

¹NC PEST ALERT

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This document serves to inform you about the pest; further information regarding management will be forthcoming as it is determined.

A new pest to the U.S. Ornamental Industry: The “box blight” pathogen *Cylindrocladium pseudonaviculatum* = *Cylindrocladium buxicola*

Common names of this disease: Box blight, *Cylindrocladium* box blight, blight disease of boxwood, boxwood leaf drop

This fungus was first discovered in the United Kingdom (UK) during the mid-1990’s causing a severe blight disease on boxwood (*Buxus* species). An outbreak of the disease occurred in the UK in 1998 and the pathogen is now considered widespread throughout most of Europe. The disease can seriously impact the appearance and aesthetics of boxwood because the entire foliage typically becomes blighted, making the plant unsalable. Young seedlings can be killed by the pathogen. The origin of this pathogen is unknown, but it is believed to have been introduced into the UK prior to being introduced into New Zealand, where it was first reported in 1998. Although some online sources indicate a source of origin, these claims have not been substantiated by scientific research.

This pathogen was recently discovered in a small region in North Carolina causing rapid and severe defoliation in container grown *Buxus* species. The identity of this fungus was confirmed by the National Mycologist at the USDA-APHIS Beltsville, MD laboratory through fungus morphology on October 24, 2011, and by DNA sequencing on October 26, 2011. This is a new U.S. record for this pathogen, as it has never been officially reported in the U.S. until now.

If this pest becomes established in boxwood production areas, it could be further dispersed naturally through water (in splashing rain, flood water, overhead

¹ (updated 11.22.2011)

irrigation, or in droplets carried by the wind), by animal vectors, on contaminated tools and equipment, or through movement of contaminated nursery stock.

Known distribution of the pathogen: Previous to this recent U.S. find, this fungus had been confirmed in Austria, Belgium, Croatia, Czech Republic, France, The Republic of Georgia, Germany, Ireland, Italy, the Netherlands, Slovenia, Spain, Switzerland, the United Kingdom, and New Zealand. This disease probably has spread throughout Europe via the movement of infected nursery stock. In Italy, infected plants were originally imported from Belgium as asymptomatic stem cuttings.

Pathogen name: *Cylindrocladium pseudonaviculatum* = *Cylindrocladium buxicola**

*Although most literature refers to this fungus as *Cylindrocladium buxicola*, which is the name given to this fungus in the UK where the disease was first observed, this pathogen was not formally reported in the literature until 2002. Crous et al. (2002) first published its identity as *Cylindrocladium pseudonaviculatum* after the fungus became established in New Zealand. Because Crous et al. were able to publish this report before the UK researchers, *Cylindrocladium pseudonaviculatum* is more technically correct. Nevertheless, this disease note will refer to the pathogen as *Cylindrocladium buxicola* because most of the published literature on the disease and methods of control refer to it as such.

Known hosts: The three main boxwood species grown as ornamentals in the U.S., *Buxus sempervirens*, *Buxus microphylla* (littleleaf boxwood), and *Buxus sinica* var. *insularis* (Korean boxwood), are known hosts for *C. buxicola*. *Buxus colchica* and *Buxus microphylla* var. *japonica* (Japanese boxwood) are also hosts. The full host range of this fungus is not currently known, but there appears to be no published evidence of resistance to this fungus in any of the commercial boxwood species available. Some varieties of boxwood are more susceptible than others, possibly due to physical features of the plant, such as cupped foliage that retains water easily. *Buxus sempervirens* ‘Suffruticosa’ (English boxwood) appears to be especially susceptible, although *Buxus sempervirens* (common or American boxwood) is also quite susceptible. Pathogenicity assays conducted in the laboratory determined that a *Sarcococca* species, another member in the family Buxaceae, is also susceptible to this fungus. However, this plant has never been found with infections under natural field conditions. It is unknown whether other members of Buxaceae, such as *Pachysandra*, are also susceptible.

Disease symptoms: Symptoms of box blight include dark or light brown spots on leaves, often in a circular pattern (Fig. 1), black streaks (cankers) on stems (Fig. 2), straw- to bronze-colored blighted foliage (Fig. 3), and defoliation. Blighting and defoliation can occur suddenly, with complete leaf loss in severe cases. Disease spreads rapidly throughout infected plants when conditions are warm and humid, and in shady areas. Unfortunately, most boxwood cuttings are initially rooted and propagated in humidity chambers or tents, and young boxwood liners are purposely grown under shady conditions. These production conditions are also conducive to the pathogen, therefore young boxwood are especially at risk to infection.

Leaf spots can grow together to cover the entire leaf surface. Infected stems can have multiple dark brown or black lesions (Fig. 2), either linear or diamond-shaped. The black streaks found on stems progress from the bottom of the plant up. New growth continues to develop on healthy stems, and often the root systems remain healthy and intact (Fig. 1).

Spores of the pathogen can sometimes be seen on the underside of the infected leaves. Under high humidity, white fuzzy masses comprised of large numbers of spores are sometimes visible to the naked eye or with a hand-lens on infected stem and leaf tissue (Fig. 1).

Disease biology: This pathogen has a disease cycle that can be completed in one week. Infection can occur very quickly in warm (64 to 77°F), humid conditions. High humidity levels or free water are needed in order for infection to occur. The fungus can penetrate the leaf through the cuticle or enter through leaf stomata. *C. buxicola* survives as mycelium on fallen leaves and can produce spores when environmental conditions become suitable. Reports in the UK have determined that the pathogen can survive at least 5 years by remaining on decomposing fallen leaves of *Buxus sempervirens*.

Often the stems of blighted boxwood will remain green under the outer bark until a secondary invader or opportunistic pathogen attacks this tissue, eventually killing the entire plant. *C. buxicola* is often associated with the secondary pathogen *Volutella buxi*, known to cause Volutella blight. *V. buxi* is associated with plant wounds, whereas *C. buxicola* does not need a wound to infect, but can penetrate directly through the cuticle. Both fungi can also occur independently.

Short distance dispersal can occur through water (splash dispersal), contaminated tools, and possibly birds and other animals carrying the sticky spores. Spores are

unlikely to travel long distances by wind. Human activities, such as pruning, may also spread the fungus.

Control of box blight: Methods for control have not been studied in detail for this specific fungus in the U.S. This document serves to inform you about the pest; further information regarding management will be forthcoming as it is determined. At this point, to limit spread and movement of the pathogen, all infected plants should be destroyed. Infected plants should be burned to ash or sealed in heavy, black plastic trash bags and taken to an approved landfill. DO NOT RECYCLE PLANTS OR MEDIA. Containers should be sanitized before reuse. Disease control recommendations have been refined in the UK where this pathogen has become established in both the nursery industry and landscape, and are discussed below.

Pruning of infected twigs and/or removal and destruction of fallen leaves and topsoil may help reduce the number of *C. buxicola* spores. Sanitation of pruning equipment is recommended to prevent spread of the disease. Controlling water and humidity may also be useful in controlling this fungus. Avoid overhead irrigation when possible by using drip irrigation instead. Thinning to open the canopy of large boxwood will allow air movement and keep humidity down, eliminating some conditions favorable to the development of the disease. Pruning to keep plants sheared or as topiaries, should be avoided, however, as this provides both an avenue for infection and keeps humidity high inside the canopy. Researchers in the UK recommend that alternative ornamentals outside of the *Buxus* family may be used in place of susceptible host plants in the landscape to prevent re-infection by the pathogen. Japanese holly (*Ilex crenata*) may serve as an alternative, especially in landscapes that receive more sun exposure.

In general, *Cylindrocladium* diseases are very difficult and costly to control with fungicides. Henricot et al. (2008) looked at the effect of 13 ornamental fungicides on *C. buxicola*. None killed the fungus, although some inhibited spore germination and mycelium growth. However, fludioxonil (trade name in the U.S. is 'Medallion') was not tested. Studies conducted on other ornamental hosts in the U.S. have shown that fludioxonil is one of the most effective chemistries against other *Cylindrocladium* species. Infected plants should be removed and destroyed immediately. Healthy looking plants may be protected by preventively applying fungicides on both sides of the leaves to prevent both germination and penetration of the fungus. Due to dense boxwood foliage, and its hydrophobic nature, it may be difficult to get good coverage within the plant canopy. Further information regarding management will be forthcoming as it is determined.

Easily confused pests and disorders: *C. buxicola* can co-occur with the pathogen *Volutella buxi* that causes Volutella blight. *V. buxi* produces pink to orange spore masses on infected tissues (Fig. 4); a microscope often helps distinguish infections by these fungi. Care must be taken to rule out the presence of *C. buxicola* when *Volutella* is observed, as both pathogens may be present in the tissue. Winter injury causes foliar symptoms similar to those caused by *Volutella buxi*, and *Volutella* infection often follows winter or frost injury. Volutella symptoms are most commonly observed in spring.

Symptoms of *Volutella* blight can be distinguished from box blight much easier during the early stages of infection. **1)** *Volutella* typically does not cause brown (often circular) leaf spots. **2)** *Volutella* typically blights one branch at a time (Fig. 4), whereas box blight often blights out the bottom foliage first and moves up the plant gradually, often making the plants look ‘top heavy’ since the only remaining foliage exists at branch tips (Fig. 1A).

Other pathogens that infect boxwood in the U.S. are *Macrophoma candolleri* (Macrophoma leaf spot), *Phytophthora nicotianae* (= *Phytophthora parasitica*), and nematodes. *Macrophoma candolleri* is considered a secondary invader and causes raised tiny black spots on the undersides of dying leaves. *Phytophthora nicotianae* can be found on all cultivars of *B. sempervirens* and causes wilting, dark brown discolored wood at the base of the stem or 2 to 3 inches above the soil line, root rot (darkened root tissues) and discoloring/dieback of the foliage (Fig. 5). Nematodes feed on root tissues and cause root lesions, reduced root growth, wilting, stunting and yellowing of the foliage.

All of these pathogens, as well as *Clonostachys buxi* (= *Paecilomyces buxi* = *Verticillium buxi*), may contribute to a disease complex called ‘boxwood decline’. This complex is poorly understood, but can lead to poor plant growth, small leaves, and defoliation or dieback. The root systems of these plants are often smaller than expected, and may be discolored or appear rotten. English boxwood are typically more affected by boxwood decline.

Got ‘box blight’? The North Carolina Department of Agriculture and Consumer Services’ Plant Industry Division (Plant Protection Section) is trying to determine if the box blight pathogen is limited in distribution or more prevalent than is generally believed. If you think you have box blight, contact either your local Cooperative Extension Agent or your NCDA nursery inspector to help collect samples for

submission to the Plant Disease and Insect Clinic (PDIC) on campus of NC State University. Digital photographs are also encouraged with sample submission (in JPG format). Contacts for the agencies mentioned above can be found at:

- Cooperative Extension Agent: <http://www.ces.ncsu.edu/index.php?page=countycenters>
- NCDA Nursery Inspector: <http://www.ncagr.gov/plantindustry/plant/nursery/fstaff.htm> or by calling the NCDA&CS Raleigh Office at 1-800-206-9333.

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Figure 1. Symptoms of box blight on *Buxus sempervirens*. **(A)** Lower foliage defoliated on container plants with intact root system; **(B)** Brown leaf spots caused by the fungus, often in a circular pattern, can coalesce and cover the entire leaf surface. Under high humidity, white fuzzy spore masses containing large numbers of spores on infected leaf **(C)** and stem tissue **(D)** are sometimes visible to the naked eye or with a hand-lens. Photo credits: Landis Lacey, Kelly Ivors, Mike Munster.



Figure 2. Infected stems can have multiple dark brown or black lesions (white arrows), either linear or diamond-shaped.



Figure 3. The beginning of 'box blight' foliar blighting in a block of American boxwood.

SYMPTOMS CAUSED BY OTHER COMMON DISEASES



Figure 4. (A) *Volutella buxi* causing dieback of individual branches on *Buxus sempervirens*; **(B)** *V. buxi* produces pink to orange spore masses on infected tissues that have been incubated in humid conditions. Photo credit: Kelly Ivors.



Figure 5. *Phytophthora nicotianae* causes root rot (loss of roots) and dieback of foliage. Photo credit: Dept. of Plant Pathology, NCSU.