease. Pageant, SP2478 and SP2700 WP treated plants were numerically similar with non-treated, non-inoculated plants in Rhizoctonia root rot severity. Plant height increase, width increase, total plant and root fresh weight were not significantly different among treated or control plants. No phytotoxicity was observed in any of the treated red maple plants.

| Treatment and rate/100 gal | Application schedule* | Rhizoctonia root rot severity (%) | Height increase (in) | Width increase (in) | Total fresh weight (oz) | Root fresh weight (oz) |
|---|---|---|---|---|---|---|
| BAS 673 05F 12 fl oz | 1, 5 | 21.7 b-f** | 7.5 a | 2.7 a | 3.9 a | 1.4 a |
| MBI-121 128 fl oz | 1, 2, 5 | 20.0 b-f | 6.8 a | 2.7 a | 3.0 a | 1.1 a |
| RD00AS-1 128 fl oz | 1, 3, 5 | 36.7 bcd | 7.6 a | 3.0 a | 3.6 a | 1.1 a |
| SP2478 4.6 fl oz | 1, 5 | 15.8 efg | 6.7 a | 2.9 a | 2.9 a | 1.2 a |
| SP2700 WP 16 fl oz | 1, 3, 5 | 18.3 d-g | 7.2 a | 3.0 a | 3.8 a | 1.4 a |
| Tril-21 64 fl oz | 2, 4 | 48.3 ab | 7.6 a | 2.9 a | 2.7 a | 1.1 a |
| Tril-21 64 fl oz | 1, 3, 5 | 38.3 bc | 7.4 a | 2.7 a | 3.1 a | 1.2 a |
| Postiva 14 fl oz | 1, 5 | 32.5 b-e | 7.8 a | 2.5 a | 3.6 a | 1.1 a |
| Postiva 21 fl oz | 1, 5 | 35.8 bcd | 7.5 a | 2.4 a | 2.8 a | 1.2 a |
| Pageant 18 fl oz | 3, 6 | 6.7 fg | 8.1 a | 2.9 a | 3.3 a | 1.4 a |
| Non-treated, inoculated | | 66.7 a | 6.2 a | 2.4 a | 3.0 a | 1.3 a |
| Non-treated, non-inoculated | | 0.0 g | 8.2 a | 3.0 a | 3.5 a | 1.1 a |
| *P*-value | | <.0001 | 0.1080 | 0.5115 | 0.6449 | 0.8741 |

*Application schedule: 1=13 Jun (preventative); 2=19 Jun; 3=23 Jun; 4=26 Jun; 5=30 Jun; 6=7 Jul

**Values are the means of six plants; treatments followed by the different letter within a column are 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, 2023.**

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 21 Jun. The experiment was conducted in a shade house with 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 Jun, 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 28 Jun and ending on 26 Jul. Black spot disease severity, defoliation and phytotoxicity were determined on 28 Jun; 5, 12, 19, 26 Jul; and 2, 9, 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 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 23 Jun and 17 Aug; height increase was calculated by subtracting the initial height from the final height. For the dates of 28-30 Jun, 1-31 Jul, and 1-16 Aug, average maximum temperatures for were 88.3°F, 87.4°F, and 85.9°F; average minimum temperatures were 63.3°F, 67.4°F, and 67.4°F; and total rainfall was 0.9 in., 4.2 in., and 5.9 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 occurred naturally in this trial. Disease pressure was moderate in this trial with non-treated control plants having 61.7% by 16 Aug. All treated plants had significantly lower disease pressure and progress compared to the non-treated control plants. All treatments were similar in their control of powdery mildew disease severity percentage. AUDPC was significantly lower in Broadform and Armada treated plants compared to the Astun, Mural and KleenGrow treated and non-treated plants. All treated plants had lower defoliation percentage compared to the non-treated control plants. Non-treated control plants had the greatest height increase, with plants treated with Armada and KleenGrow (25.0 fl oz) being similar in height increase. Phytotoxicity was not observed in any of the treated rose plants.

| Treatment/100 gal | Application dates* | Black Spot | | Defoliation (%) | Height increase (in) |
|---|---|---|---|---|---|
| | | Mean Severity (%) | AUDPC | | |
| Astun 17.0 fl oz | 1, 2, 3 | 16.7 b** | 422.9 b | 10.0 b | 6.8 c |
| Mural 6.0 oz | 1, 2, 3 | 16.7 b | 415.6 b | 8.3 b | 6.9 c |
| Broadform 4.0 fl oz | 1, 2, 3 | 9.2 b | 215.8 c | 7.1 b | 7.9 bc |
| Armada 3.0 oz | 1, 2, 3 | 9.6 b | 261.0 c | 6.7 b | 13.7 ab |
| KleenGrow 25.0 fl oz | 1, 2, 3 | 14.6 b | 447.7 b | 9.2 b | 10.5 abc |
| KleenGrow 50.0 fl oz | 1, 2, 3 | 15.0 b | 402.5 b | 8.8 b | 6.8 c |
| Non-treated control | - | 61.7 a | 1227.9 a | 43.3 a | 16.0 a |
| *P*-value | | <0.0001 | <0.0001 | <0.0001 | 0.0207 |

*Application dates: 1 = 28 Jun; 2 = 12 Jul; 3 = 26 Jul.
**Values are the means of six single plant replications; treatments followed by the same lowercase letters within a column are not significantly different at $P \leq 0.05$.

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

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