Current Plant Problems and their Management

Practical Guidelines for the Industry

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The Cornell University PDDC was established in 1971 to provide a central location for plant problem sample submissions and record keeping. The clinic offers testing serves on all types of plant pathogens to include fungi, bacteria, viruses, nematodes and phytoplasmas.

Types of Samples Processed by the PDDC

The PDDC receives samples from extension educators, homeowners, golf course managers, growers, and other green industry members. We refer to these as “routine”

We also serve as the plant disease diagnostic facility for NYS Department of Agriculture & Markets. For NYSDAM and other state and federal agencies we process “regulatory” or “survey” samples

In 2015, we processed 701 routine and 385 Phytophthora ramorum trace forward and survey samples = 807 total
The PDDC has gained National Plant Protection Laboratory Accreditation Program (NPPLAP) certification for processing *Phytophthora ramorum* samples since 2006 and must complete a proficiency panel each year.

Staff members also have leadership roles in the development of the NPDN STAR-D program that is designed to follow ISO-17025 standards and will be required for all NPDN laboratories to ensure that all meet certain standards.
2014 Notable Clinic
Quandaries
Was there a new spruce disease this year?

We received many calls from arborists and county extension educators about declining and damaged spruce... mainly blue spruce but others too.  

Asked for samples and found no obvious cause. 

Found some spider mite and spruce bud scale damage...

Images courtesy of Sandra Jensen, Cornell University
Was there a new spruce disease this year?

Also found some Stigmina and Rhizosphaera needle blights; even the elusive SNEED (Sudden Needle Drop).

Also considered Cytospora canker and Weir’s cushion rust but could not confirm since not the time of year when can find evidence on new year’s needles...

Images courtesy of Sandra Jensen, Cornell University
Was there a new spruce disease this year?

Learned that diagnosticians from surrounding states were also hearing about similar problems with no luck determining the root cause.

Hope, if it continues, to get a sample submission at the right time to find the pathogen or to determine an abiotic factor that is causing the damage.
Was there a new English walnut disease?

Almost same scenario to the spruce issue...we received many calls from, in this case, homeowners and county extension educators about declining and damaged English walnut.

A few samples from at least 3 locations around the state...**no obvious cause found.**
Significant Pathogens
Oak Wilt, caused by
*Ceratocystis fagacearum*
Oak Wilt: *Ceratocystis fagacearum*

Oak wilt is a disease caused by the fungus *Ceratocystis fagacearum*. The fungus grows in the water-conducting vessels of the tree causing the vessels to plug which prevents water transport and causes the eventual death of the tree.

Diseased trees typically start to wilt in June or July and may wilt completely in as little as three weeks. Leaves on infected trees typically show marginal “scorch” but other pathogens and environmental problems also cause scorch, so this symptom alone is not diagnostic.
What Tree Species are Susceptible?

All species of oak are susceptible to oak wilt to some degree, but those belonging to the red oak group such as northern red oak, black oak, and pin oak are much more likely to die soon after they contract the disease. White and bur oaks are more resistant to the disease (but they are not immune) and may survive for many years after infection, losing just a few branches each year.
The disease was first described in the US in Wisconsin in 1944, however, the origin is not known.

It has been commonly found throughout the Midwest, Mid-Atlantic states and in Texas but not identified in New York until 2008.

In 2008, it was found in a small area in Schenectady County and eradicated.
Oak Wilt Symptoms

As a diseased tree nears death, the fungus produces sterile tissue on the inner bark and outer wood of the tree. As these pads expand, they split the bark open, creating a 3-8 inch long fissure that is barely noticeable to untrained observers. At the same time a “mycelial mat” forms around the pressure pads. It produces a sweet odor reminiscent of rotting fruit.

Image courtesy of George Hudler, Cornell University
2008 Find

A quarantine area was established containing three zones. Helicopters were used to survey the oak trees in the quarantine area. Within each zone, multiple symptomatic trees were identified. A cutting plan was created based on the observations made. The plan can be seen in the images above.

Symptomatic trees found in yards and in the woods were marked with orange paint to indicate that they should be removed.
2008 Find

Tree crews removed the trees. The trees were cut up or chipped and sent to a burn facility to be destroyed.

Additionally, trenches were cut into some areas to break root graphs that could allow the pathogen direct access to new hosts.
Oak Wilt: Before and After

Image courtesy of NYSDAM
2008-2013

No additional sample surveys were conducted. We received some suspect samples from time to time.

In 2013, we received a red oak sample that was labelled by the submitter as a bacterial leaf scorch, Xylella fastidiosa, suspect.

Our diagnostician, called the submitter for more information and learned that the tree was one of two that remained on site in the neighborhood of the 2008 finding...so she requested additional tissue so she could determine if the oak wilt pathogen was present or not.
Confirmed for a second time in 2013

Tissue from the re-submitted material appeared to be slightly discolored and isolation attempts were made and allowed to grow for two weeks.

The fungus on the plates appeared to be morphologically identical to the oak wilt pathogen.

DNA was extracted from the cultures and forwarded to experts at Iowa State for molecular analysis. The isolates were confirmed to be *Ceratocystis fagacearum*, the oak wilt pathogen.

Image courtesy of Sandra Jensen, Cornell University
Three objectives to this project...

1. Collect visual observation of symptoms on red oaks at potentially favorable sites for the establishment of oak wilt infections,

2. Determine if symptomatic samples contain the pathogen that causes oak wilt, *Ceratocystis fagacearum*,

3. and determine if newly developed PCR identification techniques will provided consistent results from pure cultures and directly from plant material.
Thousand Cankers, caused by
*Geosmithia morbosa*
Thousand Cankers, *Geosmithia morbida*

- The disease may be present for 10 years or more before visual symptoms appear. The first symptoms are flagging of the branches. Once seen, the symptoms increase in severity quickly.
- The disease is vectored by the walnut twig beetle, for early detection, look for entry and exit holes.
- Major concerns over this pathogen becoming established in the native population of black walnut.
Thousand Cankers, *Geosmithia morbida*

- Dr. Ned Tisserat of Colorado State University started investigating substantial mortality of black walnut trees in the Boulder and Colorado Springs area in 2004
- The decline was actually first observed by others around 2001 and the decline could of started as early as the 1990s
- The first published reports of dieback of black walnut is from New Mexico in 2002
Thousand Cankers, *Geosmithia morbida*
Thousand Cankers, *Geosmithia morbida*
Thousand Cankers, *Geosmithia morbida*

- Thousand Cankers was named by Dr. Tisserat of because of the numerous cankers found beneath the bark.
- The number of cankers can vary depending on which side you are looking at...often the west side of the tree has more cankers than the east side.
- Cankers coalesce over time causing branch dieback and eventual death of the tree.
- Cankers restricted to the Phloem and Bark and initially do not extend into the Cambium.
The pathogen, *Geosmithia morbida*

- The pathogen in culture has many forms and can appear white to gray to brown and also has a yeast phase.

- The fungus has a similar appearance of another very common fungal contaminant and at first was not identified as the causal agent.

- Evidence suggests that the fungus is a native fungus that likes warm climates.
The Walnut Twig Beetle, *Pityophthorous juglandis*

- The Twig Beetle are tiny beetles that are difficult to see with the naked eye.
- The beetles’ presence in a tree will most likely occur for many years prior to the tree displaying damage symptoms.

Picture by Jim LaBonte, OR Dept. Agriculture.

K.L. Snover-Clift

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The Walnut Twig Beetle, *Pityophthorous juglandis*
The Walnut Twig Beetle, *Pityophthorous juglandis*, entrance and exit holes
The Twig Beetle, *Pityophthorous juglandis*

- The Twig Beetle carries the fungus on its body from host to host.
- Entomologists are suggesting the beetle has “jumped” hosts and has been spread throughout the western states due to people moving firewood from the southwest northward.
- Many beetles can be in a small space. For example, in the two logs shown here that are approximately 18 inches long and 5 ½ inches in diameter, there are ~23,040 beetles.
The Walnut Twig Beetle, *Pityophthorus juglandis*, galleries

- It’s best to search for the cankers in greater than 1 inch thick diameter twigs.
- The Twig Beetle will most likely attack trees mid-April through mid-September but at the recent conference they warned us that any warm period can allow for a release of adults.
- The researchers stress that symptoms of Thousand Cankers develop following **sustained introductions and inoculations** of the pathogen from the twig beetles.
Thousand Cankers Disease-Extensive Damage

• The Black Walnuts in Colorado Springs were wiped out by 2008 and over 2000 trees in the Denver-Boulder area were dead...leaving very few survivors.

• Reports from Oregon indicate a much slower progression of damage possibly due to different host presence... hybrids, larger trees, different weather.

• Fear is spread of these damaged trees as firewood and to be used by hobbyists living far away...with their hitchhikers...people are just not aware of the potential damage that can be done by moving this wood!
First find east of Mississippi River in Knoxville, TN-August 5, 2010
First find in Bucks County, PA on August 10, 2011
First find in Richmond, VA in 2011 and second in Fairfax, VA in 2012
First find in Haywood County, NC on late fall 2012
First find in Butler County, OH in early 2013 (found on WTB-late 2012)
First find in Brown County, IN on a weevil June 2014
Distribution of Thousand Cankers Disease as of August 29, 2014

Source: www.thousandcankers.com
Tennessee
Thousand Cankers Disease
Quarantine and Buffer Regulated Areas

Thousand Cankers Disease Quarantined Areas
Anderson, Blount, Jefferson, Knox, Loudon, Morgan, Rhea, Sevier and Union counties.

Citizens in these counties cannot move walnut tree products and hardwood firewood outside the quarantined counties.

Thousand Cankers Disease Buffer Regulated Areas
Bledsoe, Bradley, Campbell, Claiborne, Cocke, Cumberland, Fentress, Grainger, Greene, Hamblen, Hamilton, Marion, McMinn, Meigs, Monroe, Polk, Roane, Scott and Sequatchie counties.

Citizens in buffer counties/areas can move walnut tree products and hardwood firewood within buffer counties, but not outside. Product can also be moved into a quarantine county, but not taken back out.

November 21, 2014
http://tn.gov/agriculture/regulatory/icd.html
Pennsylvania Department of Agriculture Map of Counties Quarantined for Thousand Cankers Disease as of August 10, 2011

TCD Quarantined County  Non-Quarantined County

Bucks
VA - Thousand Cankers Disease Quarantine

Quarantined Localities

<table>
<thead>
<tr>
<th>Counties</th>
<th>Cities</th>
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<tbody>
<tr>
<td>Chesterfield</td>
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Virginia Department of Agriculture and Consumer Services

Fairfax County Urban Forest Management - 12/03/2012
Current Known Distribution of Thousand Cankers Disease in North Carolina

Thousand cankers disease poses a serious threat to walnut trees in the eastern United States. This disease is spread by the walnut twig beetle, which is native to the southwestern United States. Host trees generally die 2-3 years after initial symptoms are noticed.

Susceptible plants in North Carolina are black walnut and butternut. Non-native trees in the Juglans genus may also be affected. This disease can be moved to new locations in woody material from infested trees.
Bleeding Canker on Horsechestnut, caused by *Pseudomonas syringae* pv. *aesculi*
Bleeding Canker, *Pseudomonas syringe* pv. *aesculi*

• Bleeding cankers have been found on horse chestnuts for many years and were known to be caused by *Phytophthora* spp. but at some point the samples were no longer producing this pathogen.

• Timeframe: Early 2000s when began isolating the bacterium in the United Kingdom.

• Found in UK, the Netherlands, Belgium, France and Germany.

• A survey done in the UK in 2007 indicated that 49% of the trees they looked at were infected.
Bleeding Canker, *Pseudomonas syringae pv. aesculi*

Mainly infects the white flowering horse chestnut, *Aesculus hippocastanum* and the red flowering, *Aesculus x carnea*. The cultivar ‘Baumanii’ is extremely susceptible.

Symptoms appear as clear or dark or reddish-brown oozing liquid from lesions on the trunk and branches, hence the “bleeding canker”

• Lesions under the bark will show distinct margins but may coalesce which leads to the die off and visible crown symptoms are obvious
**Bleeding Canker, *Pseudomonas syringe pv. aesculi***

- The oozing or bleeding increases significantly in warmer weather and what starts off as dark and clear often becomes a more rusty color and opaque.

- If the conditions become very dry, the cankers may darken and become brittle and crusty.

- The orange, crusty coloration is very unique for bleeding cankers, bleeding cankers caused by *Phytophthora* spp. often remain very black and wet looking.
Bleeding Canker, *Pseudomonas syringe pv. aesculi*

Trees of all ages can become infected and those between 10-30 years of age at the time of infection will most likely die in 3-5 years.

Research has shown that not all trees die from an infection, if the infection is minimal and the tree is otherwise healthy, only parts of the tree may die, however, if cankers become so abundant that they coalesce, then in most cases coalescing cankers fill the phloem, the tree becomes girdled and dies.
Rose Rosette Disease, caused by Rose Rosette-associated virus (RRaV)
Rose Rosette Disease, Rose Rosette associated Virus

The cause of Rose Rosette Disease was in debate until just a couple of years ago, it was thought to be caused by either a virus or a phytoplasma.

Most believed it to be caused by a phytoplasma because the symptoms matched...loss of apical dominance (witches broomes), dwarfing, proliferation of throns, stunting, distorted plant parts, discoloration.

Now known to be caused by a phytoplasma and transmitted by an eriophyid mite, *Phyllacoptes fructiphylus*. A molecular test has been developed to confirm.
Rose Rosette Disease, Rose Rosette associated Virus

The disease is lethal to wild multiflora rose and to many cultivated varieties of rose.

Diagnosis can be difficult because the symptoms mimic other diseases, insect injury and abiotic disorders. Also early infections may present very mild symptoms and can be overlooked for years while present and spreading.

In 2013, the disease was confirmed in New York State after we learned of the availability of the PCR test. Dawn Dailey O’Brien collected a suspect sample from her home and we submitted it for testing. It was confirmed positive for both the mite and pathogen.
Rose Rosette Disease, Rose Rosette associated Virus

Management is difficult!

Removal of infected plants at the earliest signs of infection will lessen overall damage to mass plantings. All parts of the plant must be removed including the entire root ball.

Other management includes purchasing initial and replacement stock from reliable sources, spacing plants so they do not touch each other, and controlling the eriophyid mite vector.
Pine Wilt Nematode, caused by *Bursaphelenchus xylophilis*
Pine Wilt: *Bursaphelenchus xylophilis*

Pine Wilt, caused by the pinewood nematode is vectored by pine sawyer beetles (*Monochamus* sp.).

Attacks mainly Scots Pine but also other exotic pines.

Not a lot of samples submitted for this type of analysis so it often goes unidentified and damage is blamed on other factors.

Image courtesy of L.D. Dwinell, USDA Forest Service

Image courtesy of Sandra Jensen
Image courtesy of The Morton Arboretum
Boxwood Blight, caused by *Cylindrocladium psuedonaviculatum*
**Boxwood Blight: Cylindrocladium psuedonaviculatum**

Known to cause damage on common boxwoods used in the landscape:
- Common—*Buxus sempervirens*
- English—*Buxus sempervirens* ‘Suffruticosa’
- Korean—*Buxus sinica* var. *insularis*
- Littleleaf—*Buxus microphylla*
- Hybrids of *B. sempervirens* X *B. sinica* var. *insularis* (Green Mountain, Green Gem, Chicagoland, etc)
Boxwood Blight: *Cylindrocladium psuedonaviculatum*

Boxwoods are becoming increasingly popular for creative plantings like this one at SeaWorld and in home landscapes.
Boxwood Blight: *Cylindrocladium psuedonaviculatum*
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Impatiens Downy Mildew, caused by *Plasmopara obducens*
Impatiens Downy Mildew: *Plasmopara obducens*

Pittsburgh Post Gazette article on September 01, 2012...”Downy mildew on impatiens causes gardeners to lose patience”

Also whispers of issues from Saratoga Springs in 2009 and 2010...that now lead us to believe, they may have been on of the first sites to have an infection.
Impatiens Downy Mildew: *Plasmopara obducens*

garden impatiens (*Impatiens walleriana*)
garden balsam (*Impatiens balsamina*)
Impatiens Downy Mildew: *Plasmopara obducens*
Impatiens Downy Mildew: *Plasmopara obducens*
Impatiens downy mildew and other downy mildews of concern...

and a few other issues...

Crouch Lab (USDA-ARS Beltsville) very interested in isolates of these pathogens
Thank you!

Any Questions?