

FEATURED NEWS

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DELIVERABLES

(Dec 01, 2024 to Feb 28, 2025)

Research

3 Refereed journal articles

Extension & Outreach

1 webinar program

13 Extension presentations

11 Samples diagnosed

24 Email/phone inquiries
answered

4,202 People reached with
articles/news

Education

2 Postdoctoral associates

1 Graduate student

1 Intern

Microbiome Studies Uncover Diverse Mycorrhizal Fungi in Boxwood Crops and Plantings by Xiaoping Li, Ping Kong and Chuan Hong, Virginia Tech, Virginia Beach, VA

What makes boxwood a low maintenance and resilient iconic landscape plant has long intrigued plant scientists. Hendrix (1992) and others have speculated about the role of mycorrhizal fungi in boxwood biology, but there has been little published research in this area. Here we present the discoveries of diverse mycorrhizal fungi from boxwood crops and plantings through two soil microbiome studies that corresponded to two major objectives proposed by Hendrix over thirty years ago: 1) to determine the species of mycorrhizal fungi that infect boxwood with regards to geography, and 2) to assess whether various boxwood species and cultivars have different effects on mycorrhizal communities.

In the first study, soil samples collected from English boxwood (*Buxus sempervirens* ‘Suffruticosa’) gardens in five U.S. states – California, Illinois, New York, South Carolina, and Virginia (Li *et al.*, 2022) were further analyzed by amplifying and sequencing a signature fungal DNA region. This analysis discovered twenty-two fungal genera with many mycorrhizal members. Fourteen of these twenty-two genera: *Amanita*, *Boletus*, *Cenococcum*, *Cortinarius*, *Hyaloscypha*, *Inocybe*, *Melanogaster*, *Piloderma*, *Russula*, *Scleroderma*, *Serendipita*, *Sistotrema*, *Tricholoma*, and *Xerocomus* were consistently seen in all garden samples. The other mycorrhizal genera were also seen in samples from more than one state, suggesting their presence is not limited to any specific state or garden location. Instead, their varying populations in different states, including those below the detection limit of this study, were more than likely due to local gardening practices and weather conditions.

The second study

was based upon soil samples taken 50% from a nursery in Oregon and 50% from another in Virginia. Four cultivars – *B. sempervirens* ‘Justin Brouwers’, ‘Dee Runk’, ‘Fastigiata’, and *B. microphylla* var. *japonica* ‘Green Beauty’, representing three different levels of susceptibility to boxwood blight (*Calonectria pseudovavilata*), were included in this study. All Oregon samples were collected by the BBIG Scientist Dr. Jerry Weiland and his associates at the USDA ARS Horticultural Crops Disease and Pest

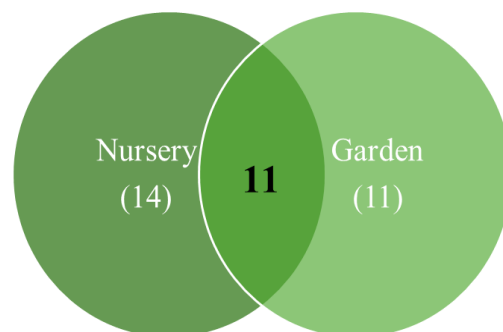


Figure 1 Thirty-six presumptive mycorrhizal genera were discovered from boxwood crops and plantings, with eleven shared between the two settings

Management Research Unit in Corvallis, Oregon. The Virginia samples were collected with on-site support from local boxwood growers. Soil sampling at both nurseries was performed in a coordinated fashion, and all

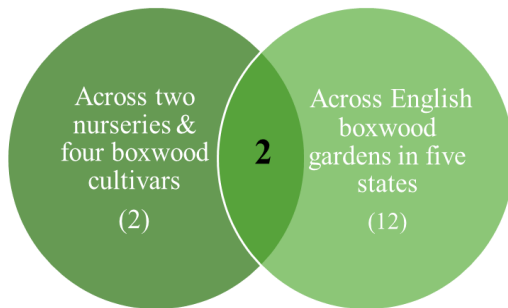


Figure 2 Four and fourteen mycorrhizal genera were consistently observed across four cultivars at two nurseries and across all English boxwood gardens in five states, respectively, with two shared between the two settings

samples were analyzed at Virginia Tech. This study found twenty-five fungal genera, with many mycorrhizal members. Four of the 25 genera: *Ceratobasidium*, *Hyaloscypha*, *Oidiodendron* and *Sistotrema* were consistently observed across all four cultivars at both nurseries. The other mycorrhizal genera were also seen in samples from at least two boxwood cultivars although not necessarily at both nurseries. None of the presumptive mycorrhizal genera found in this study was associated with only a single boxwood cultivar. Thus, the population variations of individual mycorrhizal genera seen in this study were more likely due to local climatic conditions and crop management practices than to cultivar influence.

Mycorrhizal fungi are known to benefit their hosts by extending the absorptive capacity of the root system, particularly for immobile nutrients such as phosphorus,

copper, and zinc, but also for water and nitrogen, promoting plant growth and stress adaptation. Mycorrhizal association is especially important for boxwood with a shallow root system. Overall, a total of thirty-six presumptive mycorrhizal genera were identified from the two studies with 11 shared between production nursery and garden settings (**Figure 1**). Each of these genera identified in our studies might include multiple mycorrhizal fungal species. This mycorrhizal diversity is huge compared to that identified from other crops (Hendrix, 1992). Thus, the mycorrhizal genera identified in our studies may have indeed contributed significantly to, or even have been solely responsible for, the low maintenance and resilience traits associated with this landscape staple. Further investigations are warranted to verify these presumptive mycorrhizal genera and species and their symbiosis with and benefits to boxwood crops and plantings, and to devise management practices that enhance their populations and plant benefits.

Among the other discoveries of the most interest from these studies were two genera that were consistently seen in all English boxwood gardens across five states and also in all four cultivars at both nurseries (**Figure 2**). These two genera – *Hyaloscypha* and *Sistotrema* – would be good targets for further investigations into the role of mycorrhizal fungi in boxwood biology and health.

1. Hendrix, J. W. (1992) Boxwood, holly and mycorrhizal fungi: a proposal. *The Boxwood Bulletin*, **32(1)**, 14-15.
2. Li, X. P., Kong, P., Daughtrey, M. L., Kosta, K., Schirmer, S., Howle, M., *et al.* (2022) Characterization of the soil bacterial community in selected boxwood gardens across the United States. *Microorganisms*, **10**, 1514. <https://doi.org/10.3390/microorganisms10081514>.

ADVISORY PANEL SPOTLIGHT

Interview of Laura Gladwin conducted by Claire Carter of Virginia Tech

“Happy plants simply make me happy,” says Laura Gladwin, the plant health manager at the Oregon location of Everde Growers, a large-scale nursery operation that boasts over 6,700 acres across 15 farms nationwide. With fifteen years of experience in the horticulture industry, Gladwin credits the beginning of her journey to the nursery she worked at in college and the horticulture class she was encouraged to take. Along the way, she worked as an annual & perennial buyer for many years, earned her master’s degree, dabbled in the semi-conductor industry, participated in international volunteer work, and presently serves on the BBIG Advisory Panel.

As a plant health manager, Gladwin’s day-to-day operations vary. Some days, she leads a team on chemical applications and irrigation



system maintenance, and on others, she creates plans of action for plants based on disease, pest, and nutritional assessments. Additionally, she works closely with section growers, plans seasonal programs, and leads projects within the many departments at her Everde Growers site.

Although her passion lies in plants, her favorite part of the industry is the people she works with, many of whom have decades of experience. “They have an astounding amount of knowledge; they’ve seen the industry through its many twists and turns... and they have a resiliency that I aspire to.” For those who are new to the industry, Gladwin advises them to branch out and try something outside of their specific area of interest. This will help expand their understanding of the interconnected nature of all aspects of horticulture. She also recommends attending events to ask questions and strike up conversations with experts and enthusiasts.

Gladwin’s interest in joining the Advisory Panel of the BBIG began when her predecessor introduced her to the group, though she was already familiar with the threat of boxwood blight. She says that her role as a plant health manager makes her involvement a “natural partnership” in the group, and she is impressed by the group’s commitment and the amount of practical and research-based information made available for growers. She’s rooting for her favorite boxwood cultivar, the classic dwarf English *Buxus sempervirens* ‘Suffruticosa’ despite its susceptible nature to the infamous fungal pathogen.

Even outside of her professional endeavors, Gladwin’s passion for plants is obvious; she has an outdoor pocket garden and an impressive collection of indoor houseplants and loves visiting public gardens and nurseries in her free time. When asked about her most important contribution to the horticulture industry, she simply states, “Still working on it. I’ll let you know when I retire.”

Note: Just as this newsletter was going to press, we learned that Laura would be leaving Everde and taking a new job in the landscape industry. We wish her well in her new job!

FEATURED RESEARCH

Development of a system to evaluate the effects of UV-C radiation on boxwood blight pathogen, *Calonectria* spp. by Filiz Gurel and Fred Gouker, USDA ARS Floral and Nursery Plants Research, Beltsville, MD

UV-C has long been used in various sectors for disinfection and microbial control, but its application in plant protection is relatively new. In this study, effectiveness of UV-C was investigated as an alternative non-chemical, sanitation approach to mitigate boxwood blight disease. Three sets of experiments were performed to evaluate the UV-C impact on 1) fungal growth of *Cps* and *Che* strains in Petri plates, 2) boxwood blight on detached leaves and also 3) phytotoxic damage on susceptible and tolerant boxwood cultivars. A UV-C light meter with a data logger was used to capture 20 different measurements over the course of various selectable time intervals in a trial conducted in a controlled environmental growth chamber.

The first set of experiments was to assess suppression of fungal growth of pure cultures using inoculum spread on potato dextrose agar (PDA) plates either grown under a 12-hour photoperiod or with a dark incubation period. It was observed that inhibition of mycelial growth was similar among photoperiod and dark applications, which were more observable on the 7th day after treatment, especially compared with untreated controls. UV-C treatment beyond the maximum dosage of 1,000 J/m² was also tested to see if there was greater suppression of fungal growth and it was observed there were significant differences between untreated controls and different dosages of UV-C with greater suppression of fungal growth seen with dosages beyond 942 J/m² (**Figure 3a**) as well as significant suppression of growth of cultures incubated for 4 or 24 hours in the dark after treatment.

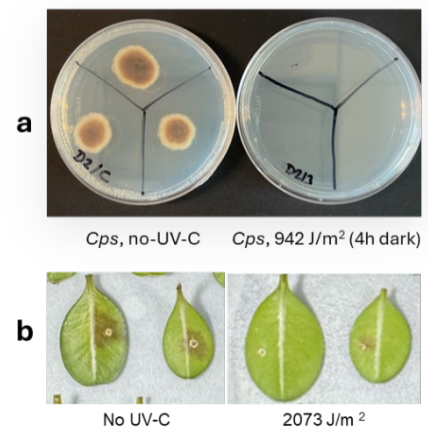


Figure 3 Effect of UV-C irradiation on mycelial growth of *Cps* strain, NCBB-1 (a) and boxwood blight symptoms on non-treated and UV-C treated leaves of *B. koreana* ‘Wintergreen’ inoculated with *Cps* conidia

Using the same UV-C dosages from the culture plates of *Cps*, a detached leaf assay performed with two cultivars indicated that higher dosages than 1,600 J/m² suppressed both incidence and severity of boxwood blight (**Figure 3b**).

Phytotoxic effects were tested using UV-C light on host plant detached leaves and it was observed that there were no noticeable differences in high-dose UV-C treatments indicating the irradiation had minimal or no effects on leaves.

Another key highlight from this study was that there was less suppression of fungal growth for *Che* than for *Cps* using the same treatments, indicating that there may be biological differences between species of boxwood blight and that stronger dosages of UV-C may be needed to inhibit growth in *Che* strains.

EXTENSION HIGHLIGHTS

Extension of Research Developments and Virtual Outreach By Margery Daughtrey, Cornell University, Riverhead, NY

The highlight of the extension of our project's research findings this winter was the BBIG Webinar presented by Dr. Nina Shishkoff on February 6, 2025. "Cleaning up boxwood blight with a full spectrum of sanitizers" was her topic. She covered the effects of disinfectants, heat, and composting on the boxwood blight pathogens *Calonectria pseudonaviculata* and *C. henricotiae*. Nina is able to work with *Calonectria henricotiae*, currently with a geographic range limited to certain European countries, because she is stationed with the Foreign Disease Weed Science Research Unit of USDA's Agricultural Research Service in Fort Detrick, Maryland. She has been a research plant pathologist and now project leader for USDA at Fort Detrick since 2003, studying diseases caused by invasive exotic pathogens, such as Sudden Oak Death, Boxwood Blight and Impatiens Downy Mildew, with access to containment facilities that allow a high level of biosecurity. The webinar is posted at boxwoodhealth.org with the other tHRIve webinars on boxwood blight produced in collaboration with the Horticultural Research Institute. Several extension presentations, including boxwood blight information, were also made to arborists, landscape gardeners, nursery growers and Master Gardeners during the winter months.

PROJECT MEETING BRIEF

The BBIG Leadership Team met with Advisory Panel (AP) members on December 6, 2024, reporting the project progress and seeking their feedback. Dr. Charlie Hall of Texas A&M University was the invited speaker and he presented "Grower-level costs of boxwood blight mitigation". Other topics of importance included: 1) fungicide drench for boxwood blight mitigation in the landscape settings, 2) hunting *Calonectria henricotiae*-a newer and potentially more devastating blight pathogen-in southern Europe, 3) BBIG Boxwood Seminars, 4) development of a new Spanish tab for the BBIG Knowledge Center to support Spanish-speaking workforce in the horticulture industry.

The project Leadership Team held three monthly meetings on December 11, 2024, January 16 and February 12, 2025. Among the most important planning topics were 1) a project-wide annual meeting, and 2) a BBIG focus issue of PhytoFrontiers – Reclaiming Boxwood from the Blight. The annual meeting will be held at the U.S. National Arboretum from May 14 to 15, 2025, celebrating what has been accomplished together over the past 5 years and charting strategies forward. The focus issue is to highlight the latest research and innovations as well as their economics and impacts, and this is done in collaboration with the American Phytopathological Society.

The Spanish tab development Team headed by Luisa Santamaria of Oregon State University and Margery Daughtrey of Cornell University met again on Feb 26, 2025, reviewing progress and discussing the educational materials that Luisa has developed to date. Also joining this meeting were two Advisory Panel members – Jennifer Gray of Horticultural Research Institute and Casey Sclar of Pennsylvania State University, as well as Nina Shishkoff of USDA ARS Foreign Disease and Weed Science Research and Chuan Hong of Virginia Tech.

ANNOUNCEMENT



As a USDA-ARS Research Geneticist for the US National Arboretum, **Dr. Lara Brindisi** is dedicated to improving disease resistance and stress tolerance in landscape plants to ensure healthier, more resilient plants for growers, gardens, and the public. She earned her PhD in Plant Biology from Rutgers University, where she explored the genetics and phytochemistry of medicinal herbs and vegetables, namely for cold tolerance in sweet basil. Subsequently, she worked as a USDA-ARS Postdoctoral Research Associate at Cornell University, where she mined wild maize relatives for genes to enhance nitrogen cycling in modern agriculture. Now, she aims to apply her expertise in traditional

breeding, stress tolerance, and gene discovery to enhance the resilience and ornamental value of woody trees and shrubs, including developing novel boxwood cultivars with blight resistance.

PUBLICATIONS

Refereed Journal Articles

1. Ghimire, B., Parajuli, M., Simmons, T., Liyanapathirana, P., and Baysal-Gurel, F. 2025. Evaluation of fungicides, host-plant defense inducer, and anti-transpirant in management of boxwood blight. HortTechnology 35:101-115. Available online at <https://doi.org/10.21273/HORTTECH05541-24>.
2. Hall, C. 2024. Costs Associated With Mitigating Boxwood Blight During Nursery Production in the U.S. Journal of Environmental Horticulture 42(2): 165-172 (Open access at <https://doi.org/10.24266/0738-2898-42.4.165>).
3. Li, X., and Hong, C. 2025. Evaluation of Biochar Liquid Extract for Control of Boxwood Blight. Available online at <https://doi.org/10.1094/PHP-12-24-0143-PDMR>.

RECENT PRESENTATIONS

Professional Conference Presentations, Seminars and Webinars

1. Shishkoff, N. 2025. Cleaning up boxwood blight with a full spectrum of sanitizers. BBIG Boxwood Seminar/THRive series of Horticultural Research Institute, February 6.

Extension/Outreach Programs and Presentations

1. Daughtrey, M. 2025. Beware of bad things that happen to good plants: boxwood, bloomers & trees! Professional Certified Applicators of Long Island Conference, Hauppauge, NY, January 16.
2. Snover-Clift, K. 2025. Basic Plant Pathology for Master Gardeners, New Master Gardener Training for Oneida & Madison counties, Ithaca, NY, January 18.
3. Santamaria, L. 2025. Boxwood blight – update on management & breeding of resistant cultivars. British Columbia Landscape & Nursery Association - Webinar. January 22.
4. Daughtrey, M. 2025. Baffling tree and shrub maladies. New York State Arborists Association. Monticello, NY, January 26.
5. Daughtrey, M. 2025. Potential and persistent plant plagues. New York State Nursery and Landscape Association. Webinar. January 29.
6. Daughtrey, M. 2025. Problems for the nursery industry that cause streaking and wilting. Long Island Nursery and Landscape Association Annual Meeting, Bayard Cutting Arboretum, Great River, NY, January 30.
7. Daughtrey, M. Understanding plant diseases. Certified Nursery and Landscape Professionals Training Program, New York State Nursery and Landscape Association, Riverhead, NY. February 2.
8. Snover-Clift, K. 2025. Basic Plant Pathology for Master Gardeners, New Master Gardener Training for Saratoga, Fulton & Warren counties, Ithaca, NY, February 03.

9. Daughtrey, M. 2025. Can we preserve boxwood in our landscapes? Communities in Bloom Spring Gardening Class. Cornell Cooperative Extension of Erie County. February 22.
10. Snover-Clift, K. 2025. Identification of Key Pathogens and Plant Disease Diagnostic Clinic Sample Submission Tips, Master Gardener Workshop for Broome, Chemung, Schuyler, Tioga, & Tompkins counties, Ithaca, NY, February 22.
11. Snover-Clift, K. and Sandra Jensen. 2025. Develop Your Diagnostic Skills (DYDS); a webinar series aimed at providing the tools needed to identify the cause of plant problems-Module 6- BOLOs-Be On the Look Out for these Significant Pathogens, Ithaca, NY, February 25.
12. Daughtrey, M. 2025. Scouting skills for crabapple, maple, and boxwood. Branching Out Webinar, Cornell Cooperative Extension. February 27.
13. Snover-Clift, K. 2025. Greenhouse Update-Best Methods for Diagnosing Plant Problems and Most Significant and Commonly Found Plant Pathogens in Greenhouse and Nursery Settings, Cornell University-Pesticide Applicator Training, Ithaca, NY, February 27.

PROJECT DIRECTORS

Chuan Hong (Project Leader), Virginia Tech, Virginia Beach, VA
 Margery Daughtrey (Extension Leader), Cornell University, Riverhead, NY
 Douglas Luster (Research Leader), USDA, ARS, Foreign Disease & Weed Science Research, Ft. Detrick, MD
 Charles Hall, Texas A&M University, College Station, TX
 Jerry Weiland, USDA, ARS, Horticultural Crops Disease and Pest Management Unit, Corvallis, OR
 Fulya Baysal-Gurel, Tennessee State University, McMinnville, TN
 Fred Gouker, USDA, ARS, Floral & Nursery Plants Research, Beltsville, MD
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 Nina Shishkoff, USDA, ARS, Foreign Disease & Weed Science Research, Ft. Detrick, MD
 Karen Snover-Clift, Cornell University, Ithaca, NY

ADVISORY PANEL & LIAISON TO AMERICANHORT

Jill Calabro (Chair), Sr Product Development Manager, Valent USA Corporation, Walnut Creek, CA
 Lynn Batdorf, Boxwood Cultivar Registration Authority, International Society for Horticultural Science
 Frank Collier, Owner, Pleasant Cove Nursery, Rock Island, TN
 Michael Gaines, President, CW Arborists, Ltd., Sagaponack, NY
 Laura Gladwin, Plant Health Manager, Everde Growers, Forest Grove, OR
 John Keller, Planning & Research Vice President, Monrovia – Grow Beautifully in CA, CT, GA, OR
 Bennett Saunders, General Manager, Saunders Genetics, LLC., Piney River, VA
 Richard Schnall, Vice President, Rosedale Nurseries, Inc., Hawthorne, NY
 Casey Sclar, H.O. Smith Endowed Director, The Arboretum at Penn State, State College, PA
 Mark Sellew, Owner, Prides Corner Farms, Lebanon, CT
 Jennifer Gray (Liaison to AmericanHort), Administrator, Horticultural Research Institute, Washington, DC

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