Boxwood blight is caused by two fungal species, *Calonectria pseudonaviculata* (syn. *Cylindrocladium pseudonaviculatum*, *C. buxicola*) and *C. henricotiae*. As of yet, only *C. pseudonaviculata* is known to be present in the United States (Gehesquière et al. 2016), where it was first identified on boxwood in nurseries and landscape plantings in North Carolina and Connecticut in 2011 (Ivors et al. 2012). Since that time boxwood blight has been confirmed in 22 additional states (Alabama, Delaware, Florida, Georgia, Illinois, Kansas, Kentucky, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, Washington and West Virginia) and the District of Columbia in the United States. *Buxus* spp. (boxwood), *Sarcococca* spp. (sweet box) (Henricot et al. 2008, Malapi-Wight et al. 2016) as well as *Pachysandra terminalis* (Japanese spurge) (LaMondia et al. 2012), *P. procumbens* (Allegheny spurge) (LaMondia and Li 2013) and *P. axillaris* (Windcliff Fragrant) (LaMondia 2017), have been reported as hosts to this pathogen (*P. procumbens* and *P. axillaris* by inoculation). Variations in boxwood blight disease susceptibility occur within *Buxus* (Table 1) and *Pachysandra* species and cultivars (Table 2).

The pathogen can infect all growth stages of boxwood plants and make plant production economically unacceptable. This fungus spreads rapidly over short distances and defoliates...
most of the plants in the *Buxaceae* family. Warm, humid, and shady conditions favor disease development. Infection is favored at 64-77°F.

The pathogen can spread a short distance via rain or irrigation water, wind, plant debris, contaminated tools and equipment (such as pruning tools), workers (contaminated boots and clothing), and animals (pets, insects, birds etc.). But, the main mechanism for long distance spread, however, is thought to be movement of contaminated plants and cuttings, including boxwood greenery used for holiday decorations (confirmed on boxwood greenery in Warren Co., TN in 2016). The pathogen may persist as mycelium in infected leaves left on the soil surface or on those buried in the soil for at least 5 years (Henricot et al. 2008). While conidia of *C. pseudonaviculata* can remain viable in soil for 3 weeks, microsclerotia were shown to survive for at least 40 weeks at optimal conditions (Dart et al. 2015). Extremes of heat and cold may kill the pathogen in plant debris but, at moderate temperatures, it may remain in soil for long periods (Shishkoff and Camp 2016). When the environmental conditions are favorable, microsclerotia produce new mycelium and new lesions can be observed within one week.

Initially, reddish-brown to brown concentric circular spots with tan to light brown centers are visible on infected leaves (Figure 1), and angular diamond-shaped dark brown to black lesions (Figure 2) can be found on stems from the base to the shoot tip. Later, whole leaves will turn brown and defoliation will begin from the lower branches and spread to the upper canopy (Figure 3 and 4). During favorable conditions, the fungus sporulates and produces white spore masses on the underside of the leaves and stem that are visible to the naked eye (Figure 6 and 7). The pathogen does not initially attack the roots; so large plants can survive by producing new leaves even while the plant is attacked by the pathogen. With repeated cycles of defoliations and die back under disease-conducive conditions, though, large plants and rooted cuttings in the nurseries may get destroyed.
Figure 1 and 2. Leaf spots of boxwood blight.

Figure 3 and 4. Leaf spots and defoliation caused by *Calonectria pseudonaviculata* on boxwood.
Figure 5. Black stem canker caused by *Calonectria pseudonaviculata* on boxwood.

Figure 6 and 7. Underside of infected boxwood leaf showing white-colored spore masses.
The black cankers or streaks develop on the green stems of the boxwood blight disease infected plants (Figure 5). This is the major symptom that can be used to differentiate this disease from other boxwood diseases such as Volutella blight (Figure 8) and Macrophoma leaf spot (Figure 9); boxwood pests such as boxwood leaf miner (Figure 10 and 11); or boxwood abiotic disorders such as winter injury or sunscald (Figure 12).

Figure 8. Volutella blight on boxwood.  
Figure 9. Macrophoma leaf spot on boxwood.  
Figure 10 and 11. Boxwood leaf miner damage.
Management Strategies

Scouting and early diagnosis of infected plants is critical for the avoidance of boxwood blight disease spread and the implementation of effective disease control strategies. If you would like to confirm that boxwood blight has infected your plants, you can submit a sample to your local university's plant diagnostic laboratory.

Since boxwood blight can be introduced via contaminated plants and cuttings, careful inspections need to be done prior to and also after the purchase of host plant material. Newly purchased plants should be isolated from existing boxwood, sweet box or spurge plantings or production areas in nurseries for at least one month. During this isolation period fungicide applications are not recommended since the fungicide treatments can suppress symptom development and mask proper diagnosis. In particular, moderately tolerant or tolerant cultivars need to be inspected carefully during this period since they may carry the pathogen without obvious symptoms. Using boxwood greenery for holiday decorations is not recommended in close proximity to landscape boxwood plantings or boxwood production areas. Homeowners who had holiday decorations using boxwood
should, dispose them in sealed double bags in a landfill; boxwood greenery should not be placed in a compost pile. Once infected plants are detected, they should be destroyed immediately to reduce the potential for spread of the disease. Along with the plants, leaf and stem debris should be removed from the landscape or nursery because the pathogen can survive for a long time (up to five years) in plant debris. Before leaf debris has been blown by wind, buried by erosion or begun to decompose, flaming the soil surfaces with a propane push flamer can significantly reduce levels of inocula of *C. pseudonaviculata* in the upper layer of soil.

Sanitation of tools, equipment, and hard surfaces is critical for boxwood blight management. Different types of disinfectants containing sodium hypochlorite, hydrogen dioxide, hydrogen peroxide + peroxycetic acid + octanic acid, phenolic compounds (O-benzyl-p-chlorophenol), and alcohol as active ingredients are helpful. To improve the effectiveness of disinfectants, surfaces need to be cleaned and free of soil and other organic matter before using disinfectants (Baysal-Gurel 2016). At least 5 minutes of contact time with the disinfectant is suggested for tools; 10 minutes is suggested for pots or other surfaces. If there is a field or landscape area where boxwood are suspected to be affected by boxwood blight, do not work in those areas when the plants are wet, and wear clean disposable booties and coveralls and dispose of the booties and coveralls before entering other boxwood areas. Do not go from areas of known infections to areas where infections have not been seen.

Proper irrigation can reduce disease spread as well. Drip irrigation is better than overhead irrigation, as it supplies water to the root system of the plant without the potential of spreading the disease through splashing.

Fungicides can be used to prevent this disease in conjunction with other management strategies previously mentioned. When there is a risk of boxwood blight occurring, repeated applications (at 7- or 14-day intervals) of fungicides may be necessary. A spray program that includes fungicides with different modes of action is ideal for fungicide resistance management (Table 3).
Table 1. Susceptibility of boxwood species and cultivars (as container grown plants or unrooted cuttings) to boxwood bight disease.

<table>
<thead>
<tr>
<th>Buxus species</th>
<th>Cultivar</th>
<th>Highly Susceptible</th>
<th>Susceptible</th>
<th>Moderately Susceptible</th>
<th>Moderately Tolerant</th>
<th>Tolerant</th>
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Table 2. Susceptibility of Pachysandra species and cultivars to boxwood blight disease (LaMondia 2017).

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<th>Pachysandra species</th>
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<th>Moderately Susceptible</th>
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</table>
Table 3. Active ingredients with effectiveness against boxwood blight in US trials.

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>FRAC Code</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azoxystrobin</td>
<td>11</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Benzovindiflupyr + azoxystrobin</td>
<td>7 +11</td>
<td>LaMondia 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Baudoin et al. 2015</td>
</tr>
<tr>
<td>Boscalid + pyraclostrobin</td>
<td>7 + 11</td>
<td>Baudoin et al. 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LaMondia 2015</td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>M5</td>
<td>Baudoin et al. 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LaMondia 2015</td>
</tr>
<tr>
<td>Cyprodinil + fludioxonil</td>
<td>9 + 12</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LaMondia 2015</td>
</tr>
<tr>
<td>Fludioxonil</td>
<td>12</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Fluoxastrobin + chlorothalonil</td>
<td>11 + M5</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Fluxapyroxad + pyraclostrobin</td>
<td>7 + 11</td>
<td>Maurer and LaMondia 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LaMondia and Maurer 2017</td>
</tr>
<tr>
<td>Mancozeb</td>
<td>M3</td>
<td>LaMondia 2014</td>
</tr>
<tr>
<td>Metconazole</td>
<td>3</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Myclobutanil</td>
<td>3</td>
<td>LaMondia 2015</td>
</tr>
<tr>
<td>Polyoxin D zinc salt</td>
<td>19</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Propiconazole</td>
<td>3</td>
<td>LaMondia 2015</td>
</tr>
<tr>
<td>Propiconazole + chlorothalonil</td>
<td>3 + M5</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Pyraclostrobin</td>
<td>11</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Tebuconazole</td>
<td>3</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Thiophanate-methyl</td>
<td>1</td>
<td>LaMondia 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Thiophanate-methyl + chlorothalonil</td>
<td>1 + M5</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Trifloxystrobin</td>
<td>11</td>
<td>Ivors et al. 2013</td>
</tr>
<tr>
<td>Trifloxystrobin + triadimefon</td>
<td>11 + 3</td>
<td>Palmer and Shishkoff 2014</td>
</tr>
</tbody>
</table>

Note: Before applying ANY disease management product, be sure to: 1) read the label to be sure that the product is allowed for the crop and the disease you intend to control; 2) read and understand the safety precautions and application restriction.

References


LaMondia, J. A. 2017. Pachysandra Species and cultivar susceptibility to the boxwood blight pathogen, Calonectria pseudonaviculata. Plant Health Progress. doi:10.1094/PHP-01-17-0005-RS.


For additional information, contact your local nursery specialist office at:

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http://www.tnstate.edu/extension

**Tennessee State University, Otis L. Floyd Nursery Research Center**  
472 Cadillac Lane McMinnville, TN 37110  
http://www.tnstate.edu/agriculture/nrc/

**Precautionary Statement**

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

**Disclaimer**

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication. Use of trade, brand, or active ingredient names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar and suitable composition, nor does it guarantee or warrant the standard of the product. The author(s) and Tennessee State University assume no liability resulting from the use of these recommendations.

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