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# Woody Ornamental Disease Management Research Reports 2017

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# Woody Ornamental Disease Management Research Reports 2015 and 2016

Hydrangea, Viburnum, Rose, Crapemyrtle, Flowering Dogwood and Magnolia

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TENNESSEE STATE UNIVERSITY

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HYDRANGEA (*Hydrangea macrophylla*)
Cercospora leaf spot; *Cercospora hydrangea*

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**Evaluation of fungicides and biorational products for control of Cercospora leaf spot on Hydrangea, 2016.**

Hydrangea (*Hydrangea macrophylla*) 'Zaunkoenig' x 'Princess Juliana' plants were potted in no. 5 nursery containers filled with 100% pine bark substrate, which was amended with 0.48 lb of 19-5-9 Osmocote® Pro controlled release fertilizer, 0.06 lb of Micromax® micronutrient fertilizer, 0.04 lb iron sulfate and 0.01 lb Epsom salt per cubic feet of mix. Plants received additional 2.5 oz of 19-5-9 Osmocote® Pro in Apr and Jul. Four single-plant replications per treatment were arranged in a randomized complete block design outdoor under 56% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN (USDA Hardiness Zone 7a). Plants were irrigated for 3 minutes twice a day in Jun and for 4 minutes twice a day in Jul using micro bubbler emitters installed on short stakes. Treatments were applied to run-off using a backpack $CO_2$-pressurized sprayer on a 7- or 14-day interval beginning on 21 Jun and ending on 5 Jul. Severity of Cercospora leaf spot resulting from natural infections and phytotoxicity were determined on 22, 24, 26 and 28 Jun; 5 and 12 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 rating at each evaluation time and $(t_i-t_{i-1})$ is the number of days between evaluations. Plant quality/acceptability was evaluated on 12 Jul using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. Average maximum temperatures for 21-30 Jun and 1-12 Jul were 90.0 and 88.8ºF; average minimum temperatures were 67.9 and 68.8ºF; and total rainfall was 1.65 and 2.33 in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's LSD test.

Cercospora leaf spot disease pressure was moderate to high in this trial with non-treated control plants showing 55.0% disease severity by 12 Jul and nearly 7.5% defoliation (data not shown). All of the treatments significantly reduced Cercospora leaf spot severity and area under the disease progress curve (AUDPC) throughout the experiment compared to the non-treated control. The treatments that most effectively reduced Cercospora leaf spot severity and the progression of disease were Orkestra Intrinsic, Regalia, Mural, GreenClean Pro and Mildew Cure. Phytotoxicity was observed as necrotic flecks and streaks on foliage of plants treated with GreenClean Pro (22.5%; data not shown). Non-treated control, GreenClean Pro and Triact-treated plants were not commercially acceptable due to disease severity or phytotoxicity at the end of the experiment (data not shown).

| Treatment and rate | Application dates* | Cercospora leaf spot | |
|---|---|---|---|
| | | Mean severity (%) (12 Jul) | AUDPC |
| Orkestra Intrinsic SC 6 fl oz/100 gal | 1, 3 | 9.4 f** | 142.0 f |
| Mural 45WG 7 oz/100 gal | 1. 3 | 14.4 ef | 240.2 def |
| Strike plus 50WDG 2.4 oz/100 gal | 1, 3 | 17.5 cde | 289. 6 cde |
| ZeroTol 2.0 2% (v/v) | 1, 2, 3 | 22.5 bcd | 332.7 bcd |
| GreenClean Pro 6 lb/100 gal | 1, 2, 3 | 16.3 def | 251.5 def |
| Regalia SC 1% (v/v) | 1, 2, 3 | 11.9 ef | 198.4 ef |
| Mildew Cure 1.5 fl oz/gal | 1, 2, 3 | 16.9 c-f | 265.6 def |
| GreenCure 50 oz/100 gal | 1, 2, 3 | 24.4 bc | 399.3 bc |
| Triact 70EC 2% (v/v) | 1, 2, 3 | 29.4 b | 447.3 b |
| Non-treated control | | 55.0 a | 783.4 a |
| *P*-value | | ≤0.0001 | ≤0.0001 |

*Application dates: 1=21 Jun; 2=28 Jun; 3=5 Jul.
**Values are the means of four replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

HYDRANGEA (*Hydrangea paniculata*)
Phytophthora root rot; *Phytophthora nicotianae*

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**Evaluation of biorational products and fungicides for the control of Phytophthora root rot of Hydrangea, 2016.**

The experiment was conducted at the Otis L. Floyd Nursery Research Center in McMinnville, TN in a field plot with Waynesboro loam soil. The field was cultivated on 20 Jun and leveled on 24 Jun. Plots were measured and marked in a randomized complete block design with four replications on 27 Jun. Plots were inoculated with *Phytophthora nicotianae* grown on rice grains for 10 days. Four rice grains were placed 2 inches below the surface soil every 1 ft on 28 Jun. Non-treated, non-inoculated and inoculated plots served as controls. Hydrangea rooted cuttings were transplanted on 28 Jul. Each plot consisted of 5 plants spaced 2 ft apart with 7 ft between rows. Plants were fertilized with 0.4 oz of 18-6-8 Nutricote controlled-release fertilizer on 1 Aug. Plants were watered as needed using drip irrigation. The herbicide Finale (3 fl oz/gal) was applied as spot treatment into the test field on 20 Jul; 23 and 29 Aug; 6, 14 and 21 Sep. On 27 Jul, TerraClean 5.0 was drenched into the soil 24 hr prior to transplanting in dedicated plots (70 gal of mixed solution/1000 $ft^2$). On 28 Jul, TerraGrow at 1.0 oz/10 gal rate was prepared and dedicated rooted cuttings for this treatment were dipped into mixed solution prior to planting; one day after transplanting, these plants received TerraGrow at 0.4 oz/10 gal as a soil drench. The other treatments were applied as soil drenches starting after transplanting on 28 Jul and ending on 20 Oct (application dates for each treatment are listed in the table). The number of plants killed by Phytophthora root rot was determined on 23 Sep, 14 Oct and 9 Nov. Plant height and width were recorded on 9 Nov. Plants were dug on 10 Nov for root infection analysis. On 10 Nov, fresh weight was recorded and severity of Phytophthora root rot was assessed using a scale of 0-100% roots affected. Average maximum temperatures for 28-30 Jun, Jul, Aug, Sep, Oct and 1-10 Nov were 72.1, 81.5, 87.5, 88.0, 84.8 and 81.6ºF; average minimum temperatures were 46.8, 57.6, 65.8, 69.5, 64.2 and 59.4ºF; and total rainfall amounts were 1.80, 0.97, 2.11, 3.12, 1.52 and 1.65 in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Phytophthora root rot disease pressure was high. An average of 25% of the hydrangea plants in the non-treated inoculated control plots were killed by the end of the season (data not shown). The percentage of plants with Phytophthora root rot was significantly different among the non-treated, inoculated control and treated plots. All of the treatments significantly reduced Phytophthora root rot severity compared to non-treated inoculated control. The treatments most effective in reducing Phytophthora root rot severity were Segovis, Empress Intrinsic, Subdue Maxx and MBI110. All of the treatments except RootShield *PLUS*$^+$ WP significantly increased the plant fresh weight and root weight compared to non-treated, inoculated control. Segovis, TerraClean 5.0 + TerraGrow and Empress Intrinsic treatments numerically increased plant fresh weight and root weight compared to MBI110, OxiPhos and Subdue Maxx. TerraClean 5.0 + TerraGrow and Segovis numerically increased the plant height compared to other treatments and non-treated inoculated control. There were no significant differences among the treatments in plant width. Phytotoxicity and defoliation were not observed in any of the hydrangea plants.

| Treatment and rate | Application dates[z] | Phytophthora root rot severity (%)[y] | Plant fresh weight (oz) | Root weight (oz) | Plant height (in) | Plant width (in) |
|---|---|---|---|---|---|---|
| RootShield *PLUS*$^+$ WP 8 oz/100 gal | 2,10 | 29.9 bcd[x] | 3.9 fg | 2.6 ef | 18.7 ab | 12.2 |
| MBI110 1% | 2-14 | 17.1 def | 6.5 b-e | 4.6 bcd | 17.6 b | 13.3 |
| IT-5103 WP 2 g/plant | 2,5,8,11,14 | 35.8 b | 4.9 ef | 3.3 de | 17.0 b | 12.6 |
| OxiPhos 0.2% (v/v) | 2,4,6,8,10,12,14 | 33.3 bc | 5.9 cde | 4.3 b-e | 17.3 b | 12.1 |
| TerraClean 5.0 0.2% (v/v) | 1 | 21.4 cde | 7.7 abc | 5.5 abc | 20.6 a | 14.3 |
| TerraGrow 1.0 oz/10 gal | 2 | | | | | |
| TerraGrow 0.4 oz/10 gal | 2 | | | | | |
| TerraGrow 0.1 oz/10 gal | 5,8,11,14 | | | | | |
| Empress Intrinsic 23.8SC 3 fl oz/100 gal | 2,5,8,11,14 | 14.9 ef | 7.2 a-d | 4.9 a-d | 19.3 ab | 13.5 |
| Segovis 1.67SC 3 fl oz/100 gal | 2,5,8,11,14 | 9.2 ef | 9.0 a | 6.8 a | 20.7 a | 15.0 |
| Subdue Maxx 22ME 2 fl oz/100 gal | 2,12 | 15.6 ef | 5.6 def | 3.7 cde | 19.5 ab | 12.5 |
| Non-treated, inoculated control | | 68.9 a | 2.8 g | 1.8 f | 18.5 ab | 10.7 |
| Non-treated, non-inoculated control | | 4.2 f | 7.7 ab | 5.9 ab | 20.6 a | 13.3 |
| *P*-value | | ≤0.0001 | ≤0.0001 | 0.0001 | 0.0518 | 0.3866 |

[z]Application dates: 1=27 Jul; 2=28 Jul; 3=4 Aug; 4=11 Aug; 5=18 Aug; 6=25 Aug; 7=11 Sep; 8=8 Sep; 9=15 Sep; 10=22 Sep; 11=29 Sep; 12=6 Oct; 13=13 Oct; 14=20 Oct.
[y]Disease severity was based on percentage of roots affected.
[x]Values are the means of ten replicates; treatments followed by the same letter within a column are not significantly different at $P \leq 0.0518$.

VIBURNUM (*Viburnum odoratissimum*)
Rhizoctonia root rot; *Rhizoctonia solani*

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**Evaluation of biorational products and fungicides for the control of Rhizoctonia root rot of viburnum, 2016.**

The experiment was conducted at the Otis L. Floyd Nursery Research Center in McMinnville, TN in field plot with Waynesboro loam soil. The field
was cultivated on 20 Jun and leveled on 24 Jun. Plots were measured and marked in a randomized complete block design with four replications on 27 Jun. Plots were drench-inoculated with a slurry of *Rhizoctonia solani* (7-day old cultures on PDA were homogenized) at a rate of 3.4 fl oz/ft$^2$ on 28 Jun. Non- treated, non-inoculated and inoculated plots served as controls. Viburnum rooted cuttings were transplanted on 28 Jul. Each plot consisted of 5 plants spaced 2 ft apart with 7 ft between rows. Plants were fertilized with 0.4 oz of 18-6-8 Nutricote controlled-release fertilizer on 1 Aug. Plants were watered as needed using a drip irrigation system. The herbicide Finale (3 fl oz/gal) was applied as spot treatments in the test field on 20 Jul, 23, 29 Aug, 6, 14 and 21 Sep. On 27 Jul, TerraClean 5.0 was drenched into the soil 24 hr prior to transplanting in dedicated plots (70 gal of mixed solution/1000 ft$^2$). On 28 Jul, dedicated rooted cuttings were dipped in TerraGrow at 1.0 oz/10 gal rate prior to planting and then received a soil drench of TerraGrow at 0.4 oz/10 gal after planting. The other treatments were applied as soil drenches starting after transplanting on 28 Jul and ending 20 Oct. Plant height and width were recorded on 9 Nov. Plants were dug on 10 Nov for root infection analysis. On 10 Nov, fresh weight was recorded and severity of Rhizoctonia root rot was assessed using a scale of 0-100% of roots affected. Average maximum temperatures for 28-30 Jun, Jul, Aug, Sep, Oct, 1-10 Nov were 89.1, 90.1, 92.6, 86.2, 79.9 and 75.0ºF; average minimum temperatures were 66.8, 67.9, 69.8, 61.5, 50.7 and 44.2ºF; and total rainfall amounts were 0.02, 2.59, 2.70, 0.56, 0.10 and 0.01 in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Rhizoctonia root rot disease pressure was high in this trial. All of the treatments significantly reduced Rhizoctonia root rot severity compared to the non-treated, inoculated control. Plots treated with Mural, Empress Intrinsic, Pageant Intrinsic and TerraClean 5.0 + TerraGrow had significantly less Rhizoctonia root rot than the other treatments. Pageant Intrinsic, Mural, TerraClean 5.0 + TerraGrow and Empress Intrinsic treatments significantly increased plant fresh weight and root weight compared to the non-treated, inoculated control. Mural, Empress Intrinsic, Pageant Intrinsic, RootShield *PLUS*$^+$ WP and TerraClean 5.0 + TerraGrow significantly increased the plant height compared to the non-treated inoculated control. Pageant Intrinsic significantly increased plant width compared to the non-treated, inoculated control. Phytotoxicity and defoliation were not observed in any of the viburnum plants.

| Treatment and rate | Application dates[z] | Rhizoctonia root rot severity (%)[y] | Plant fresh weight (oz) | Root weight (oz) | Plant height (in) | Plant width (in) |
|---|---|---|---|---|---|---|
| RootShield *PLUS*$^+$ WP 8 oz/100 gal | 2,10 | 26.5 c[x] | 0.9 c | 0.6 abc | 7.8 a | 5.5 bc |
| MBI110 1% | 2-14 | 28.4 c | 0.9 c | 0.6 abc | 6.5 bc | 5.0 c |
| SoilGard 2 lb/100 gal | 2 | 24.3 c | 1.0 bc | 0.6 abc | 7.4 abc | 5.7 abc |
| IT-5103 WP 2 g/plant | 2,5,8,11,14 | 37.7 b | 0.9 c | 0.5 bc | 7.2 abc | 5.4 bc |
| TerraClean 5.0 0.2% (v/v)<br>TerraGrow 1.0 oz/10 gal<br>TerraGrow 0.4 oz/10 gal<br>TerraGrow 0.1 oz/10 gal | 1<br>2<br>2<br>5,8,11,14 | 13.9 d | 1.3 ab | 0.8 ab | 7.8 ab | 6.3 abc |
| Mural 45WG 3 oz/100 gal | 2,5,8,11,14 | 5.9 de | 1.4 ab | 0.9 a | 8.5 a | 6.1 abc |
| Empress Intrinsic 23.8SC 3 fl oz/100 gal | 2,5,8,11,14 | 6.7 de | 1.3 ab | 0.8 ab | 7.8 a | 5.7 abc |
| Pageant Intrinsic 38WG 18 oz/100 gal | 2,5,8,11,14 | 13.6 d | 1.5 a | 0.8 ab | 8.0 a | 6.9 a |
| Non-treated, inoculated control | | 63.3 a | 0.7 c | 0.4 c | 6.2 c | 5.3 c |
| Non-treated, non-inoculated control | | 3.7 e | 1.5 a | 0.8 ab | 8.5 a | 6.7 ab |
| *P*-value | | ≤0.0001 | 0.0008 | 0.0643 | 0.0799 | 0.0150 |

[z]Application dates: 1=27 Jul; 2=28 Jul; 3=4 Aug; 4=11 Aug; 5=18 Aug; 6=25 Aug; 7=11 Sep; 8=8 Sep; 9=15 Sep; 10=22 Sep; 11=29 Sep; 12=6 Oct; 13=13 Oct; 14=20 Oct.
[y]Disease severity was based on the percentage of roots affected.
[x]Values are the means of four replications; treatments followed by the same letter within a column are not significantly different at *P*≤0.0799.

ROSE (*Rosa* sp. 'Radtkopink')
Downy mildew; *Peronospora sparsa*

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**Evaluation of fungicides for the control of downy mildew of knockout roses, 2016.**

The Pink Double Knock Out® roses were grown in no. 3 nursery containers under 45% shade at a commercial nursery in Smithville, TN. Plants were fertilized with 1.6 oz of 18-6-12 Osmocote Classic on 1 Jun. Four single-plant replications per treatment were arranged in a randomized complete block design. Rose plants were watered daily using overhead impact sprinklers. The initial sprays were applied when disease was first observed on leaves. Treatments were applied to run-off using a backpack $CO_2$ -pressurized sprayer at 40 psi. The first application occurred on 22 Jun for all treatments. The second applications for 7-day interval treatments was made on 29 Jun, and 14-day interval treatments on 6 Jul. The severity of downy mildew was evaluated on 29 Jun; 6, 14 and 22 Jul using a scale of 0-100% foliage affected. Rose plants also were rated for downy mildew by counting the total number of infected leaves per plant on 22 Jul. Mean plant width and height were measured on 22 Jul. Average maximum temperatures for 22-30 Jun and 1-22 Jul were 90.0 and 89.1ºF, average minimum temperatures were 67.9 and 69.2ºF, and total rainfall amounts were 2.73 and 2.87 in, respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Downy mildew infection occurred naturally and the final mean downy mildew severity rating (22 Jul) was 27.5% in the non-treated control plants. All of the treatments significantly reduced downy mildew severity and infected leaf incidence as rated at the end of the experiment and area under the disease progress curve (AUDPC) compared to the non-treated control. Treatments with the high rate of Segovis on a 7-day schedule significantly reduced downy mildew severity compared to the low rate of Segovis and Adorn on a 7-day schedule or both rates of Segovis and Adorn on a 14-day schedule. Both rates of Segovis on 7 or 14-day schedule and Adorn on a 7-day schedule significantly reduced infected leaf incidences (no. and %) compared to Adorn on a 14-day schedule. All treatments on 7 or 14-day schedules except Adorn on a 14-day schedule significantly increased plant height compared to the non-treated control. Average plant width was numerically greater in plants treated with Adorn on a 7-day schedule compared to the both rates of Segovis on 7 or 14-day spray schedule, Adorn on 14-day spray schedule and the non-treated control. Phytotoxicity was not observed in any of the treated rose plants.

| Treatment and rate | Application dates[z] | % severity[y] (22 Jul) | AUDPC[y] | Infected leaf incidence (no.) | Infected leaf incidence (%)[x] | Plant height (in) | Plant width (in) |
|---|---|---|---|---|---|---|---|
| Segovis 1.67SC 1.0 fl oz/100 gal | 1,2 | 7.5 d[w] | 163.4 c | 1.8 c | 1.9 c | 21.1 a | 22.5 abc |
| Segovis 1.67SC 2.4 fl oz/100 gal | 1,2 | 5.0 e | 115.0 d | 1.3 c | 1.4 c | 25.6 a | 20.5 bcd |
| Adorn 4SC 4.0 fl oz/100 gal | 1,2 | 7.5 d | 136.9 cd | 2.0 c | 2.5 c | 25.5 a | 27.7 a |
| Segovis 1.67SC 1.0 fl oz/100 gal | 1,3 | 10.0 c | 202.8 b | 1.8 c | 3.0 c | 20.9 a | 23.7 ab |
| Segovis 1.67SC 2.4 fl oz/100 gal | 1,3 | 10.0 c | 200.6 b | 1.5 c | 2.2 c | 21.5 a | 23.9 ab |
| Adorn 4SC 4.0 fl oz/100 gal | 1,3 | 12.5 b | 205.9 b | 3.5 b | 12.7 b | 15.4 b | 16.7 cd |
| Non-treated control | | 27.5 a | 434.4 a | 6.3 a | 28.9 a | 14.4 b | 14.1 d |
| *P*-value | | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 | 0.0063 | 0.0013 |

[z]Application dates: 1=22 Jun; 2=29 Jun; 3=6 Jul.
[y]Disease severity and area under the disease progress curve (AUDPC) were based on a percentage of foliage affected.
[x]Infected leaf incidence was calculated as the number of infected leaves/total number of leaves.
[w]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. 'Louis Philippe')
Black spot; *Diplocarpon rosae*

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**Evaluation of fungicides for the control of black spot of rose, 2016.**

One-year old roses were grown in no. 1 nursery containers in Morton's grow mix (no. 2) under 45% shade at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were fertilized with 0.4 oz of 18-6-8 Florikan on 25 May. Ten single-plant replications per treatment were arranged in a randomized complete block design. Rose plants were watered twice a day for 2 minutes using a drip irrigation system. Spray applications of Orkestra Intrinsic and OxiPhos were applied to run-off using a backpack $CO_2$-pressurized sprayer at 40 psi beginning on 15 Jun and ending on 13 Jul for a total of 3 applications on a 14-day schedule; a soil drench of Orkestra Intrinsic was applied on 15 Jun at 6.8 fl oz of final product per plant for 1 application on designated treatment plants. The severity of black spot was evaluated on 22, 29 Jun, 6,13 and 20 Jul using a scale of 0-100% foliage affected. Area under the disease progress curve (AUDPC) values were 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. Phytotoxicity (scored as 0 = no phytotoxicity and 10 = complete kill), chlorosis, defoliation, discoloration and stunting (scored as 0 = no effect and 10 = complete plant affected) were evaluated on 22, 29 Jun, 6, 13 and 20 Jul. Mean plant width and height were measured on 20 Jul. Average maximum temperatures for 15-30 Jun and 1-20 Jul were 89.3 and 89.8°F, average minimum temperatures were 66.9 and 69.2°F, and total rainfall amounts were 1.7 and 2.5 in, respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Black spot infection occurred naturally and disease pressure was low; foliar disease severity rating was 16% in the non-treated control plants by 20 Jul. All of the treatments significantly reduced final severity (20 Jul) and the area under the disease progress curve (AUDPC) compared to the non-treated control. Treatment with 4 gal/100 gal OxiPhos most effectively reduced black spot, but final disease severity ratings in these plants were statistically comparable to those treated with drench application of 20 and 30 fl oz/100 gal Orkestra Intrinsic, spray application of 1 and 2 gal/100 gal OxiPhos and spray application of 32 fl oz/100 gal Orkestra Intrinsic. The spray application of 4 gal/100 gal OxiPhos and 32 fl oz/100 gal Orkestra Intrinsic, and the soil drench application of 30 fl oz/100 gal Orkestra Intrinsic were more effective in reducing AUDPC than the soil drench application of 10 fl oz/100 gal Orkestra Intrinsic, the spray application of 1 gal/100 gal OxiPhos, 8 and 16 fl oz/100 gal Orkestra Intrinsic. The 1 and 2 gal/100 gal OxiPhos treatments significantly increased the plant height compared to the non-treated control. There were no significant differences in plant width between treated and non-treated plants. Phytotoxicity, chlorosis, defoliation, discoloration and stunting were not observed in any of the treated plants.

| Treatment and rate | Application method | Disease severity (%)* (20 Jul) | AUDPC* | Plant height (in) | Plant width (in) |
|---|---|---|---|---|---|
| Orkestra Intrinsic SC 10 fl oz/100 gal | Drench | 5.0 cd** | 39.6 cd | 14.4 c | 15.2 |
| Orkestra Intrinsic SC 20 fl oz/100 gal | Drench | 2.8 de | 23.6 de | 14.6 c | 14.6 |
| Orkestra Intrinsic SC 30 fl oz/100 gal | Drench | 1.5 de | 15.4 ef | 14.7 bc | 14.8 |
| Orkestra Intrinsic SC 8 fl oz/100 gal | Spray | 7.8 bc | 79.6 b | 14.5 c | 15.7 |
| Orkestra Intrinsic SC 16 fl oz/100 gal | Spray | 10.3 b | 64.9 b | 15.1 bc | 15.6 |
| Orkestra Intrinsic SC 32 fl oz/100 gal | Spray | 2.5 de | 21.2 def | 14.4 c | 14.8 |
| OxiPhos 1 gal/100 gal | Spray | 3.8 cde | 44.3 c | 17.8 a | 15.7 |
| OxiPhos 2 gal/100 gal | Spray | 1.9 de | 23.1 de | 16.9 ab | 15.9 |
| OxiPhos 4 gal/100 gal | Spray | 0.3 e | 3.2 f | 15.6 abc | 15.1 |
| Non-treated control | | 16.0 a | 127.4 a | 14.2 c | 15.4 |
| *P*-value | | ≤0.0001 | ≤0.0001 | 0.0281 | 0.7572 |

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

ROSE (*Rosa* 'Radtkopink')
Downy mildew; *Peronospora sparsa*

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**Evaluation of fungicide rotations at different application intervals for the control of downy mildew of knockout roses, 2016.**

This study was conducted on The Pink Double Knock Out® roses grown in no. 5 nursery containers under 45% shade at a commercial nursery in Smithville, TN. Plants were fertilized with 3.2 oz of 18-6-12 Osmocote Classic on 1 Jun. The experimental design was a randomized complete block with 10 single plant replicates. Plants were watered daily using overhead impact sprinklers. The initial fungicide application was made after observing the first symptoms of downy mildew disease. Treatments were mixed with CapSil® at 4 fl oz/100 gal and applied in a 7 or 14-day rotation program to run-off using a backpack $CO_2$-pressurized sprayer at 40 psi beginning on 12 Aug and ending on 21 Oct. Downy mildew incidence was evaluated by counting the total number of infected leaves per plant on 28 Oct. Phytotoxicity and defoliation were evaluated using a scale of 0-100% foliage affected, while visual residue was evaluated using a scale of 0 to 10 (0=no effect; 10=complete plant affected) on 19 and 26 Aug; 2, 9, 16, 23 and 30 Sep; 7, 14, 21 and 28 Oct. Plant average width and height were measured at the end of the trial on 28 Oct. Average maximum temperatures for 12-31 Aug, 1-30 Sep and 1-28 Oct were 87.4, 85.3 and 77.7ºF; average minimum temperatures were 70.1, 62.2 and 51.2ºF; and total rainfall was 1.25, 1.13 and 0.33 in., respectively. Analysis of variance was performed using the general linear models procedure using SAS statistical software and means were separated using Fisher's LSD test.

Downy mildew infection occurred naturally in this trial. Disease pressure was low until late Sep and then slowly increased due to cool weather conditions. Disease incidence reached a maximum of 15.1% in the non-treated control plants. Both fungicide rotation programs equally and significantly reduced downy mildew incidence as well as the average number of infected leaves compared to the non-treated control. The 7-day rotation program significantly increased plant height compared to the non-treated control, but no differences were observed in plant width values between treated plants on a 7-day schedule or 14-day schedule and non-treated control plants. Phytotoxicity, defoliation and visual residue were not observed in any of the treated plants.

| Treatment and rate | Application dates[z] | Spray interval (days) | Downy mildew | | Plant height (in) | Plant width (in) |
|---|---|---|---|---|---|---|
| | | | Average number of infected leaves | Mean incidence (%)[y] (28 Oct) | | |
| Subdue Maxx 22ME 2 fl oz/100 gal + Micora 23.3SC 4 fl oz/100 gal | 1 | 7 | 1.1 b[x] | 0.9 b | 26.1 a | 29.5 a |
| *alt* Mural 45WG 7 oz/100 gal | 2 | | | | | |
| *alt* Segovis 1.67SC 2 fl oz/100 gal | 3 | | | | | |
| *alt* Mural 45WG 7 oz/100 gal | 4 | | | | | |
| *alt* Segovis 1.67SC 2 fl oz/100 gal | 5 | | | | | |
| *alt* Mural 45WG 7 oz/100 gal | 6 | | | | | |
| Subdue Maxx 22ME 2 fl oz/100 gal + Micora 23.3SC 4 fl oz/100 gal | 1 | 14 | 1.8 b | 1.5 b | 24.5 ab | 28.1 a |
| *alt* Mural 45WG 7 oz/100 gal | 3 | | | | | |
| *alt* Segovis 1.67SC 2 fl oz/100 gal | 5 | | | | | |
| *alt* Mural 45WG 7 oz/100 gal | 7 | | | | | |
| *alt* Segovis 1.67SC 2 fl oz/100 gal | 8 | | | | | |
| *alt* Mural 45WG 7 oz/100 gal | 9 | | | | | |
| Non-treated control | | | 13.9 a | 15.1 a | 22.9 b | 26.7 a |
| *P*-value | | | ≤0.0001 | ≤0.0001 | 0.0508 | 0.1811 |

[z]Application dates: 1=12 Aug; 2=19 Aug; 3=26 Aug; 4=2 Sep; 5=9 Sep; 6=16 Sep; 7=23 Sep; 8= 7 Oct; 9=21 Oct.
[y]Disease incidence was calculated according to the formula: Incidence=number of infected leaves/total number of leaves.
[x]Values are the means of ten replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.0508$.

ROSE (*Rosa* sp. 'Radtkopink')
Downy mildew; *Peronospora sparsa*

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**Evaluation of fungicide drench applications for the control of downy mildew of knockout roses, 2016.**

This study was conducted on The Pink Double Knock Out® roses grown in no. 3 nursery containers under 45% shade at a commercial nursery in Smithville, TN. Plants were fertilized with 3.2 oz of 18-6-12 Osmocote Classic on 1 Jun. Six single-plant replications per treatment were arranged in a randomized complete block design. Plants were watered daily using overhead impact sprinklers. Treatments were applied as a drench at the first signs of downy mildew with a volume of 20 fl oz per pot on 22 Jun. The severity of downy mildew was evaluated on 29 Jun; 6, 14 and 22 Jul using a scale of 0-100% foliage area affected. Plants were also rated for downy mildew by counting the total number of infected leaves per plant on 22 Jul. Phytotoxicity and defoliation were evaluated using a scale of 0-100% foliage affected, while visual residue was evaluated using a scale of 0 to 10 (0=no effect; 10=complete plant affected) on 29 Jun; 6, 14 and 22 Jul. Plant average width and height were measured on 22 Jul. Average maximum temperatures for 22-30 Jun and 1-22 Jul were 90.0 and 89.1ºF; average minimum temperatures were 67.9 and 69.2ºF; and total rainfall was 2.73 and 2.87 in., respectively. Analysis of variance was performed using the general linear models procedure using SAS statistical software and means were separated using Fisher's LSD test.

Downy mildew infection occurred naturally in this trial and the final severity mean value was 44.2% in the non-treated control plants. All fungicide treatments significantly reduced the final severity rating, disease progression, downy mildew incidence, and average number of infected leaves compared to the non-treated control. The severity of downy mildew and disease progression among fungicide-treated plants was significantly lower in plants treated with the higher rate of Segovis. All treatments significantly increased the average plant height compared to the non-treated control. Average plant width did not differ between treated and non-treated control plants. Phytotoxicity, defoliation and visual residue were not observed in any of the treated plants.

| Treatment and rate | Downy mildew | | | | Plant height (in) | Plant width (in) |
|---|---|---|---|---|---|---|
| | Mean severity (%)[z] (22 Jul) | AUDPC[z] | Average number of infected leaves | Mean incidence (%)[y] (22 Jul) | | |
| Segovis 1.67SC 1.0 fl oz/100 gal | 5.4 b[x] | 63.8 b | 1.0 b | 1.6 b | 26.6 a | 19.8 a |
| Segovis 1.67SC 3.0 fl oz/100 gal | 0.8 c | 8.8 c | 0.3 b | 0.5 b | 27.2 a | 21.3 a |
| Subdue Maxx 22ME 2 fl oz/100 gal | 5.4 b | 68.2 b | 1.2 b | 2.0 b | 25.6 a | 20.6 a |
| Plentrix SC (A13836B) 2.75 fl oz/100 gal | 5.0 b | 56.9 b | 0.8 b | 1.5 b | 26.9 a | 22.6 a |
| Inosco 4.2L (A14658C) 20 fl oz/100 gal | 5.8 b | 71.8 b | 1.2 b | 1.8 b | 24.3 a | 22.4 a |
| Non-treated control | 44.2 a | 667.92 a | 11.3 a | 24.2 a | 18.3 b | 18.5 a |
| *P*-value | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 | 0.3908 |

[z]Disease severity ratings and area under the disease progress curve (AUDPC) were based on percentage of foliage area affected.
[y]Disease incidence was calculated according to the formula; Incidence=number of infected leaves/total number of leaves.
[x]Values are the means of six replications; treatments followed by the same letter within a column are not significantly different at $P \leq 0.05$.

CRAPEMYRTLE (*Lagerstroemia* spp. 'Muskogee' and 'Whit III')
Powdery mildew; *Erysiphe lagerstroemia*

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**Evaluation of fungicides for the control of powdery mildew of crapemyrtle, 2016.**

Crapemyrtle 'Muskogee' (*Lagerstroemia indica* x *L. fauriei*) and 'Whit III' (*L. indica* Pink Velour™) plants were potted in no. 3 nursery containers in Barky Beaver Premium Potting Soil on 21 Mar and each pot was top dressed with 1.59 oz of 18-6-12 Osmocote Classic controlled release fertilizer. Four single-plant replications per treatment were arranged in a randomized complete block design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Plants were watered with a drip irrigation system two times per day for 5 minutes. The initial fungicide application was made when disease was first observed on leaves. Fungicide treatments were applied to run-off using a backpack $CO_2$ -pressurized sprayer at 40 psi on 9 and 23 Jun. The severity of powdery mildew was evaluated weekly from 16 Jun to 14 Jul 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 quality/acceptability was evaluated on 14 Jul using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. New growth length was measured on 14 Jul. Average maximum temperatures for 9-30 Jun and 1-14 Jul were 91.8 and 85.1ºF; average minimum temperatures were 63.6 and 65.9ºF, respectively. Analysis of variance was performed using the general linear models procedure using SAS statistical software and means were separated using Fisher's LSD test.

Powdery mildew infections occurred naturally in the greenhouse and disease pressure was high. The final disease severity mean value was 76.3% and 63.8% in the non-treated control Muskogee and Whit III plants, respectively. All fungicide treatments significantly reduced powdery mildew severity and disease progress compared to non-treated control in both cultivars. Mural was more effective in reducing disease severity in Muskogee plants than Pageant Intrinsic, but statistically similar in efficacy to the other fungicides. The new growth length in Muskogee plants was greater in fungicide-treated plants with the exception of the lower rate of Concert II, compared to the non-treated control plants. Among these, plants treated with both rates of Picatina Gold, Mural, and Pageant Intrinsic had the highest and statistically similar growth length values. The new growth length in Whit III plants was greater in plants treated with both rates of Concert II, Mural and the higher rate of Picatina Gold compared to plants treated with the other fungicides or non-treated control plants. Phytotoxicity was not observed in any of the treated crape myrtle plants for both varieties. Non-treated control plants for both varieties were not commercially acceptable due to the level of disease at the end of the experiment (data not shown). There were no significant differences in powdery mildew severity between Whit III and Muskogee crapemyrtle plants.

| Treatment and rate | Cultivar | Powdery mildew* | | New growth length (in) |
|---|---|---|---|---|
| | | Disease severity (%) (14 Jul) | AUDPC | |
| Picatina Gold 2.5SE (A21461A) 7.0 fl oz/100 gal | Muskogee | 10.6 bc** | 216.6 b | 18.5 ab |
| Picatina Gold 2.5SE (A21461A) 13.7 fl oz/100 gal | Muskogee | 6.9 bc | 132.6 b | 19.9 a |
| Concert II 4.3SE 22 fl oz/100 gal | Muskogee | 8.1 bc | 188.1 b | 14.7 cde |
| Concert II 4.3SE 35 fl oz/100 gal | Muskogee | 6.3 bc | 155.3 b | 16.1 bcd |
| Pageant Intrinsic 38WG 12 oz/100 gal | Muskogee | 11.3 b | 229.7 b | 17.6 abc |
| Mural 45WG 6 oz/100 gal | Muskogee | 4.4 c | 97.6 b | 18.9 ab |
| Non-treated control | Muskogee | 76.3 a | 1583.8 a | 12.4 e |
| *P*-value | | 0.0015 | 0.0001 | 0.0001 |

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

| Treatment and rate | Cultivar | Powdery mildew* | | New growth length (in) |
|---|---|---|---|---|
| | | Disease severity (%) (14 Jul) | AUDPC | |
| Picatina Gold 2.5SE (A21461A) 7.0 fl oz/100 gal | Whit III | 6.3 b** | 97.6 b | 14.8 abc |
| Picatina Gold 2.5 SE (A21461A) 13.7 fl oz/100 gal | Whit III | 2.1 b | 39.4 b | 15.3 ab |
| Concert II 4.3SE 22 fl oz/100 gal | Whit III | 5.6 b | 97.1 b | 15.9 a |
| Concert II 4.3SE 35 fl oz/100 gal | Whit III | 2.5 b | 60.4 b | 16.1 a |
| Pageant Intrinsic 38WG 12 oz/100 gal | Whit III | 9.4 b | 184.2 b | 14.1 abc |
| Mural 45WG 6 oz/100 gal | Whit III | 3.4 b | 72.6 b | 16.3 a |
| Non-treated control | Whit III | 63.8 a | 1295.0 a | 12.2 c |
| *P*-value | | 0.0001 | 0.0403 | 0.0001 |

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

CRAPEMYRTLE (*Lagerstroemia* spp.)
Cercospora leaf spot; *Cercospora lythracearum*

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**Response of crapemyrtle varieties to Cercospora leaf spot, 2015.**

Crapemyrtle varieties (*Lagerstroemia* spp.) were planted in two test evaluations, 2004 and 2011, in field plots with Waynesboro loam soil at the Otis L. Floyd Nursery Research Center in McMinnville, TN (USDA Hardiness Zone 7a). The experimental designs for both test evaluations were a randomized complete block design with five replications, however, in 2014, the 2004 test was reduced to three replications due to plant size. Plants were spaced 15 ft apart on 12 ft centers in staggered row planting. The field was fertilized annually with nitrogen, phosphorus and potassium based on University of Tennessee soil test recommendations and maintained at a soil pH of 6.5. Grass alleys between rows were mowed routinely, and vegetation in the row was controlled in a 4 ft strip with pre-and post-emergence herbicides. Severity of Cercospora leaf spot was determined on 8 Sep, 15 Sep and 22 Sep in the 2004 test and 2 Sep, 15 Sep and 22 Sep in the 2011 test and disease severity was evaluated using a scale of 0-100% foliage affected. Average maximum temperatures for Apr, May, Jun, July, Aug and 1-22 Sep were 72.1, 81.5, 87.5, 88.0, 84.8 and 81.6ºF; average minimum temperatures were 46.8, 57.6, 65.8, 69.5, 64.2 and 59.4ºF; and total rainfall amounts were 1.80, 0.97, 2.11, 3.12, 1.52 and 1.65-in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Cercospora leaf spot appeared naturally and disease pressure was high in the tests. There were significant differences among varieties in severity of Cercospora leaf spot. 'Townhouse', 'Woodlander's Chocolate Soldier' and 'Kiowa' varieties in the 2004 test were highly resistant to Cercospora leaf spot under these conditions, with foliar ratings of 1.0-2.0% foliage affected. Season-long disease progress (AUDPC) was highest in the crapemyrtle varieties 'Dynamite', 'Christiana' and 'Burgundy cotton' in the 2004 test. In the 2011 test, Cercospora leaf spot severity on 22 Sep was significantly lower in '*L. limii* 1', 'Tuscarora', '*L. subcoastata* ', 'Arapaho' and 'Osage' than in the other varieties, with foliar ratings of 1.7-3.0% foliage affected in 2011 plantation. Season-long disease progress in the 2011 test was highest in the crapemyrtle variety 'Rhaposody in Pink'.

| Variety | Cercospora leaf spot* | |
|---|---|---|
| | Severity (%) (22 Sep) | AUDPC* |
| Acoma | 88.3 ab** | 1162.0 a-d |
| Apalachee | 13.3 lm | 131.3 mn |
| Arapaho | 70.0 b-e | 939.2 d-g |
| Burgundy Cotton | 95.0 a | 1324.2 a |
| Carolina Beauty | 78.3 a-d | 974.2 c-f |
| Catawba | 48.3 f-i | 560.0 h-k |
| Centennial Spirit | 83.3 abc | 1050.0 a-e |
| Cheyenne | 93.3 a | 1277.5 ab |
| Choctaw | 35.0 h-k | 393.2 j-m |
| Christiana | 95.0 a | 1330.0 a |
| Country Red | 63.3 c-f | 775.8 e-h |
| Dynamite | 95.0 a | 1330.0 a |
| Fantasy | 8.3 lm | 29.2 n |
| Kiowa | 2.0 m | 21.0 n |
| Miami | 18.3 klm | 198.3 lmn |
| Muskogee | 61.7 d-g | 717.5 f-i |
| Natchez | 35.0 h-k | 367.5 j-m |
| Osage | 41.7 g-j | 455.0 i-l |
| Pecos | 53.3 e-h | 659.2 g-j |
| Powhatan | 83.3 abc | 1073.3 a-e |
| Raspberry Sundae | 85.0 ab | 1085.0 a-d |
| Red Rocket | 78.3 a-d | 974.2 c-f |
| Sarah's Favorite | 28.3 i-l | 297.5 k-n |
| Sioux | 78.3 a-d | 1020.8 b-e |
| Siren | 78.3 a-d | 1079.2 a-d |
| Splash of Pink | 85.0 ab | 1085.0 a-d |
| Tonto | 20.3 j-m | 220.5 lmn |
| Townhouse | 1.0 m | 14.0 n |
| Tuscarora | 13.3 lm | 123.7 mn |
| Tuskegee | 18.3 klm | 221.7 lmn |
| Velma's Royal Delight | 48.3 f-i | 583.3 h-k |
| Wm Toovey | 91.7 a | 1242.5 abc |
| Woodlander's Chocolate Soldier | 1.3 m | 15.2 n |
| *P* value | ≤0.0001 | ≤0.0001 |

*Cercospora leaf spot disease severity and area under the disease progress curves (AUDPC) were based on percentage foliage affected.

**Values are the means of three replicate plots planted in 2004; means followed by the same letter within a column are not significantly different at $P \leq 0.05$. Means were separated using Fisher's least significant difference test.

| Variety | Cercospora leaf spot[*] | |
|---|---|---|
| | Severity (%) (22 Sep) | AUDPC[*] |
| Arapaho | 2.8 e[**] | 37.6 d |
| Carolina Beauty | 41.0 b | 751.5 b |
| *L. limii* 1 | 1.7 e | 22.3 d |
| *L. limii* 2 | 15.0 de | 300.0 cd |
| *L. subcoastata* | 2.0 e | 23.5 d |
| Miami | 14.0 de | 180.7 d |
| Natchez | 21.0 cd | 305.0 cd |
| Osage | 3.0 e | 15.8 d |
| Red Rocket | 82.0 a | 1419.5 a |
| Rhapsody in Pink | 95.0 a | 1747.0 a |
| Tuscarora | 1.9 e | 22.3 d |
| Twilight | 34.0 bc | 584.5 bc |
| *P* value | ≤0.0001 | ≤0.0001 |

[*]Cercospora leaf spot disease severity and area under the disease progress curves (AUDPC) were based on percentage foliage affected.
[**]Values are the means of five replicate plots planted in 2011; means followed by the same letter within a column are not significantly different at $P \leq 0.05$. Means were separated using Fisher's least significant difference test.

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, 2016.**

Flowering dogwood (*Cornus florida*) 'Cherokee Princess' plants were potted in no. 7 nursery containers in 100% bark substrate. Four single-plant replications per treatment were arranged in a randomized complete block design under 54% shade at a commercial nursery in Smithville, TN. Plants were watered daily using overhead impact sprinklers. The initial fungicide application was made when the two diseases were first observed on leaves. Treatments were applied to run-off using a backpack $CO_2$-pressurized sprayer at 40 psi on a 14-dy interval beginning on 9 Jun and ending on 7 Jul. The severities of powdery mildew and spot anthracnose were evaluated on 16, 23 and 29 Jun; 7 and 14 Jul 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 quality/acceptability was evaluated at the end of the trial on 14 Jul using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. Plant height was also measured on 14 Jul. Average maximum temperatures for 9-30 Jun and 1-14 Jul were 89.7 and 89.1ºF; average minimum temperatures were 65.9 and 69.1ºF; and total rainfall was 1.87 and 2.48 in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's LSD test.

Powdery mildew and spot anthracnose infections occurred naturally in this trial. Powdery mildew disease pressure was moderate, and mean disease severity reached 58.8% by the end of the experiment in the non-treated control plants. Spot anthracnose disease pressure was low, with an average disease severity of 13.1% in the non-treated control plants. All fungicide treatments significantly reduced powdery mildew and spot anthracnose severity and disease progress compared to non-treated control plants. Moreover, the higher rate of Mural was the most effective in reducing powdery mildew disease progress. All treatments significantly increased plants' height compared to the non-treated control. Among fungicide-treated plants, plant height was significantly greater in plants treated with the higher rate of Mural. Phytotoxicity was not observed in any of the treated plants. Non-treated control plants were not commercially acceptable due to powdery mildew and spot anthracnose diseases at the end of the experiment (data not shown).

| Treatment and rate | Powdery mildew* | | Spot anthracnose* | | Plant height (in) |
|---|---|---|---|---|---|
| | % Mean severity (14 Jul) | AUDPC | % Mean severity (14 Jul) | AUDPC | |
| Mural 45WG 5 oz/100 gal | 5.0 b** | 140.0 bc | 1.0 b | 28.0 b | 67.0 b |
| Mural 45WG 7 oz/100 gal | 5.0 b | 87.8 c | 0.3 b | 7.0 b | 70.7 a |
| Concert II 4.3SE 35 fl oz/100 gal | 6.3 b | 147.1 b | 1.0 b | 28.0 b | 65.7 b |
| Pageant Intrinsic 38WG 18 oz/100 gal | 6.9 b | 190.3 b | 1.0 b | 28.0 b | 67.5 b |
| Non-treated control | 58.8 a | 1016.9 a | 13.1 a | 273.1 a | 61.8 c |
| *P*-value | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 |

*Disease ratings and area under the disease progress curve (AUDPC) were based on percentage of foliage area affected.
**Values are the means of four replication; 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, 2016.**

Flowering dogwood (*Cornus florida*) 'Cherokee Princess' plants were potted in no. 7 nursery containers in %100 bark substrate. Four single-plant replications per treatment were arranged in a randomized complete block design under 54% shade at a commercial nursery in Smithville, TN. Plants were watered daily using overhead impact sprinklers. The initial fungicide application was made when the two diseases were first observed on leaves. Treatments were applied to run-off using a backpack $CO_2$ -pressurized sprayer at 40 psi on a 14-day interval beginning on 9 Jun and ending on 7 Jul. The severities of powdery mildew and spot anthracnose were evaluated on 16, 23 and 29 Jun; 7 and 14 Jul 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 quality/acceptability was evaluated at the end of the trial on 14 Jul using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. Plant height was also measured on 14 Jul. Average maximum temperatures for 9-30 Jun and 1-14 Jul were 89.7 and 89.1ºF; average minimum temperatures were 65.9 and 69.1ºF; and total rainfall was 1.87 and 2.48 in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's LSD test.

Powdery mildew and spot anthracnose infections occurred naturally in this trial. Powdery mildew disease pressure was moderate, and mean disease severity reached 51.3% by the end of the experiment in the non-treated control plants. Spot anthracnose disease pressure was low, with an average disease severity of 10% in the non-treated control plants. All fungicide treatments significantly reduced powdery mildew and spot anthracnose severity as well as disease progress compared to non-treated control plants. The higher rate of Picatina Flora most effectively reduced powdery mildew severity. However, with the exception of Pageant Intrinsic, final severity ratings were statistically identical for all the fungicide treated plants. All treatments significantly increased plants' height compared to the non-treated control. Among fungicide-treated plants, plant height was significantly greater in plants treated with the higher rates of Picatina Flora and Picatina. Phytotoxicity was not observed in any of the treated dogwood plants. Non-treated control plants were not commercially acceptable due to the level of disease at the end of the experiment (data not shown).

| Treatment and rate | Powdery mildew* | | Spot anthracnose* | | Plant height (in) |
|---|---|---|---|---|---|
| | % Mean severity (14 Jul) | AUDPC | % Mean severity (14 Jul) | AUDPC | |
| Picatina 1.67SC (A19649B) 7 fl oz/100 gal | 5.0 bc** | 103.3 b | 1.0 b | 28.0 b | 66.5 b |
| Picatina 1.67SC (A19649B) 13.8 fl oz/100 gal | 4.4 bc | 106.7 b | 1.0 b | 28.0 b | 70.5 a |
| Picatina Flora 2.08SC (A20808C) 14 fl oz/100 gal | 3.8 bc | 95.7 b | 1.0 b | 28.0 b | 65.5 b |
| Picatina Flora 2.08SC (A20808C) 20 fl oz/100 gal | 2.5 c | 65.7 b | 0.8 b | 20.6 b | 71.2 a |
| Pageant Intrinsic 38WG 12 oz/100 gal | 8.8 b | 150.0 b | 1.3 b | 35.0 b | 65.7 b |
| Concert II 4.3SE 35 fl oz/100 gal | 5.0 bc | 129.9 b | 1.0 b | 28.0 b | 64.5 b |
| Non-treated control | 51.3 a | 900.9 a | 10.0 a | 173.5 a | 61.5 c |
| *P* value | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 | ≤0.0001 |

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

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

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**Evaluation of fungicides for the control of powdery mildew of dogwood, 2016.**

Flowering dogwood (*Cornus florida*) cultivar 'Cherokee Princess' seedlings were potted in no. 1 nursery containers in Morton's no. 2 Grow Mix. Each plant was top-dressed with 0.5 oz of 18-6-12 Osmocote Classic controlled release fertilizer. Four single-plant replications per treatment were arranged in a randomized complete block design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Flowering dogwood plants were hand watered two times per day. Treatments were applied to run-off using a backpack $CO_2$-pressurized sprayer at 40 psi on 9, 23 Jun and 7 Jul. The severity of powdery mildew was evaluated on 16, 23 and 30 Jun; 7,14 and 22 Jul using a scale of 0-100% foliage area affected. Area under the disease progress curve (AUDPC) values were 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 quality/acceptability was evaluated on 22 Jul using a scale of 1-9 where 1 is dead, 6 is commercially acceptable and 9 is a perfect plant. Plant height was measured on 22 Jul. Average maximum temperatures for 9-30 Jun and 1-22 Jul were 91.8 and 84.8ºF; average minimum temperatures were 63.6 and 65.9ºF, respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew infection occurred naturally in the greenhouse and disease pressure was high; the final (22 Jul) mean disease severity rating was 93.8% in the non-treated control plants. All treatments significantly reduced powdery mildew severity and disease progress compared to the non-treated control. Both rates of Picatina and Picatina Flora, as well as Concert II reduced powdery mildew disease progress when compared to Pageant Intrinsic and the non-treated control. Disease severity in the high rate of Picatina treated plants was numerically comparable to those treated with the low rate of Picatina, the high rate of Picatina Flora and Concert II. All treatments significantly increased the plant height compared to the non-treated control. Plant height was numerically greater for plants treated with Concert II than any other treatment. Phytotoxicity was not observed in any of the treated dogwood seedlings. Non-treated control plants were not commercially acceptable due to disease at the end of the experiment (data not shown).

| Treatment and rate | Final disease severity (%)* | AUDPC* | Plant height (in) |
|---|---|---|---|
| Picatina A19649B 7 fl oz/100 gal | 4.4 cd** | 143.3 c | 12.0 b |
| Picatina A19649B 13.8 fl oz/100 gal | 3.0 d | 81.4 c | 13.7 ab |
| Picatina Flora A20808C 14 fl oz/100 gal | 5.6 c | 154.1 c | 12.8 ab |
| Picatina Flora A20808C 20 fl oz/100 gal | 3.8 cd | 110.6 c | 12.6 ab |
| Pageant Intrinsic 38WG 12 oz/100 gal | 10.0 b | 340.0 b | 12.3 b |
| Concert II 4.3SE 35 fl oz/100 gal | 4.4 cd | 145.5 c | 15.4 a |
| Non-treated control | 93.8 a | 2749.4 a | 8.9 c |
| *P*-value | ≤0.0001 | ≤0.0001 | 0.0079 |

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

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

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**Response of container-grown flowering dogwood cultivars to powdery mildew under sun/shade production regime, 2015.**

Flowering dogwood (*Cornus florida*) cultivars Comco No.1 ('Cherokee Brave™') and 'Cherokee Princess' were potted in #5 nursery containers in an amended 100% bark substrate at the Otis L. Floyd Nursery Research Center in McMinnville, TN (USDA Hardiness Zone 7a). Treatments were based on exposure time to a full sun/shade condition during the growing season; treatment 1 = plants grown in full sun, treatment 2 = plants grown in full sun until 13 Jul, then placed under 48% shade, treatment 3 = plants grown in full sun until 13 Aug, then placed under 48% shade, treatment 4 = plants grown in 48% shade. All plants were arranged in a randomized split plot design with four replications with 10 plants per experimental unit for each cultivar. Weed control was maintained with BroadStar (150 lb/A) a granular herbicide, applied on 11 May and 24 Jul. For control of broad mites, the insecticide/miticide Talstar P Professional (0.5 oz/1000 $ft^2$) was applied on 5 Jun; Sanmite (4 oz/100 gal) was applied on 14 Jul and 12 Aug; Judo (3.5 oz/100 gal) applied on 30 Jul and 4 Sep; and Triact 70 (1 gal/100 gal) was applied 24 Jul, 21 Sep, and 13 Oct using an airblast sprayer. The fungicide Subdue GR (100 oz/1000 $ft^2$) was applied on 14 May as soil surface application. The fungicide Cleary's 3336F (15 oz/100 gal) was applied on 22 Jun and 26 Aug; and Banner MAXX II (3 oz/100 gal) was applied on 19 Jul for control of powdery mildew using an airblast sprayer. Flowering dogwood plants were watered using drip irrigation system as necessary. Severity of powdery mildew was determined on 15 Jul, 2 Sep and 5 Oct and disease severity was evaluated using a scale of 0-100% foliage affected. Average maximum temperatures for Apr, May, Jun, Jul, Aug, Sep and 1-5 Oct were 72.1, 81.5, 87.5, 88.0, 84.8, 81.6 and 73.7ºF; average minimum temperatures were 46.8, 57.6, 65.8, 69.5, 64.2, 59.4 and 51.7ºF; and total rainfall amounts were 1.80, 0.97, 2.11, 3.12, 1.52, 1.80 and 1.89-in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew appeared naturally and disease pressure was low to moderate in this trial primarily due to fungicides periodically applied. The effects of sun/shade treatments on powdery mildew severity (final rating and area under the disease progress curve (AUDPC)) were significant. However, the effect of cultivar or the interaction between sun/shade treatments and cultivar on powdery mildew was not significant. Regardless of cultivar, the disease was more severe with treatments 2 and 4 that were in the shade for the longest period during the growing season, compared to treatments 1 and 3 that were grown in full sun for most of the growing season.

| Fixed effects* | Powdery mildew** | |
|---|---|---|
| | Severity (%) (5 Oct) | AUDPC |
| Cultivar *P* values | 0.1221 | 0.5113 |
| Sun/shade treatment *P* values | 0.0003 | 0.0044 |
| Cultivar x Sun/shade treatment *P* values | 0.1066 | 0.1752 |

*Statistical analyses were performed using a linear mixed model with cultivar, sun/shade treatment and cultivar x sun/shade treatment as fixed variables.
**Disease ratings and area under the disease progress curve (AUDPC) were based on percentage foliage affected.

| Production condition | Powdery mildew* | |
|---|---|---|
| | Severity (%) (5 Oct) | AUDPC |
| Full sun | 12.3 c | 455.9 b |
| Full sun until 13 Jul, then placed under 48% shade | 31.3 a | 730.5 a |
| Full sun until 13 Aug, then placed under 48% shade | 13.2 c | 415.2 b |
| Shade, 48% | 24.5 b | 617.9 a |
| *P* value | 0.0003 | 0.0044 |

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

MAGNOLIA (*Magnolia* spp.)
Powdery mildew; *Phyllactinia corylea, Microsphaera alni*

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**Response of yellow flowering magnolia varieties to powdery mildew, 2015.**

Yellow flowering varieties of *Magnolia* spp. hybrids were planted on 17 Apr 2008 in a field plot with Waynesboro loam soil at the Otis L. Floyd Nursery Research Center in McMinnville, TN (USDA Hardiness Zone 7a). The experiment was established using a randomized complete block design with three replications. Plants were spaced with 15 ft in-row spacing and 12 ft between rows. The field was fertilized annually with nitrogen, phosphorus and potassium based on University of Tennessee soil test recommendations and maintained at a soil pH of 6.5. Grass alleys between rows were mowed routinely and vegetation in the row was controlled in a 4 ft strip with pre-and post-emergence herbicides. Severity of powdery mildew was determined on 14 Jul, 21 Aug and 15 Oct. Foliar disease severity was evaluated using a scale of 0-100% foliage affected. Average maximum temperatures for Apr, May, Jun, July, Aug, Sep and 1-15 Oct were 72.1, 81.5, 87.5, 88.0, 84.8, 81.6 and 73.7ºF; average minimum temperatures were 46.8, 57.6, 65.8, 69.5, 64.2, 59.4 and 51.7ºF; and total rainfall amounts were 1.80, 0.97, 2.11, 3.12, 1.52, 1.80 and 1.89-in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Powdery mildew appeared naturally and disease pressure was high in this trial. There were significant differences among varieties in severity of powdery mildew. Powdery mildew severity on 15 Oct was significantly lower in 'Sun Spire', 'Elizabeth', 'Banana Split' and 'Carlos' than in the other varieties. Season-long disease progress (AUDPC) was highest in the magnolia varieties 'Green Bee' and 'Stellar Acclaim'.

| | Powdery mildew* | |
|---|---|---|
| Variety | Severity (%) (15 Oct) | AUDPC* |
| Anilou | 50.0 c-f** | 3779 cd |
| Banana Split | 20.0 h | 1828 ef |
| Carlos | 20.0 h | 911 ef |
| Elizabeth | 16.7 h | 954 ef |
| Gold Cup | 46.7 c-g | 3748 cd |
| Gold Star | 66.7 abc | 7228 ab |
| Golden Pond | 30.0 e-h | 2109 def |
| Golden Rain | 58.3 bcd | 6186 ab |
| Golden Sun | 35.0 d-h | 2489 de |
| Goldfinch | 25.0 fgh | 1187 ef |
| Green Bee | 83.3 ab | 7701 a |
| Honey Liz | 80.0 ab | 6905 ab |
| Judy Zuk | 23.3 gh | 2448 de |
| Koban Dori | 70.0 abc | 5528 bc |
| Lois | 28.3 e-h | 1472 ef |
| Petit Chicon | 21.7 gh | 1290 ef |
| Stellar Acclaim | 85.0 a | 7638 a |
| Sun Ray | 21.7 gh | 1898 ef |
| Sun Spire | 13.3 h | 643 f |
| Sunburst | 61.7 abc | 7028 ab |
| Sunsation | 51.7 cde | 3851 cd |
| Yellow Bird | 71.7 abc | 5852 b |
| Yellow Lantern | 26.7 e-h | 1498 ef |
| *P* value | ≤0.0001 | ≤0.0001 |

*Powdery mildew disease severity and area under the disease progress curves (AUDPC) were based on percentage foliage affected.
**Values are the means of three replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$. Means were separated using Fisher's least significant difference test.

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

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