Boxwood Blight, Downy Mildews, and Other Diseases of 2013


Sharon M. Douglas
The Connecticut Agricultural Experiment Station
New Haven, CT

www.ct.gov/caes

BOXWOOD BLIGHT UPDATE

- Causal Agent: *Calonectria pseudonaviculata* (syn. *Cylindrocladium pseudonaviculatum*) (fungus)
- Hosts:
  - All *Buxus* species
  - Other Buxaceae including *Sarcococca, Pachysandra terminalis, and P. procumbens*

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Symptoms



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Blighted appearance from leaf and stem symptoms

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Excessive leaf debris in pots

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Apparently healthy root system

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Boxwood Blight – July 2013

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Infected pachysandra with foliar lesions

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CAES Research- Efficacy of Sanitizing Agents (Douglas)

- Concerns about contaminated tools or equipment as a way to initiate new infections within and between nurseries, garden centers, or landscapes
- Current BMPs suggest using sanitizers to decontaminate equipment and tools that have come in contact with *Cps*
  - Studies have not been conducted that specifically target sanitizer efficacy for *Cps*

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Efficacy of Sanitizing Agents

- Sanitizing Agents:
  - Bleach (and bleach + Tween and bleach + detergent)
  - Hydrogen peroxide and peroxyacetic acid (Sanidate)
  - Hydrogen dioxide (ZeroTol, Oxidate)
  - Hydrogen peroxide, peroxyacetic acid, and octanoic acid (X-3)
  - Alcohol (isopropanol and ethanol)
  - Phenol, ethanol, and isopropanol (Lysol)
  - Quarternary ammonium compounds (GreenShield, KleenGrow)
- Concentrations of Sanitizing Agents:
  - 1:10, 1:100, 1:1,00, and 1:10,000
- Pathogen (CT isolates):
  - *Cps* CT-S1 from infected boxwood
  - *Cps* CT-P1 from naturally infected pachysandra

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Efficacy of Sanitizing Agents on Fungal (Mycelial) Growth

- Fungal cultures are exposed to log concentrations of sanitizing agents using two methods
  - Method 1- plates amended with sanitizer
  - Method 2- plates flooded with sanitizer for different contact times (5, 15, 30, and 60 minutes)
- Growth measured on ½PDA at 2, 7, 14, and 21 days

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Mycelial Growth-Method 1 (Amended Plates)

Product	1:10	1:100	1:1,000	1:10,000
Sanidate	–	+	+	+
ZeroTol	–	+	+	+
Oxidate	–	+	+	+
X3	–	+	+	+
Lysol	–	+	+	+
GreenShield	+	+	+	+
KleenGrow	+	+	+	+
Bleach	+	+	+	+
Ethanol	+	+	+	+
Isopropanol	+	+	+	+
Water Control	+	+	+	+

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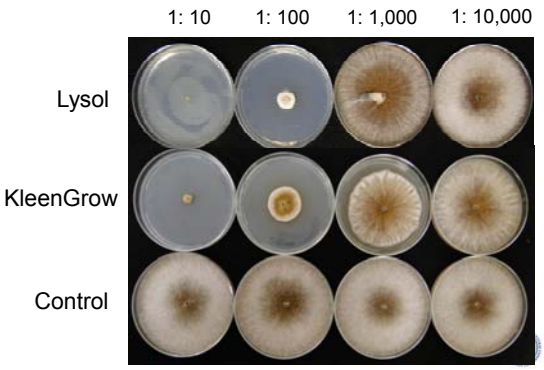
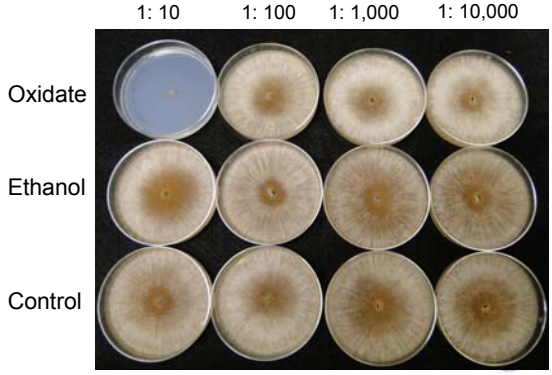
Method 1-Amended Plates



Method 1-Amended Plates



Mycelial Growth-Method 2 (Flooded Plates)

(All contact times: 5, 15, 30, and 60 minutes)

Product	1:10	1:100	1:1,000	1:10,000
Sanidate	–	–	+	+
ZeroTol	–	–	+	+
Oxidate	–	–	+	+
X3	–	–	+	+
Lysol	–	–	+	+
GreenShield	–	–	+	+
KleenGrow	–	+	+	+
Bleach	–	+	+	+
Ethanol	+	+	+	+
Isopropanol	+	+	+	+
Water Control	+	+	+	+

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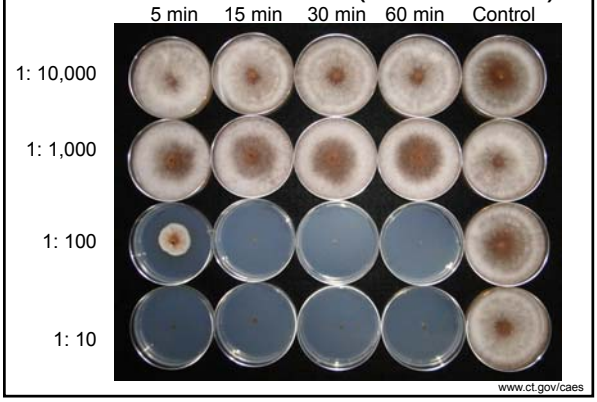
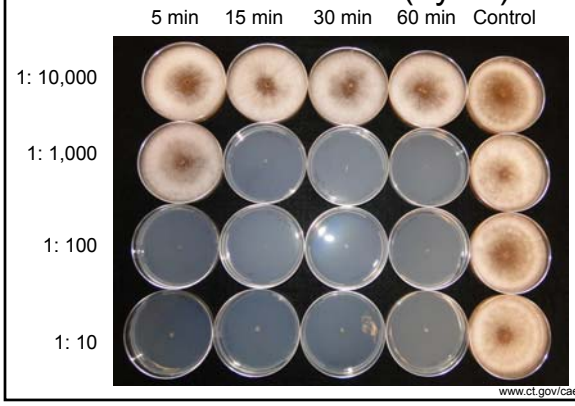
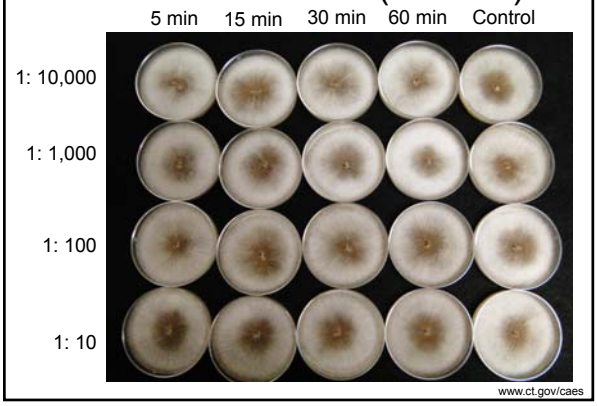
Method 2- Flooded (KleenGrow)



Method 2- Flooded (Lysol)



Method 2-Flooded (Ethanol)



Mycelial Growth-Amended Plates (Method 1)

▨ = Growth

Product	1:10	1:100	1:1,000 1:10,000
Sanidate		▨	▨
ZeroTol		▨	▨
Oxidate		▨	▨
X3		▨	▨
Lysol		▨	▨
GreenShield	▨	▨	▨
KleenGrow	▨	▨	▨
Bleach	▨	▨	▨
Ethanol	▨	▨	▨
Isopropanol	▨	▨	▨
Water Control	▨	▨	▨

Mycelial Growth-Flooded Plates (Method 2)

▨ = Growth (All contact times: 5, 15, 30, and 60 minutes)

Product	1:10	1:100	1:1,000 1:10,000
Sanidate			▨
ZeroTol			▨
Oxidate			▨
X3			▨
Lysol			▨
GreenShield			▨
KleenGrow		▨	▨
Bleach		▨	▨
Ethanol	▨	▨	▨
Isopropanol	▨	▨	▨
Water Control	▨	▨	▨

Management Strategies

- Start with pathogen-free material by purchasing from reputable suppliers, nurseries, or garden centers
  - Carefully inspect plants for symptoms at time of purchase or at planting

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Management Strategies (cont'd)

- In nurseries, garden centers, wholesalers, or landscapes *with existing boxwood*:
  - Isolate newly purchased plants for at least 4 weeks
  - Avoid co-mingling of plants from different vendors
- Check new plants regularly for symptoms
- To date, all properties diagnosed with boxwood blight installed new plants in 2011 or 2012 (2013?)

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Management Strategies (cont'd)

- Keep accurate, detailed records of:
  - Plants received and source
  - Location in landscape
  - Mortality and cause
  - All fungicide applications

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Management Strategies (cont'd)

- Space plants to maximize air circulation and minimize conditions favorable for disease development, when possible
- Avoid overhead watering or working with plants when they are wet
  - Water is important for the spread and development of boxwood blight

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Management Strategies (cont'd)

- Sanitation-
  - Critical for eliminating/reducing inoculum, since the fungus can survive in plant debris for up to five years
    - Rake, vacuum, or remove leaf debris
    - Work in areas where infected plants were located last and after completing work with healthy plants
    - Sanitize all equipment between plantings and properties (e.g., ZeroTol, Sanidate, X3, Lysol)
    - Sanitize shoes and clothing (e.g., Lysol solution or spray)

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Management Strategies (cont'd)

- Scout and inspect all boxwood and pachysandra plantings weekly
  - As soon as you observe suspicious symptoms on either host, bring samples to a specialist (plant pathologist) for examination and diagnosis
  - *CAES Plant Disease Information Office*
    - Web: www.ct.gov/caes/pdio
  - *UCONN Home & Garden Center*
    - Web: www.ladybug.uconn.edu/

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Management Strategies (cont'd)

- Regulatory actions in CT are under the statutory authority of The Connecticut Agricultural Experiment Station (CAES)
  - Sec. 22-84 and Sec 22-98 of the Connecticut General Statutes
- Official diagnosis of disease must be confirmed by CAES plant pathologists
- When a positive confirmation is made, CAES plant inspectors will immediately be notified

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Management Strategies (cont'd)

- Once boxwood blight is confirmed, immediately pull and remove whole plants and place them in plastic bags to avoid carrying infected material through the landscape
  - Follow guidelines for removal of adjacent plants
- Infected plant material should NOT be composted

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Management Strategies (cont'd)

- Once boxwood blight has been detected on either boxwood or pachysandra in a landscape, very difficult to effectively manage the disease and keep both hosts
  - Consider removal of one or the other host
  - Infected pachysandra will not be killed, but will serve as a continual source of the fungus
- Refer to "*Guidelines for reporting and managing boxwood blight in Connecticut Landscapes. Version 2.0"* for more information

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Management Strategies (cont'd)

- Fungicides-Professional
  - *NOT CURATIVE*
  - **Only effective as protectants**
  - Boxwood:
    - Pyraclostrobin (Insignia), chlorothalonil (Daconil), fludioxonil (Medallion), kresoxim-methyl (Cygnus), mancozeb (Protect), propiconazole (Procon Z), and thiophanate methyl (3336)
  - Pachysandra:
    - [Boscalid]+ pyraclostrobin (Pageant), chlorothalonil (Daconil), fludioxonil (Medallion), mancozeb (Protect), and thiophanate methyl (3336)

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Management Strategies (cont'd)

- Fungicides-Homeowner
  - *NOT CURATIVE*
  - **Only effective as protectants**
  - For homeowner use on boxwood and pachysandra:
    - Chlorothalonil
    - Mancozeb

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Additional Information

- CAES Boxwood Blight Page
  - CT BMPs, Guidelines, and Fact Sheets (some available in Spanish)
  - www.ct.gov/caes
- ANLA Knowledge Center
  - www.boxwoodblight.org/

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DOWNY MILDEW DISEASES

- Becoming an increasing problem in the horticultural industry, but are not new to the U.S.
- Have resulted in serious losses in many floricultural and greenhouse crops
- Early detection usually difficult

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DOWNY MILDEW DISEASES

- Causal Agents: *Peronspora, Plasmopora, Pseudoperonospora* (fungus-like organisms, water molds)
- Highly specialized pathogens that are generally host specific

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Common Hosts of Downy Mildew:

- Bacopa
- Pansy
- Lisianthus
- Salvia
- Gazania
- Scabiosa
- Coreopsis
- Alyssum
- Gaillardia
- Aster
- Lamium
- Veronica
- Dusty miller
- Coreopsis
- **Impatiens**
- Snapdragon
- Coleus
- Rose
- Buddleia

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DEVELOPMENT OF DOWNY MILDEW:

- Moderately cool temperatures, high humidity, and moisture are favorable for disease
- Spores are readily spread by circulating air or in air currents
- Spores also spread by splashed or wind-driven rain or irrigation water

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SYMPTOMS OF DOWNY MILDEW:

- Symptoms first appear as pale-yellow or green areas on the upper leaf surface
- Often misdiagnosed
- Diagnostic symptoms gradually develop on the **undersurface of the leaf** as the pathogen grows out of the infected leaf
  - Appears as a fuzzy, tan-gray-purple-brown mass
- Symptoms often go unnoticed until leaves brown, shrivel, and drop

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Impatiens Downy Mildew

- Causal Agent: *Plasmopara obducens* (fungus-like organism, water mold, oomycete)
- Present in the U.S. since late 1800's, but not considered a problem
- Sporadic reports in U.S. from 2004-2011
- Widespread problem in U.S. in 2012

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Impatiens Downy Mildew

- Hosts:
  - *Impatiens walleriana (*seed and vegetative standard garden impatiens, including double and mini-impatiens) and *I. walleriana* interspecific hybrids
  - *I. balsamina* (balsam impatiens, garden balsam, or rose balsam)
  - *I. pallida* and *I. capensis* (native wild impatiens known as jewelweeds)
  - Other species of impatiens?
- *New Guinea impatiens (I. hawkeri) appear highly tolerant*

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Early Symptoms

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Early symptoms—off-colored leaves and curling

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Stunting

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Twisting and stunting

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Defoliation of landscape planting

Photo courtesy of M. Daughtrey

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Coleus Downy Mildew

- Causal Agent: *Peronospora* sp. (fungus-like organism)
- Hosts: coleus (seed and vegetative), perilla and agastache (possibly more)
- First reported in U.S. in 2005; sporadic reports since 2006

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Coleus Downy Mildew- Twisting

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Coleus Downy Mildew- Twisting and Distortion

Photo courtesy of M. Daughtrey

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Coleus DM-severe defoliation

Photo courtesy of Brian Eshenaur

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Downy Mildew of Potentilla


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Downy Mildew of Rudbeckia



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Downy Mildew of Salvia


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Downy Mildew of Argyranthemum


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Downy Mildew of Rose


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Downy Mildew Management

- Cultural Methods-
  - Purchase from reputable, trusted source
  - Prior to planting and at end of every season, remove as much debris as possible (roots, stems, leaves)
  - Examine plants prior to/during planting (undersides of leaves)
  - Manage water- using drip irrigation or overhead irrigation in early morning
  - Interplant with other bedding plants (not coleus or impatiens)

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Downy Mildew Management (cont'd)

- Scout-
  - Check plantings regularly for symptoms of yellowing foliage or stunting
  - Most important in spring and fall
  - Carefully examine undersurfaces of leaves for sporulation
  - IF DOWNY MILDEW is detected, follow good sanitation
  - Keep records of outbreaks for future plantings

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Downy Mildew Management (cont'd)

- Sanitation-
  - Remove entire plants (including roots and leaf debris) before plants collapse
  - Bag and dispose
  - Do not compost

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Downy Mildew Management (cont'd)

- Alternative Bedding Plants for **Impatiens**-
  - Begonia
  - Dipladenia
  - Euphorbia
  - Geranium
  - Ipomoea
  - Lobelia
  - New Guinea Impatiens
  - Nicotiana
  - Petunia
  - Salvia
  - Torenia
  - Vinca
  - And many more....

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Downy Mildew Management (cont'd)

- Fungicide Program-
  - NOT suggested for most host plants in the landscape
  - FOR IMPATIENS: Check with supplier to find out their treatment program
    - If they used a systemic fungicide for downy mildew just before shipping, may help protect plants during the first few weeks after planting
  - Spring and fall are the most important times to scout and protect plants

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Downy Mildew Management (cont'd)

- Fungicide Program (cont'd)-
  - Offer short-term protection—need to be reapplied throughout the season (often every 7 days)
  - Fungicide resistance is a concern for downy mildew diseases, so rotate fungicides (FRAC group)

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Downy Mildew Management (cont'd)

- Fungicide Program (cont'd)-
  - Professionals can incorporate mefanoxam (Subdue GR) into soil prior to planting
  - Use contact and systemic fungicides
  - Foliar sprays or soil drenches of mefanoxam (Subdue Maxx); foliar sprays of azoxystrobin (Heritage) or potassium phosphite (Alude, Fosphite, Vital)

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FOLIAGE DISEASES

- Leaf Spots
- Needle Diseases

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LEAF SPOTS

- Causal Agents: wide range of fungi, bacteria, and nematodes
- Primary symptom-spots on foliage—the size, color, and shape depend on host and pathogen
- Generally host-specific
- Usually considered aesthetic rather than life-threatening diseases
- Most require water for infection and spread—usually more serious in wet weather or with overhead irrigation

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Septoria Leaf Spot of Phlox

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Septoria Leaf Spot of Rudbeckia

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Septoria Leaf Spot of Pagoda Dogwood

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Septoria Leaf Spot of Sugar Maple

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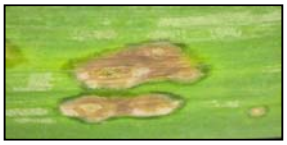
Leaf Spot of Iris



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Foliar Nematode Damage

Lupine

Hosta

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Bacterial Leaf Spot of Columbine

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Bacterial Leaf Spot of Ivy

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Black Spot of Rose

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Leaf Spot of Mountain Laurel

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Leaf Spot of Rhododendron

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NEEDLE DISEASES

- Loss of aesthetic value (similar to leaf spots)
- Impact survival and vigor
  - Conifers rely on several years of needles for their photosynthetic needs
  - Partial defoliation for several years can weaken and disfigure trees
  - Complete defoliation can be fatal

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NEEDLE DISEASES (cont'd)

- Usually not severe enough to warrant fungicide protection every year
- Conifers under stress from cultural, site, or other environmental factors are usually more susceptible

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RHABDOCLINE NEEDLECAST

- Causal Agent: *Rhabdocline* spp. (fungus)
- Hosts: Douglas-fir

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Early Rhabdocline Symptoms: Chlorotic Spots in Late Summer

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Look-Alike: Cooley Adelgid Feeding Damage

Needle bending and discoloration (yellow spots)

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Spring symptoms- diagnostic brown bands on needles

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Diagnostic symptoms-lower epidermis splits longitudinally

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Rhabdocline Needlecast

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Bare twigs after needles drop in spring

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SWISS NEEDLECAST

- Causal Agent: *Phaeocryptopus gaumanni* (fungus)
- Hosts: Douglas-fir

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Yellowing and lion's tail in spring

D. Shaw, Oregon State University

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Needle Symptoms

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Swiss needlecast fruiting bodies in green, "healthy" needles

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Swiss Needlecast Fruiting Bodies

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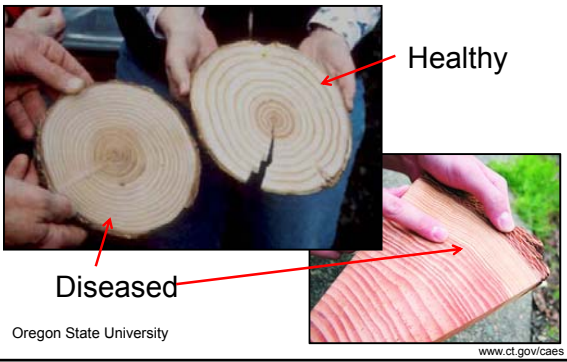
Reduced growth associated with Swiss needlecast



Oregon State University

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RHIZOSPHAERA NEEDLECAST

- Causal Agent: *Rhizosphaera kalkhoffii* and *Rhizosphaera* spp. (fungi)
- Hosts: Spruce (Colorado, occasionally white spruce); other hosts include pine, Douglas-fir, balsam and true firs

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Symptoms on 1-year spruce needles in late winter

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Discolored 1-year needles

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Fruiting bodies on infected needles

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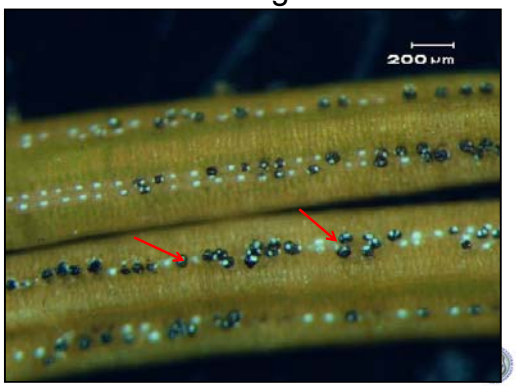
Black fruiting bodies



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Rhizosphaera Needlecast

Fungus usually attacks needles on the lower branches first

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AUTOECIOUS (REPEATING) SPRUCE NEEDLE RUST:

- Causal Agent: *Chrysomyxa weirii* (fungus)
- Hosts: Spruce, especially Colorado spruce (occasionally white spruce)

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Early symptoms of infection appear as chlorotic spots in winter or early spring

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Pustules break open on 1 yr needles

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MANAGEMENT OF FOLIAGE DISEASES:

- Maintain vigor by following sound cultural practices
- Rake and remove symptomatic foliage and plant debris in autumn
- Prune dead or dying branches or twigs in spring
- Work with healthy plants first
- Select resistant species/varieties when possible

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MANAGEMENT OF FOLIAR DISEASES (cont'd):

- Avoid overhead irrigation or water early in day
- Provide adequate plant spacing to allow good air circulation
- Usually not severe enough to warrant yearly fungicide protection

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MANAGEMENT OF FOLIAR DISEASES (cont'd):

- Fungicides can be effective, but are generally used as protectants
- Efficacy depends on host and pathogen:
  - Chlorothalonil, copper, mancozeb, sulfur, potassium bicarbonate, soaps, oils….

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APPS

- Smart phone apps for horticulture

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Purdue Annual Doctor, Purdue Perennial Doctor, Purdue Tree Doctor

- Developed by Purdue University specialists *Cliff Sadof*, entomologist, and *Janna Beckerman*, plant pathologist
- Include the latest science-based recommendations for managing specific pests
- Recommendations include cultural practices that prevent or minimize the problem and pesticide recommendations
- $1.99 Each

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Purdue Annual Doctor

Features:

- Identify problems on annuals by matching damaged plant parts to over 600 high-resolution photos.
- Check diagnoses with detailed descriptions of damage and stages of problem development linked to each photo.
- Get current recommendations from Purdue University on how to manage over 150 flower problems on over 60 kinds of flower.
- Search information by flower or by pest.

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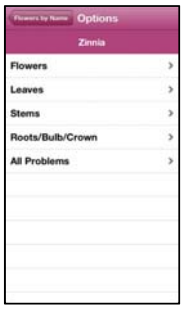
Purdue Annual Doctor



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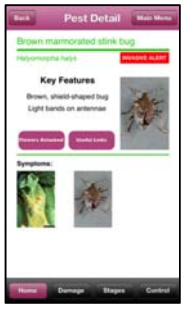

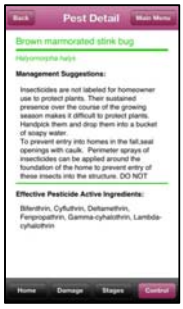

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Purdue Perennial Doctor

Features:

- Identify perennials diseases by matching damaged plant parts to over 600 high-resolution photos
- Check diagnoses with detailed descriptions of damage and stages of problem development linked to each photo
- Get current recommendations from Purdue University on managing over 150 flower problems on over 100 kinds of flower
- Search information by flower or by pest.

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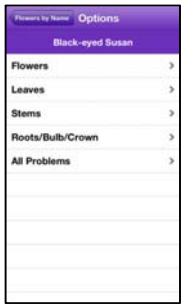
Purdue Perennial Doctor



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Purdue Perennial Doctor

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Purdue Tree Doctor

Features:

- Identify tree problems by matching damaged plant parts to over 1,000 high-resolution photos
- Check diagnoses with detailed descriptions of damage and stages of problem development linked to each photo
- Get current recommendations from Purdue University on managing over 175 tree problems on over 60 kinds of trees
- Search information by tree or by pest

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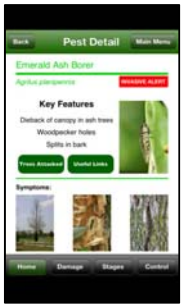
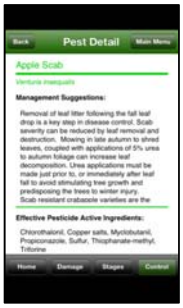
Purdue Tree Doctor





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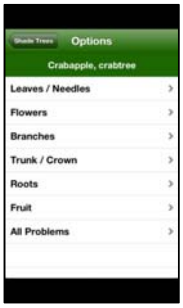
Purdue Tree Doctor



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Dirr's Tree and Shrub Finder

- App brings the "The Manual of Woody Landscape Plants" to an easy-to-use, mobile format
- Covers 1,670 species and 7,800 cultivars with 7,600 high-quality images and more than 1,120 line drawings
- The database is searchable by 72 criteria, including hardiness zones, water and light requirements, growth characteristics, flowers, fruits and fall colors
- $14.99

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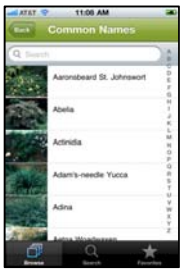
Dirr's Tree and Shrub Finder



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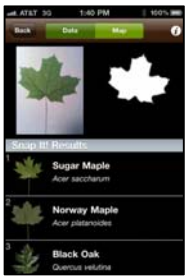
Leaf Snap

- Developed by Columbia University, the University of Maryland, and the Smithsonian Institution
- Helps identify tree species from photographs of their leaves--snap a photo and algorithms analyze it for ID
- Contains high-resolution images of their flowers, fruit, petiole, seeds, and bark
- Leafsnap currently includes the trees of the Northeast and will soon grow to cover the trees of the entire continental United States
- Can create your own "tree" library
- Free for iPhone

www.ct.gov/caes

Leaf Snap



ID your photo

Mark the location

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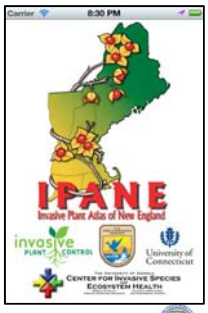
IPANE

- The Invasive Plant Atlas of New England's (IPANE) app allows users to report sightings of invasive plants directly in the field
- The database will facilitate education and research that will lead to a greater understanding of invasive plant ecology and support informed conservation management
- Important focus of the project is the early detection of, and rapid response to, new invasions
- Free



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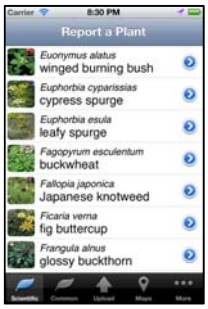
IPANE



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IPANE

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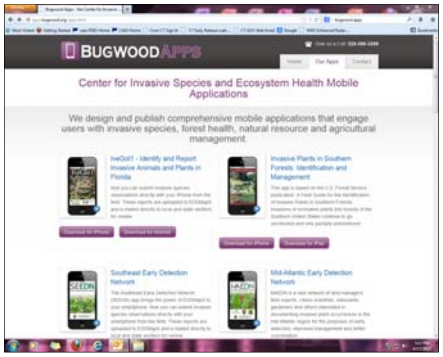
Bugwood Apps



http://apps.bugwood.org/apps.html

www.ct.gov/caes

ID Weeds

- Developed by University of Missouri Extension
- Helps identify over 400 plant species common to fields, pastures, lawns, gardens and pond areas
- Search by common or Latin name, view a list of weeds, or identify weeds based upon 28 different characteristics
- Details about each weed are presented, along with photographs of the weed specified
- Has "What is This" links to provide information if you're unfamiliar with the term "ligule," click "what's this" and an example is shown
- Free

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Acknowledgements

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Thank you! Questions?

2008 Farm Bill: Section 10201

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