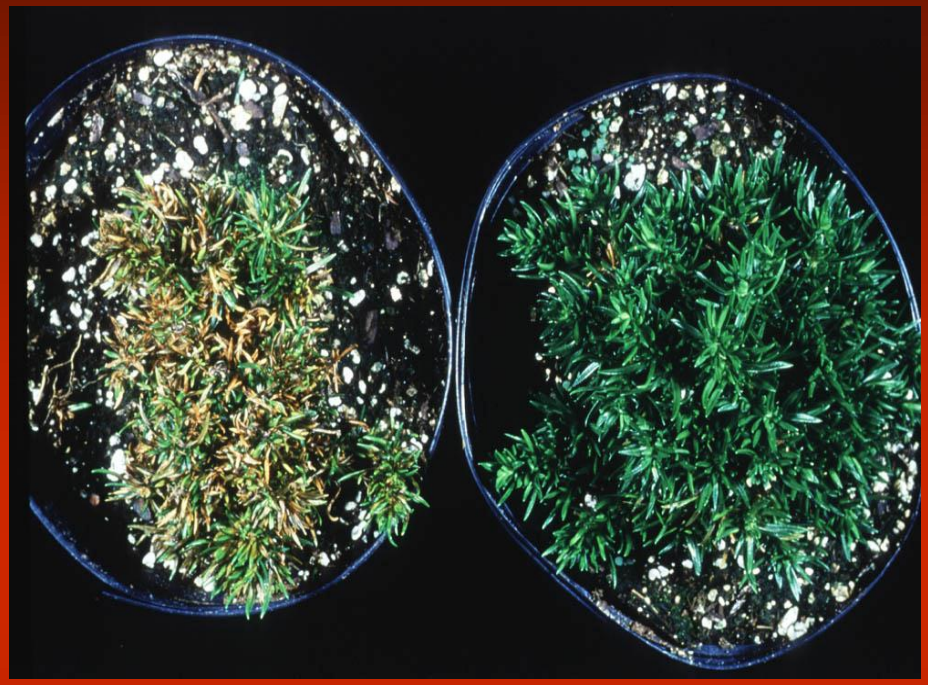
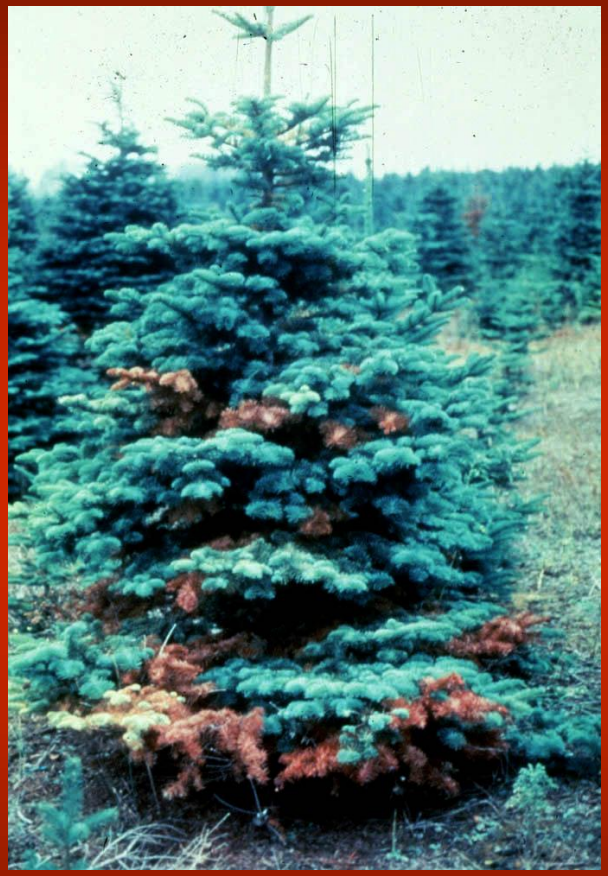


Diagnosing Plant Problems

Karen L. Snover-Clift
Director, Plant Disease Diagnostic Clinic
Associate Director, NEPDN
Cornell University

Plant Disease Diagnostic Clinic

Plant Disease
Diagnostic Clinic



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Diagnostic Clinic

Plant Disease
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How do we approach a problem?

A Five Step Process…

1. Determine that a ‘REAL’ problem exists.
2. Look for PATTERNS, in the community, on an individual plant and on an individual plant part.
3. Determine the TIME development of the damage pattern.
4. Ask QUESTIONS.
5. SYNTHESIZE the information.

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1. Determine that a ‘REAL’ problem exists…

- Identify the plant.
- Learn about it’s normal characteristics.
- Determine normal vs abnormal characteristics.
- Look for symptoms and signs.
  - Symptoms: Changes in growth or appearance of a plant in response to a damaging factor.
  - Sign: Evidence of the damaging factor.

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Plant Disease
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Plant Disease
Diagnostic Clinic

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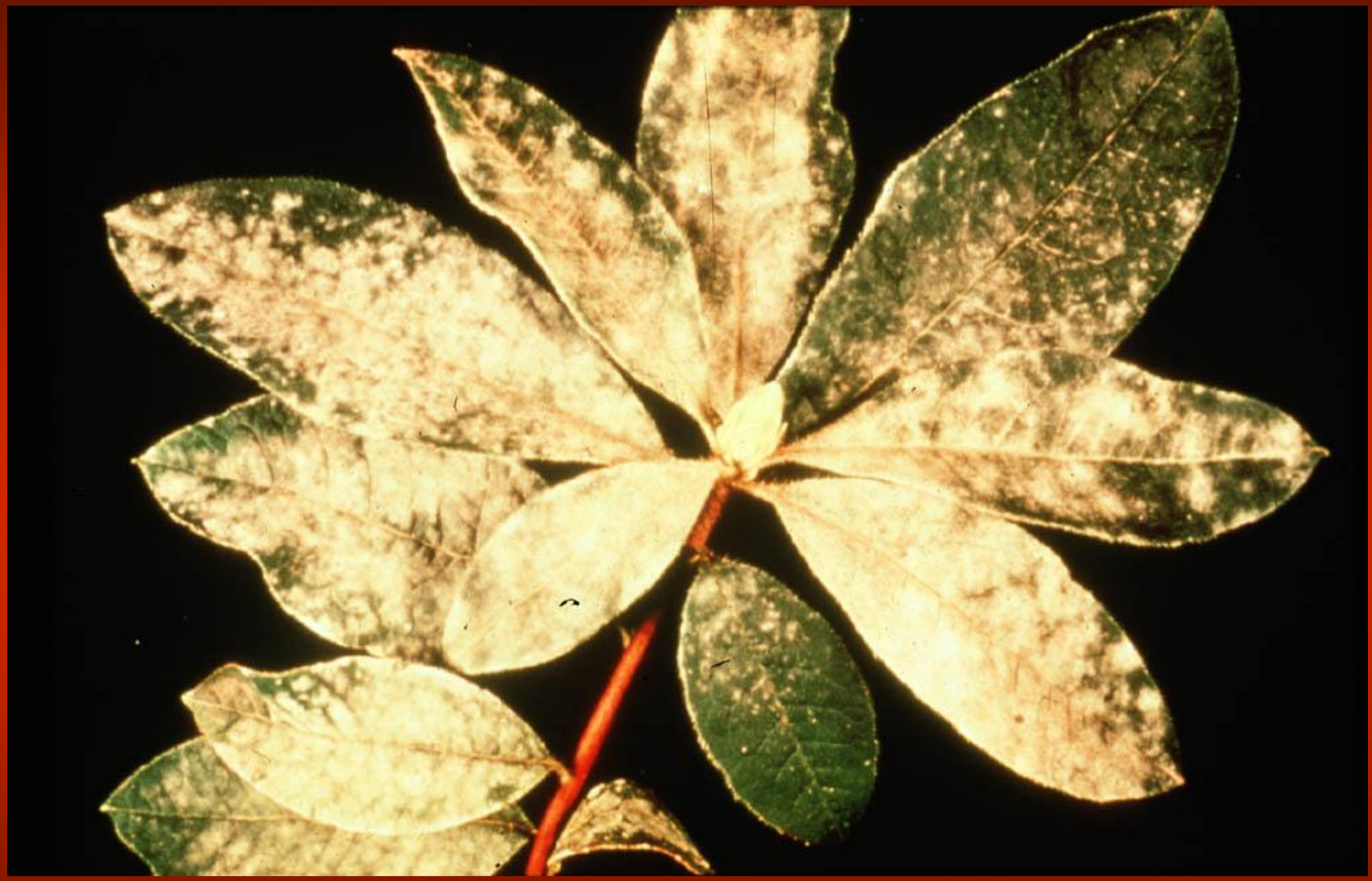
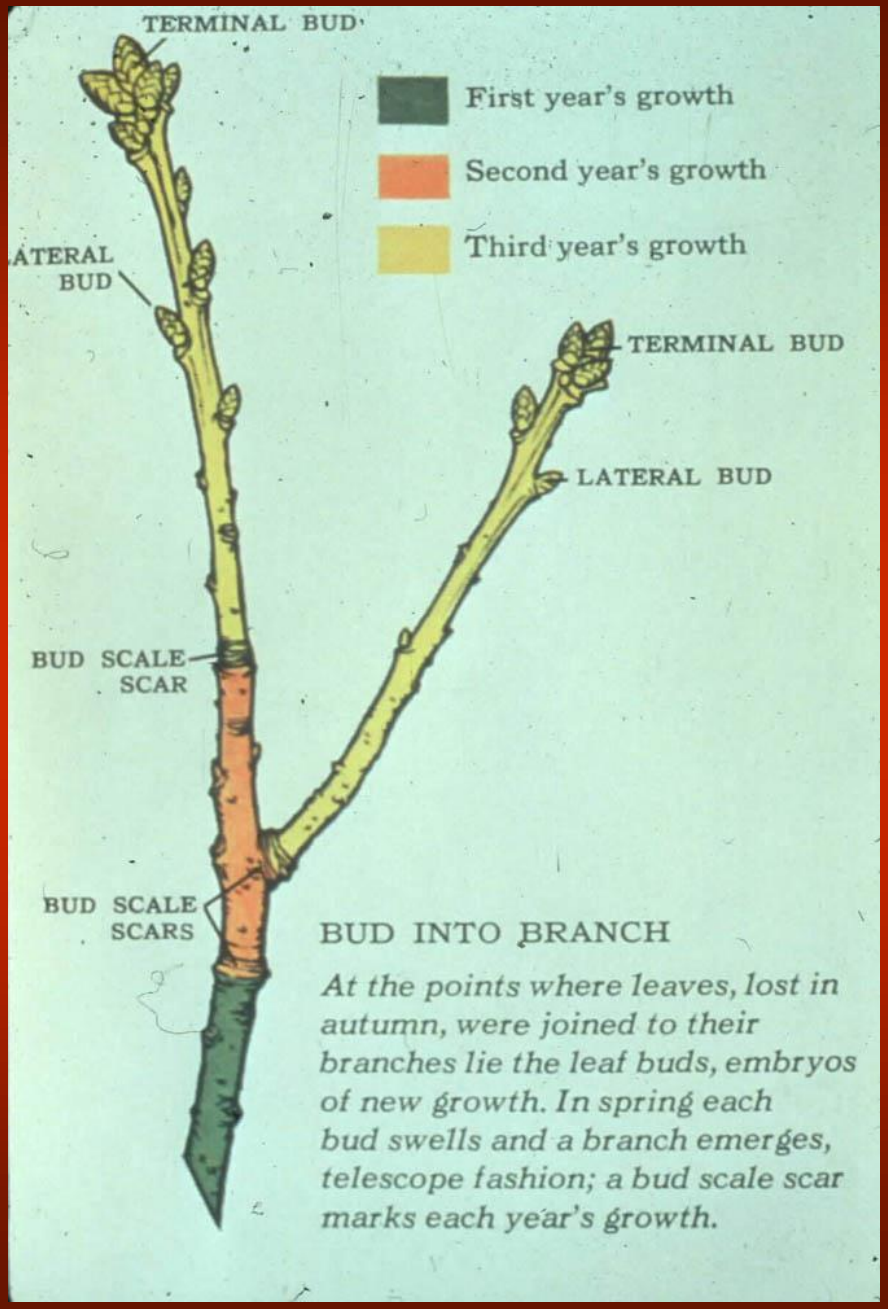


Plant Disease
Diagnostic Clinic

Plant Disease
Diagnostic Clinic

Plant Disease
Diagnostic Clinic



BUD INTO BRANCH

At the points where leaves, lost in autumn, were joined to their branches lie the leaf buds, embryos of new growth. In spring each bud swells and a branch emerges, telescope fashion; a bud scale scar marks each year's growth.

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Symptoms and Signs

Symptoms: Changes in growth or appearance of a plant in response to a damaging factor.

Sign: Evidence of the damaging factor.

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Symptoms: Changes in growth or appearance of a plant in response to a damaging factor.

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Sign: Evidence of the damaging factor.

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Disease Pyramid

Environment

Time

Disease

Pathogen

Host

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Diagnostic Clinic

2. Look for Patterns…

- Look for patterns in the plant community.
  - Is the damage on more than one plant?
  - Is the damage on more than one plant species?

- Look for patterns on an individual plant.
  - Is the damage on the entire plant or certain parts?
  - Is the damage on certain age of growth?

- Look for patterns on an individual plant part.

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Patterns of damage…

- Non-uniform, expanding damage patterns are usually caused by living factors, because of movement of feeding sites, life cycles, and population increases and decreases.
- Uniform, non-expanding damage patterns are usually caused by non-living factors such as chemical injuries, temperature changes, and mechanical damage.

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Damage patterns in the plant community…

Loblolly pine killed by southern pine beetle

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Cotton field with chemical damage

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Rhododendron with a *Phytophthora* sp. infection.

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Woody container plants with Chemical injury .

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Turfgrass displaying Fairy Ring symptom.

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Damage patterns on an individual plant…

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American Elm displaying symptoms of Dutch Elm Disease.

Spruce displaying symptoms of Nutrient Deficiency (most likely Magnesium).

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Rhododendron displaying symptoms of an Iron Deficiency.

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Damage patterns on an individual plant part…

Douglas Fir with Rhabdocline Needlecast.

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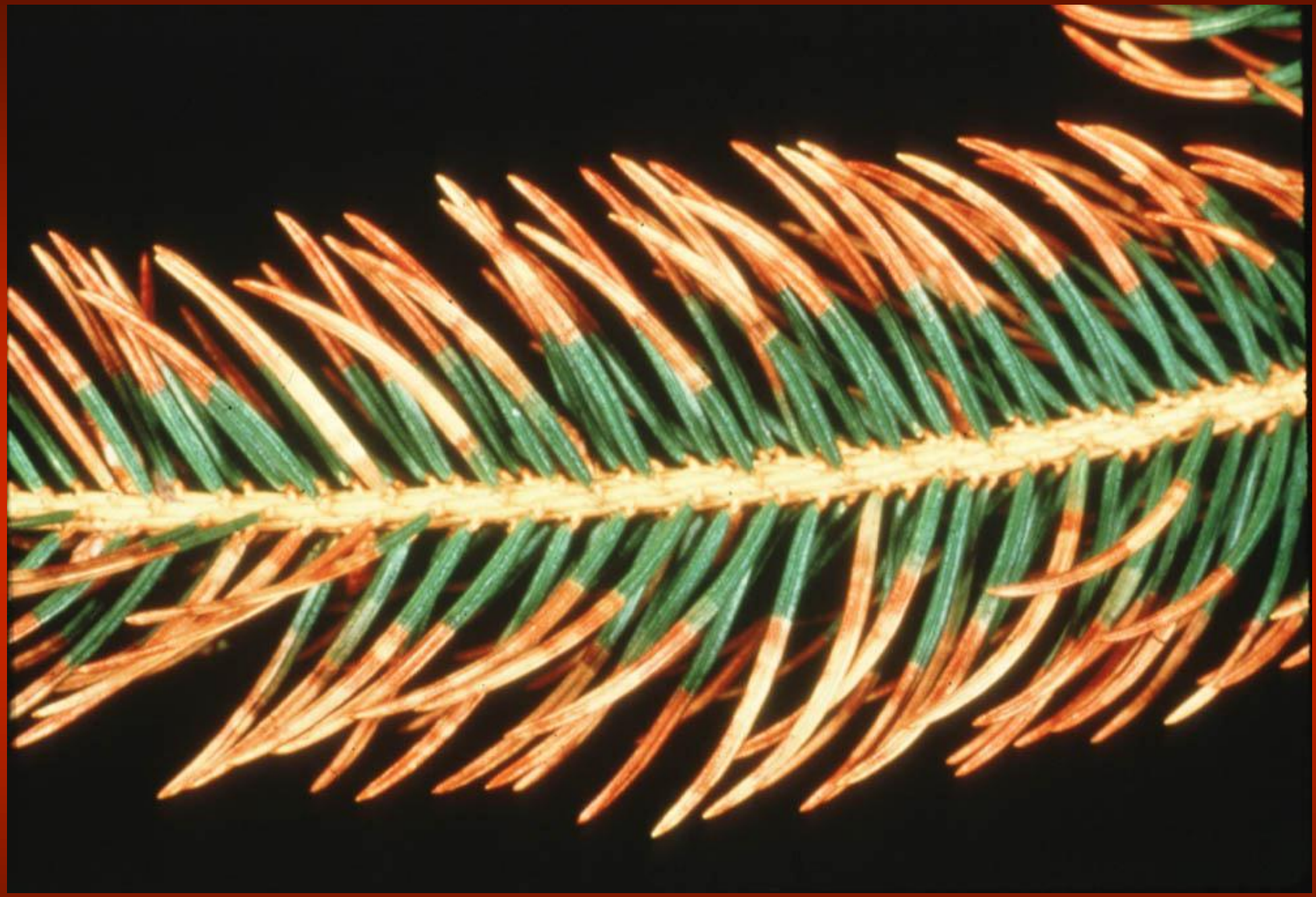

Fir with Freeze Injury.

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Downy mildew of Buddleia caused by *Peronospora harotii*.

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Kalmia with a viral infection.

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3. Determine the TIME development of the damage pattern…

- Progressive spread with time to other areas is characteristic of living factors.
- Intensification of symptoms where damage first occurred but no spread to new sites is characteristic of non-living factors.

Aspergillus niger

Day 1 Day 4 Day 7

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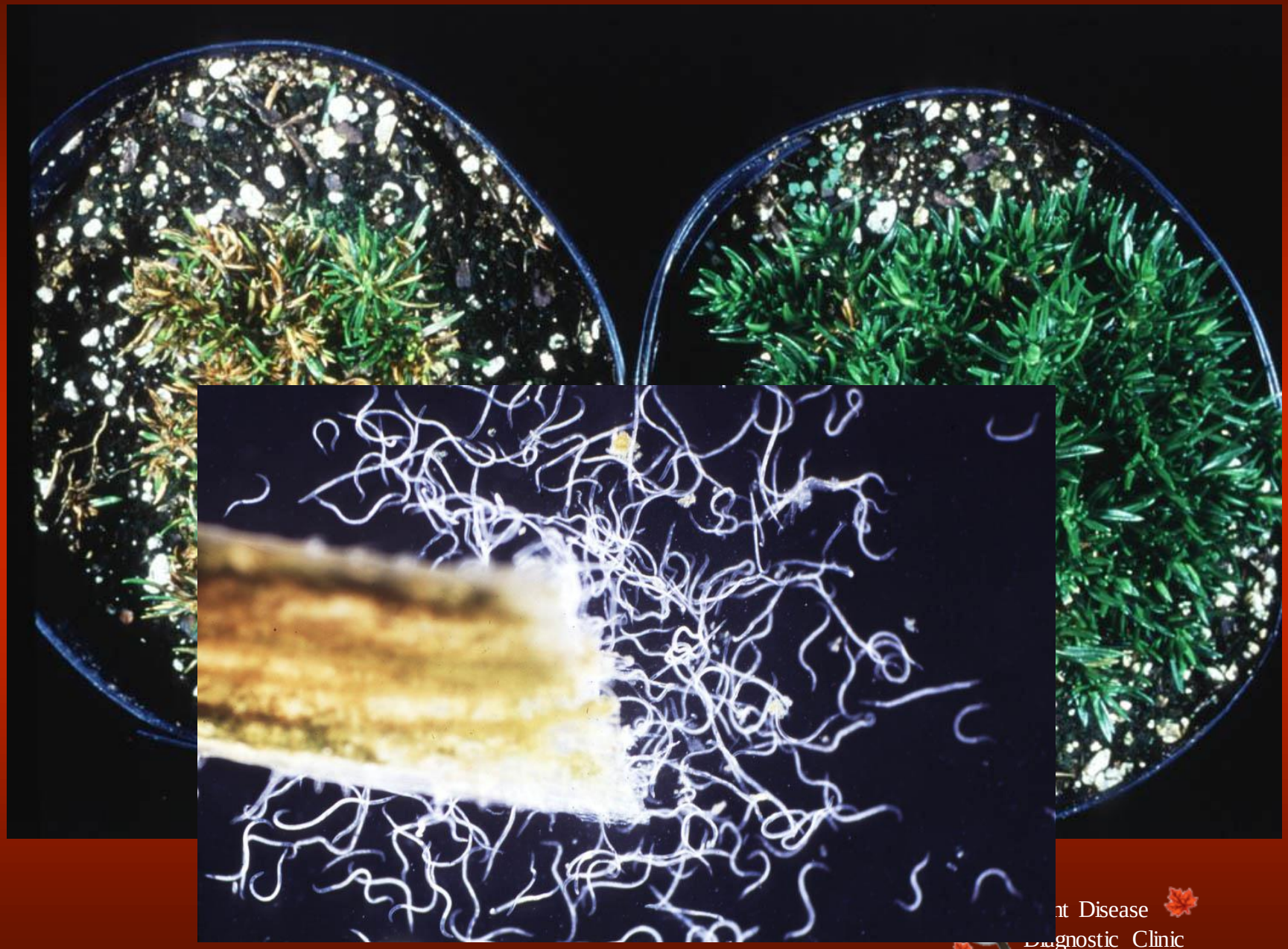

nt Disease
Diagnostic Clinic

4. Ask QUESTIONS…

- Get a history of the problem…
- Get a history of all pesticides and fertilizers that have been applied…
- Found out the history of the site…
- Could environmental conditions explain the problem…
- Look for obvious symptoms and signs…
- Don’t ignore the roots…
- Beware of secondary insects and pathogens…
- Be patient and avoid jumping to conclusions…

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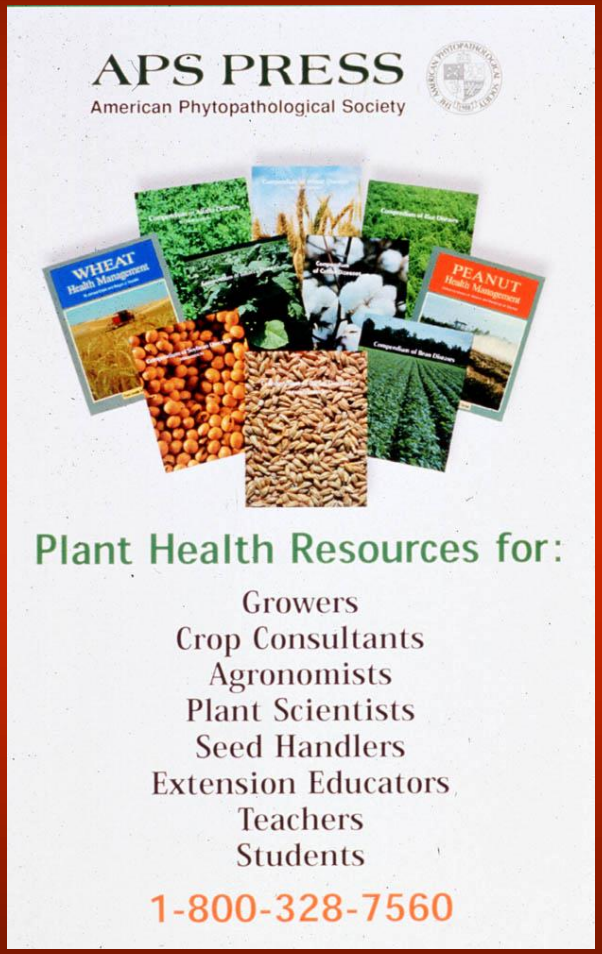
Diagnostic Clinic

5. SYNTHESIZE the information…

- Refer to literature…



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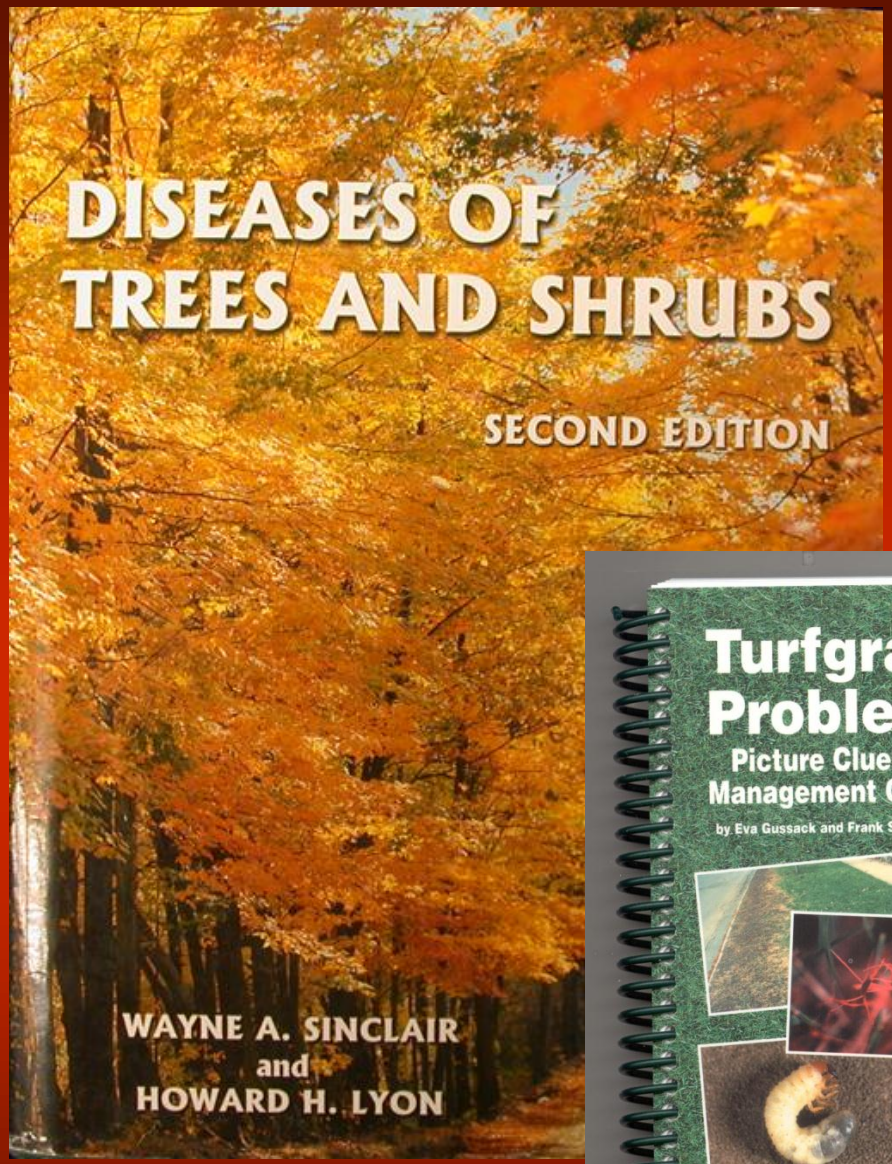

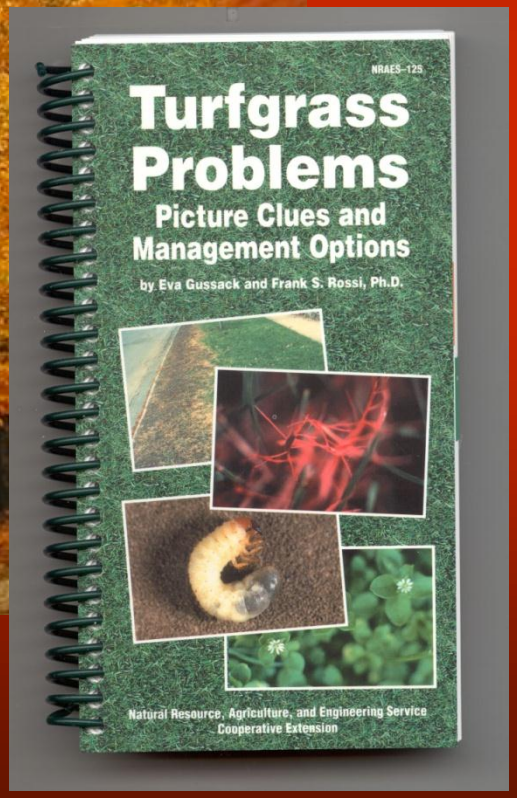

Plant Disease Diagnostic Clinic
CORNELL UNIVERSITY
329 Plant Science Ithaca, NY 14853
Phone:(607) 255-7850 Fax: (607) 255-4471
Karen L. Sirois, Director email: kls13@cornell.edu

Welcome to the Plant Disease Diagnostic Clinic at Cornell University.

Annuals & Herbaceous Perennials
Fruits
Greenhouse & Foliage Plants
Field Crops
Late Blight
Molds & Other Fungi
Trees & Shrubs
Turf
Vegetables & Herbs
Abiotic Diseases

The Clinic is designed to provide plant disease diagnostic services for anyone interested in plant diseases. Our services include analysis of plant material and soil for bacterial, fungal, viral, and nematode pathogens as well as suggesting appropriate control measures when available. Our clients include Extension Educators, Growers, Retailers, Arborists, Golf Courses, Researchers, and Homeowners. The Plant Disease Diagnostic Clinic works very closely with the Cornell Cooperative Extension county offices. If there is an office near you, you may want to contact them for assistance with your plant disease problem. The Cooperative Extension staff are very helpful and may be able to satisfy your needs. If no office is available or if you would like to use our services directly, please review the pages of this document for information on fees, sample submission, and plant disease fact sheets. Please follow the instructions for submitting samples carefully. The diagnosis of a sample that was improperly collected, packed, and/or shipped and arrives in poor shape is very difficult.

This Web Site allows users to quickly access information by utilizing the subject specific icons found on the left of this page. You may also visit the pages on Fees, Sample Submission methods, the Sample Submission Form, and plant disease Diagnostic Fact Sheets for generic information and an alphabetical listing of fact sheets.

The Clinic is a facility of the Departments of Plant Pathology at Cornell University. This alliance allows the clinic to maintain a strong connection with the leading Researchers in the field of Plant Pathology. The clinic provides accurate plant disease diagnosis, quick turn around time, professional services, and up-to-date control recommendations. The Clinic promotes a "Test, Don't Guess" attitude. Knowing the pest prior to taking action allows for more efficient use and selection of control methods. down

A Weekly Update listing the diseases diagnosed by county is updated each Monday during the growing season. This listing may be especially valuable to those interested in the distribution of pathogens around the state.

Departments of Plant Pathology, Fees, Sample Submission, Diagnostic Fact Sheets, CALS, Cornell Cooperative Extension , IPM in New York State, Plant Pathological Terms, Plant Disease Profiles, Branching Out, Karen L. Sirois

Some files available from this site use Adobe Portable Document Format (PDF). To access these files you will need Adobe Acrobat Reader. If you do not have this program it can be downloaded at no charge from the Adobe Acrobat Reader Website.

A Five Step Process…

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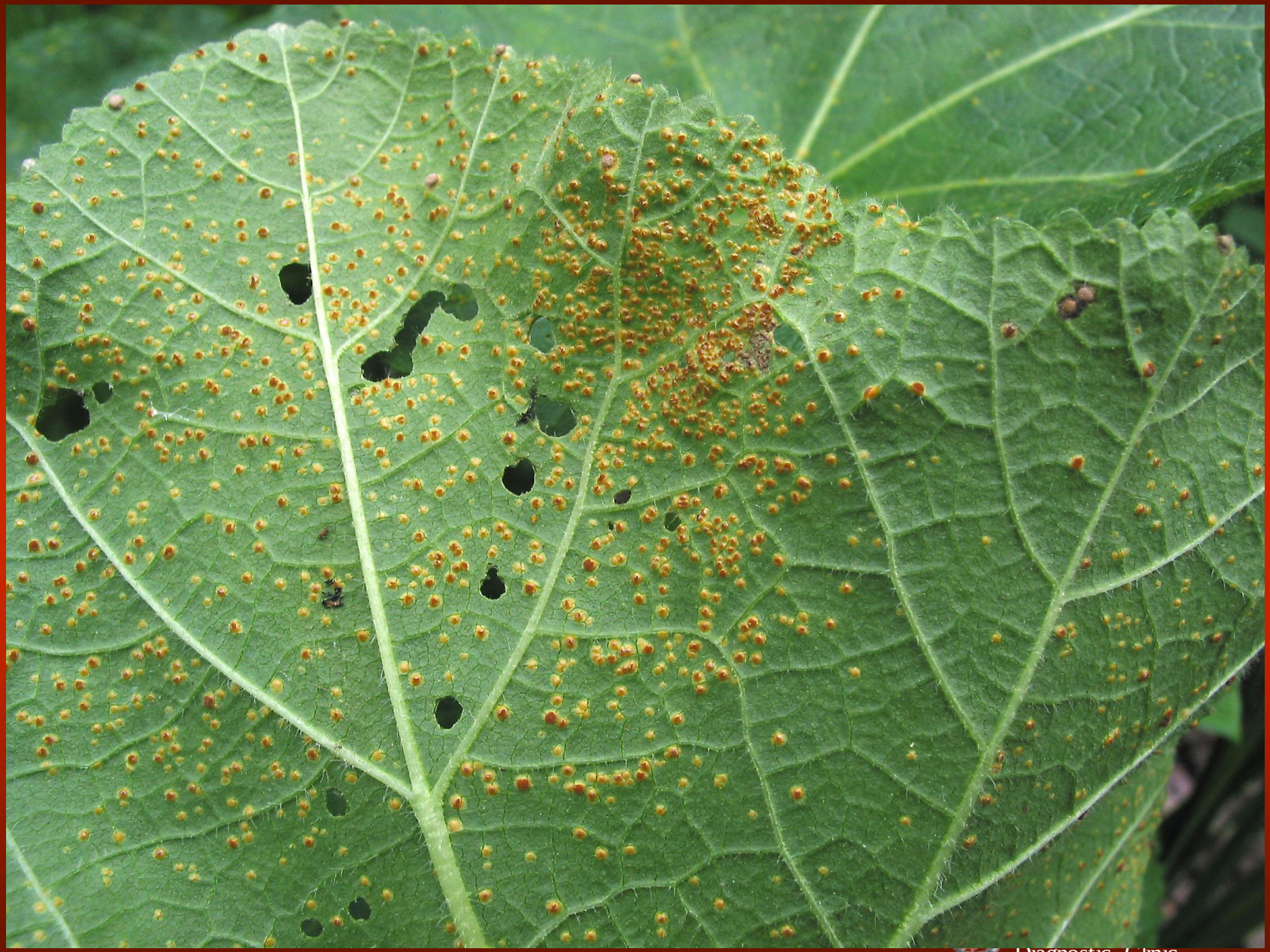
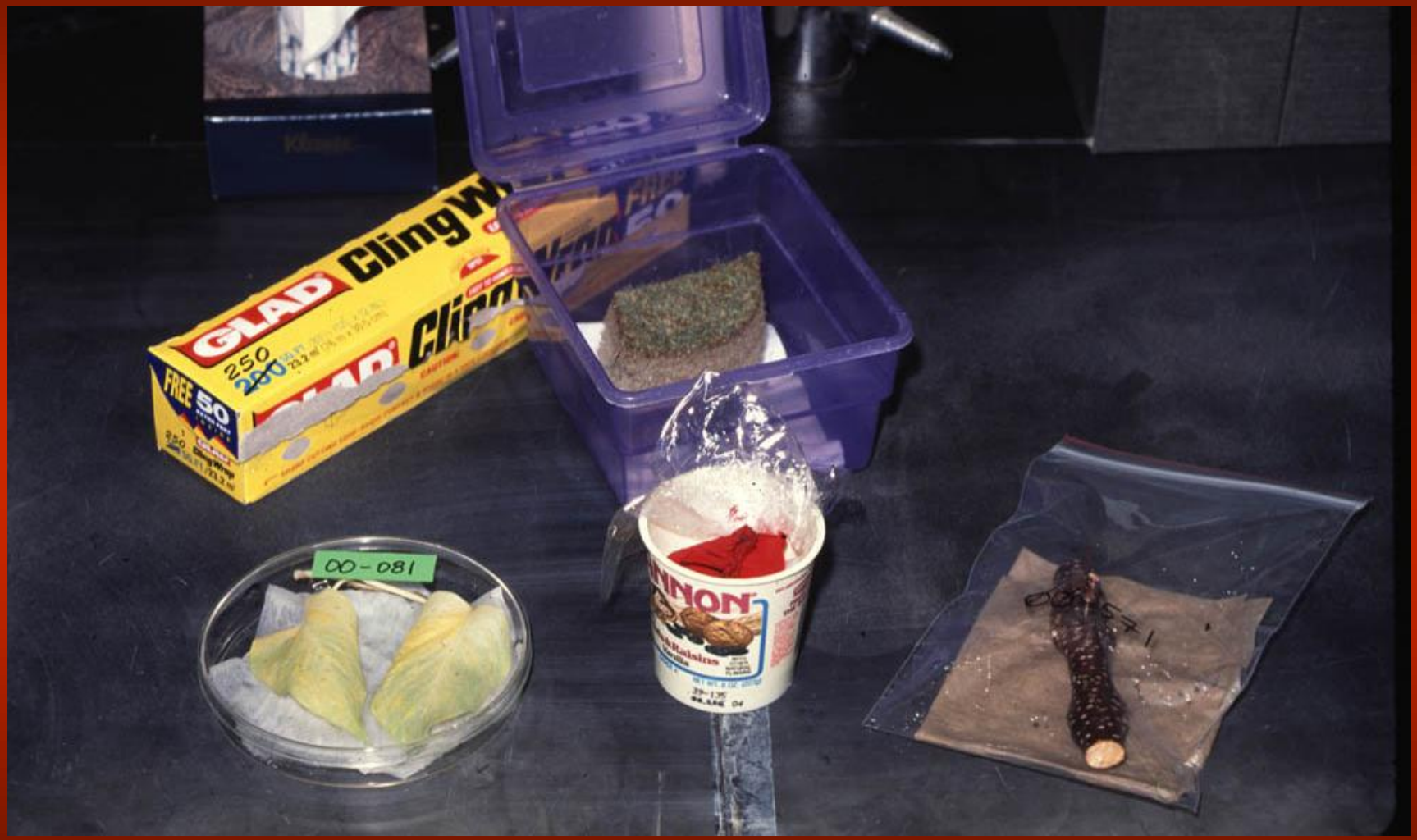
Scenario 1:



Laboratory Techniques for Identifying Plant Pathogens

Moist Chambers



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Isolations

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Extractions

Plant Disease
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Microscopy

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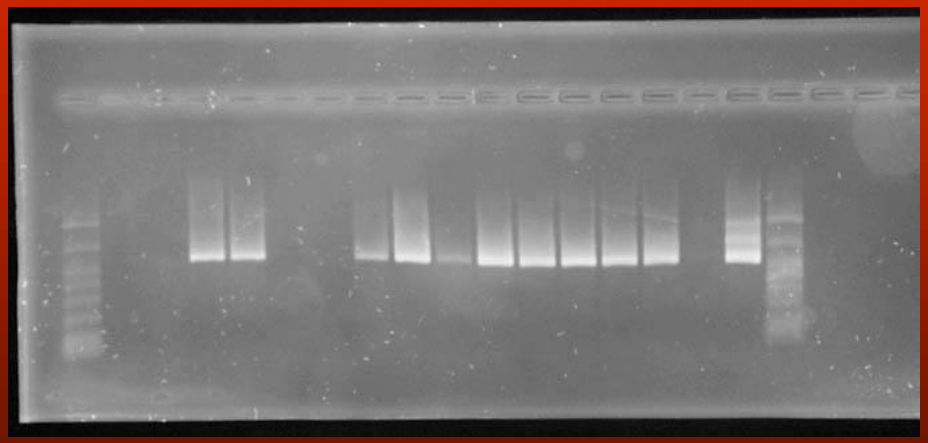
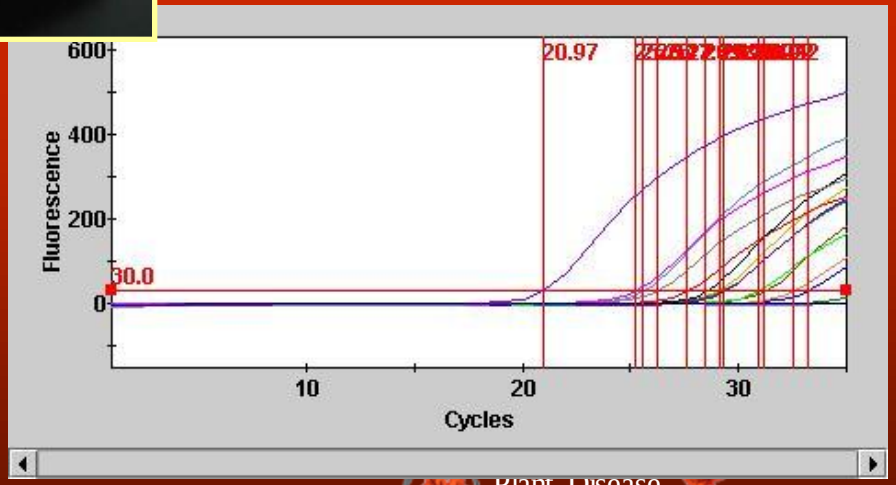
Diagnostic Clinic

Chemical Analysis
ELISA

Molecular Analysis
PCR





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Common Diseases found in the Northeast Region

Plant Disease
Diagnostic Clinic

Lilac Bacterial Blight

Lilac Bacterial Blight

- Brown spots on leaves and stems
- Leaves may die and drop

Stem may turn black and wilt as disease progresses.

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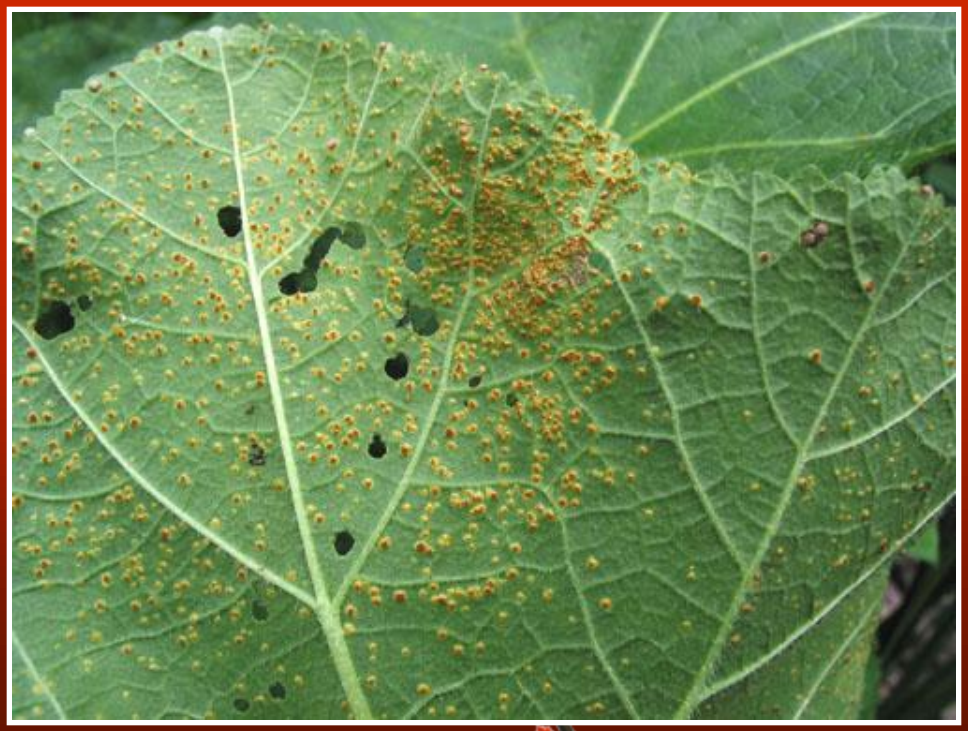
Powdery Mildew

Powdery mildews appear as a dusty white to gray coating over leaf surfaces or other plant parts.

Hollyhock Rust

The surface of the leaves may develop numerous yellow spots.



Orangebrown pustules on the undersides of the leaves are the most obvious symptoms which are characteristic signs of a rust infection.

Tar Spot

Symptoms truly appear as black spots of tar on leaves. Caused by a fungus, seeds may also become infected.

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Black Knot

This disease is characterized by the presence of thick, black, irregular swellings on the twigs.

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Cedar-Apple Rust

Symptoms on the juniper hosts can include a swelling of the woody tissue and gall-like growth that may enlarge over time.

Characteristic symptoms of a rust infection include bright orange colored growths emerging from the swollen woody tissue or galls.

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Anthracnose

Symptoms vary according to the plant part and the host attacked. Leaf infections may show necrotic spots, irregular dead blotches or necrotic lesions associated with large leaf veins.

Infections on new shoots may kill them entirely or cause severe tissue distortion. Defoliation may occur early in the season followed by a second growth of leaves in early summer.

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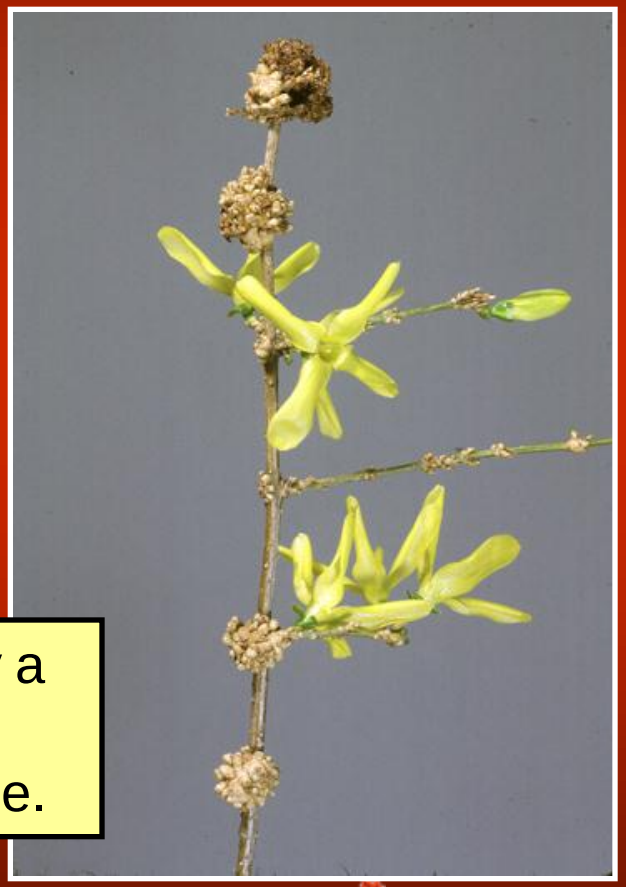
Forsythia Gall



This disease is thought to be caused by a fungus. The gall is characterized by bumpy, woody overgrowth of stem tissue.

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Daylily Rust

- The pathogen was first described in 1880.
- It is native to Asia, commonly found in China, Japan, Korea, Taiwan, and Russia.
- It was first identified in August of 2000 in the southeast United States.
- The disease moved swiftly throughout the country and by the fall of 2001 it had been identified in over 30 states including New York State.

Diagnostic Clinic

Daylily Rust

- Yellow to brown streaking on leaves
- Upper surface of leaves may have bright, small yellow spots
- Under surface of leaves may have numerous yellow to orange pustules

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Select and Significant Pathogens found in the Northeast Region

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What are Select Agents?

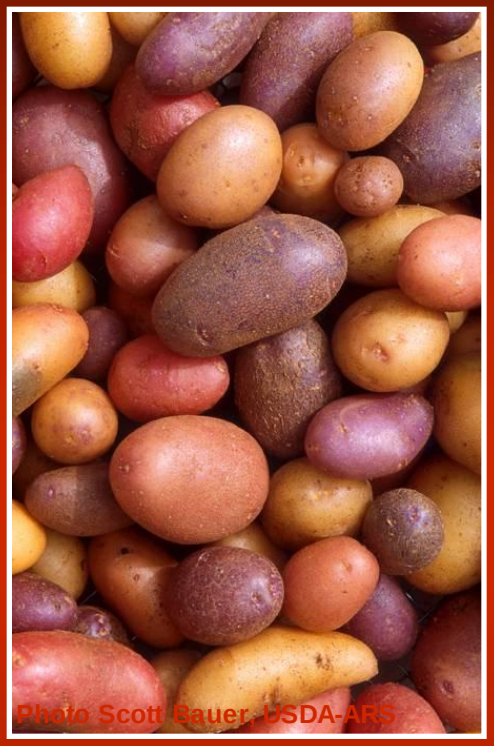
- Select Agents are plant pathogens that have been deemed of high concern if they entered the country.
- 10 organisms that cause 9 diseases were originally listed in the Agricultural Bioterrorism Act of 2002.
- Because of this classification, researchers must become **registered** to work with any select agents. Registration requires strict containment facilities.
- In April 2005, *Phakopsora pachyrhizi* and Plum Pox Virus were removed from the select agent listing. *P. pachyrhizi* was removed because of its introduction (November 2004) and continued presence. The Plum Pox Virus was removed due to the minimal spread potential.

Highly Significant Pests and Pathogens

- We are not only concerned with Select Agents but also any organism that can reduce yield, reduce the landscape diversity, and cause economical loss.
- Highly significant pests and pathogens are of regulatory concern and can cause devastating damage to crops.
- Their presence can limit or stop exportation of a crop from that State.
- The network currently is working with a number of pests and pathogens that fall into this category; *Phytophthora ramorum*, *Phakopsora pachyrhizi*, Plum Pox Virus, Pink Hibiscus Mealybug, Emerald Ash Borer, and Asian Longhorned Beetle.

Southern Wilt / Brown Rot

- The bacterium *Ralstonia solanacearum* Race 3 Biovar 2 causes diseases commonly known as Southern Wilt or Brown Rot
- Southern Wilt is a disease of Geranium and Brown Rot is a disease of Potato



- *Ralstonia solanacearum* Race 3 Biovar 2 has appeared on Geranium a few times in recent years but it appears to be confined to greenhouse crops and there is no evidence of spread to potato, tomato, or eggplant

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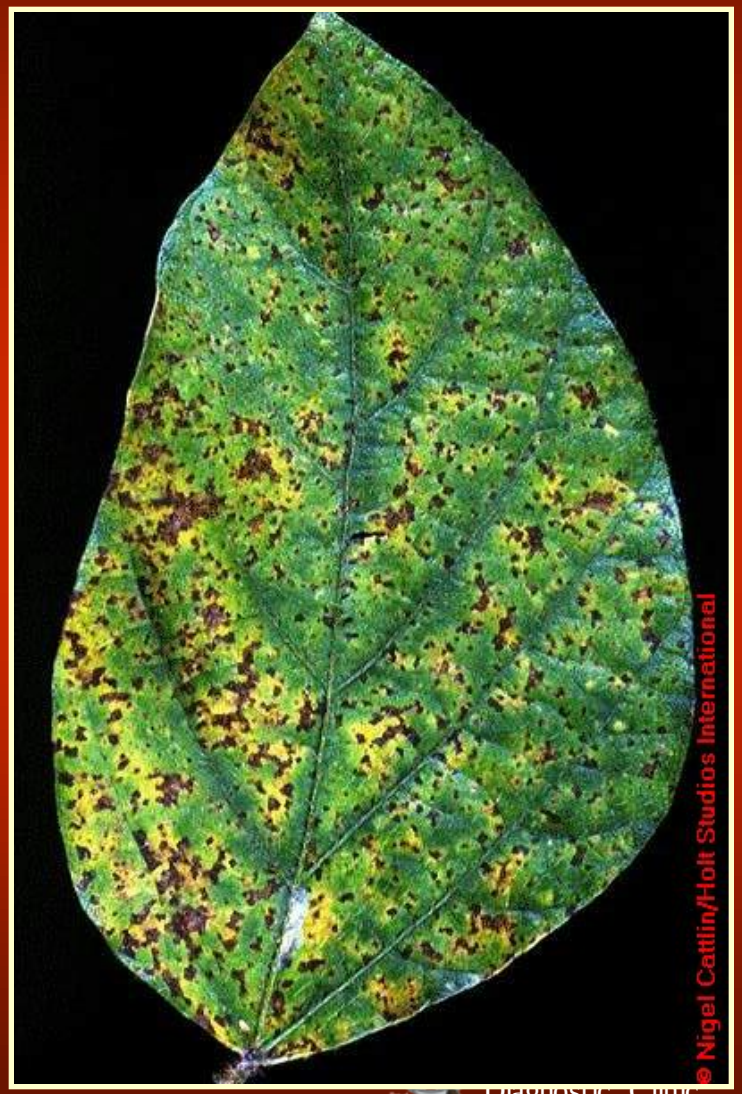
Sudden Oak Death

- A disease caused by *Phytophthora ramorum*
- Also called ramorum blight and ramorum dieback
- Although the disease was first observed in the United States in tanoaks in California, it is also found to infect other plant species

(Govt of British Columbia, Ministry of Agriculture, Food, & Fisheries)

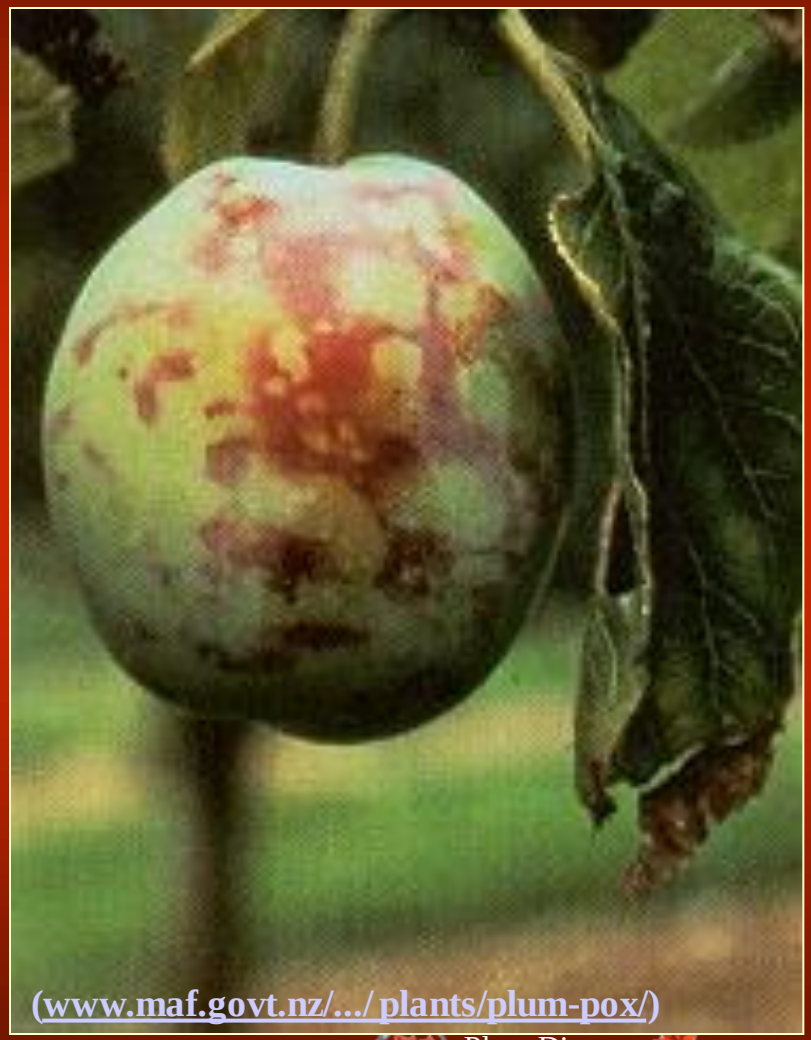
Soybean Rust

- This disease is caused by two fungi named *Phakopsora pachyrhizi* and *Phakopsora meibomiae*
- *P. pachyrhizi* appeared in the US in November 2004, apparently entering on winds of Hurricane Ivan. It was found in 9 States shortly thereafter. Detected by a NPDN exercise participant.
- A member of the Agricultural Bioterrorism Select Agent Listing of 2002. It was removed from the listing in April 2005 due to its established presence in the US.



Plum Pox

- A disease of stone fruits caused by a viral pathogen called the Plum Pox Virus
- Also known as “Sharka”
- First discovered in an Adams County, Pennsylvania Orchard in 1999
- A member of the Agricultural Bioterrorism Select Agent Listing of 2002. It was removed from the listing in April 2005 due to its limited ability to spread easily.



(www.maf.govt.nz/.../plants/plum-pox/)

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Phytophthora kernoviae

- A pathogen currently found in Europe and thought to be a much more aggressive pathogen than *P. ramorum*
- In April 2005, the US DOA notified the European Union that annual surveys would be required of plants shipped to US. The following genera were named as regulated: *Fagus* sp., *Gevuina* sp., *Liriodendron* sp., *Michelia* sp., *Magnolia* sp., *Pieris* sp., *Quercus* sp., *Rhododendron* sp.

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Thousand Cankers Disease: *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.

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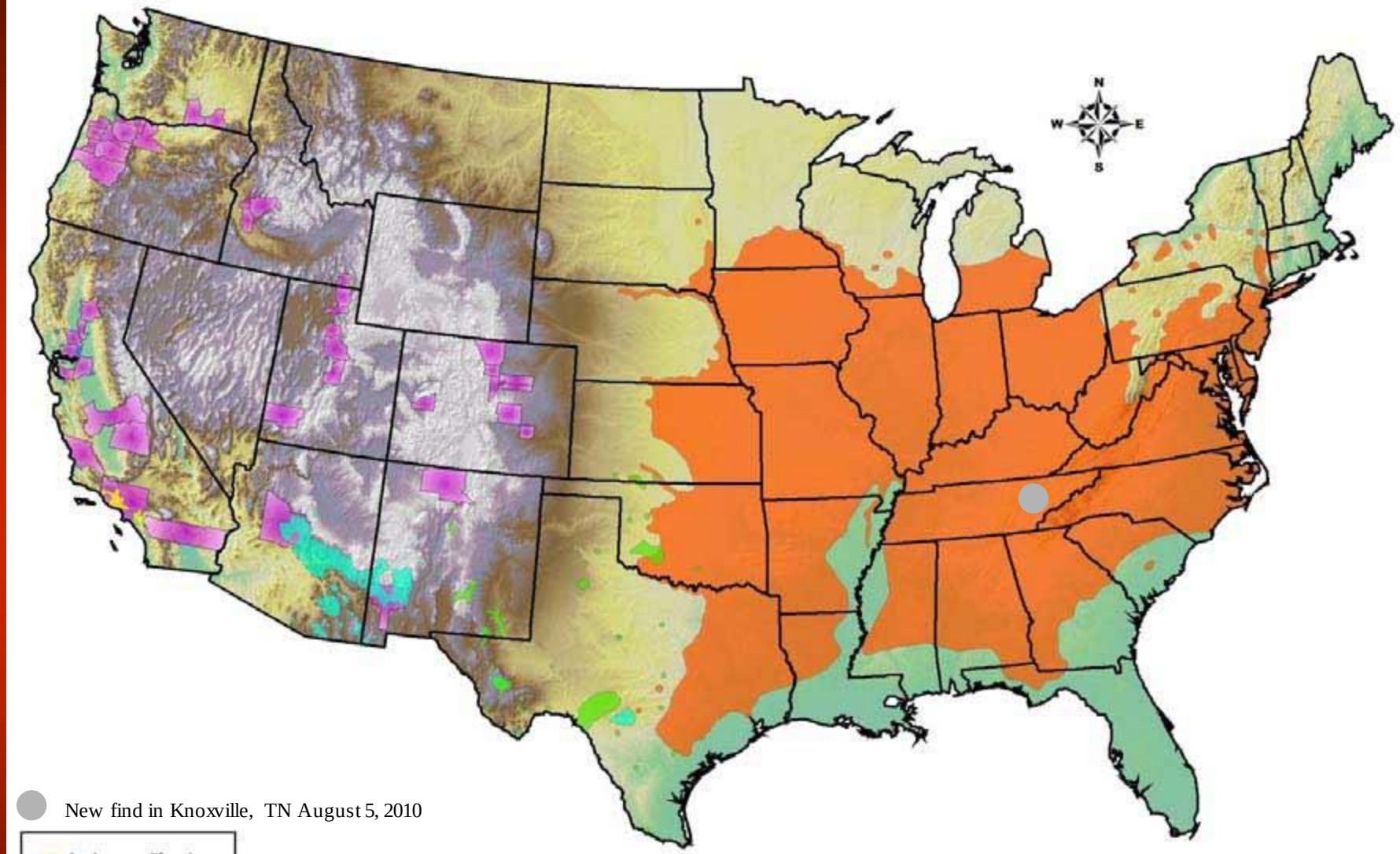
K.L. Snover-


K.L. Snover-Clift


K.L. Snover-Clift


K.L. Snover-

U.S. Native Walnut Distributions and TCD Affected Counties



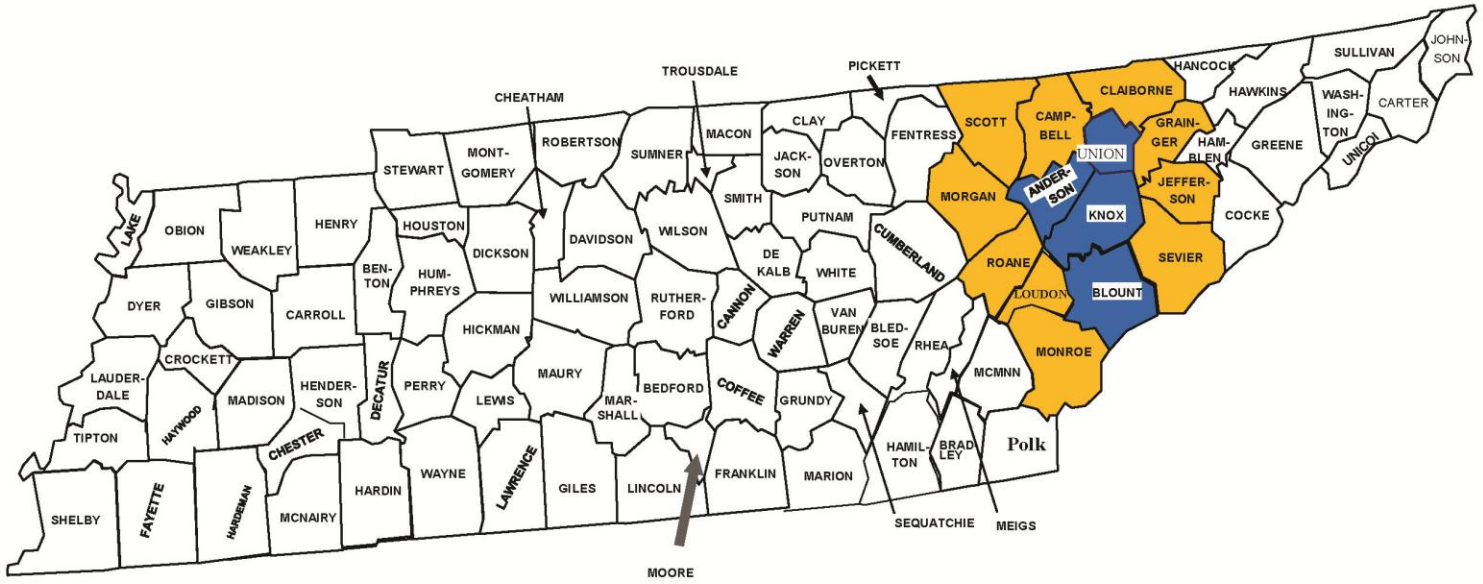
New find in Knoxville, TN August 5, 2010

- *Juglans californica*
- *Juglans hindsii*
- *Juglans major*
- *Juglans microcarpa*
- *Juglans nigra*
- Affected County

500 Kilometers

Sources: Alston, 2008; Cranshaw and Tisserat, 2008; Little, 1971; Murray, 2009; Pizzo, 2009; Pscheidt, 2009; Seybold, 2009; Tisserat, 2009; UI CALS, 2009;
Created By: Glenn Fowler and Leslie Newton
USDA-APHIS-PPQ-CPHST-PERAL
NAD 83 Albers Equal Area Conic
October 7, 2009

2010
Tennessee
TCD Quarantine



Thousand Cankers Disease September 2010 Quarantined Areas

Anderson, Blount, Knox, Union

Thousand Cankers Disease Buffer Regulated Areas

Campbell, Claiborne, Grainger, Jefferson
Loudon, Monroe, Morgan, Roane, Scott,
Sevier

October 11, 2010

- Emerald Ash Borer
- Asian Longhorned Beetle
- Pink Hibiscus Mealybug
- Sirex Woodwasp
- Soybean Aphid

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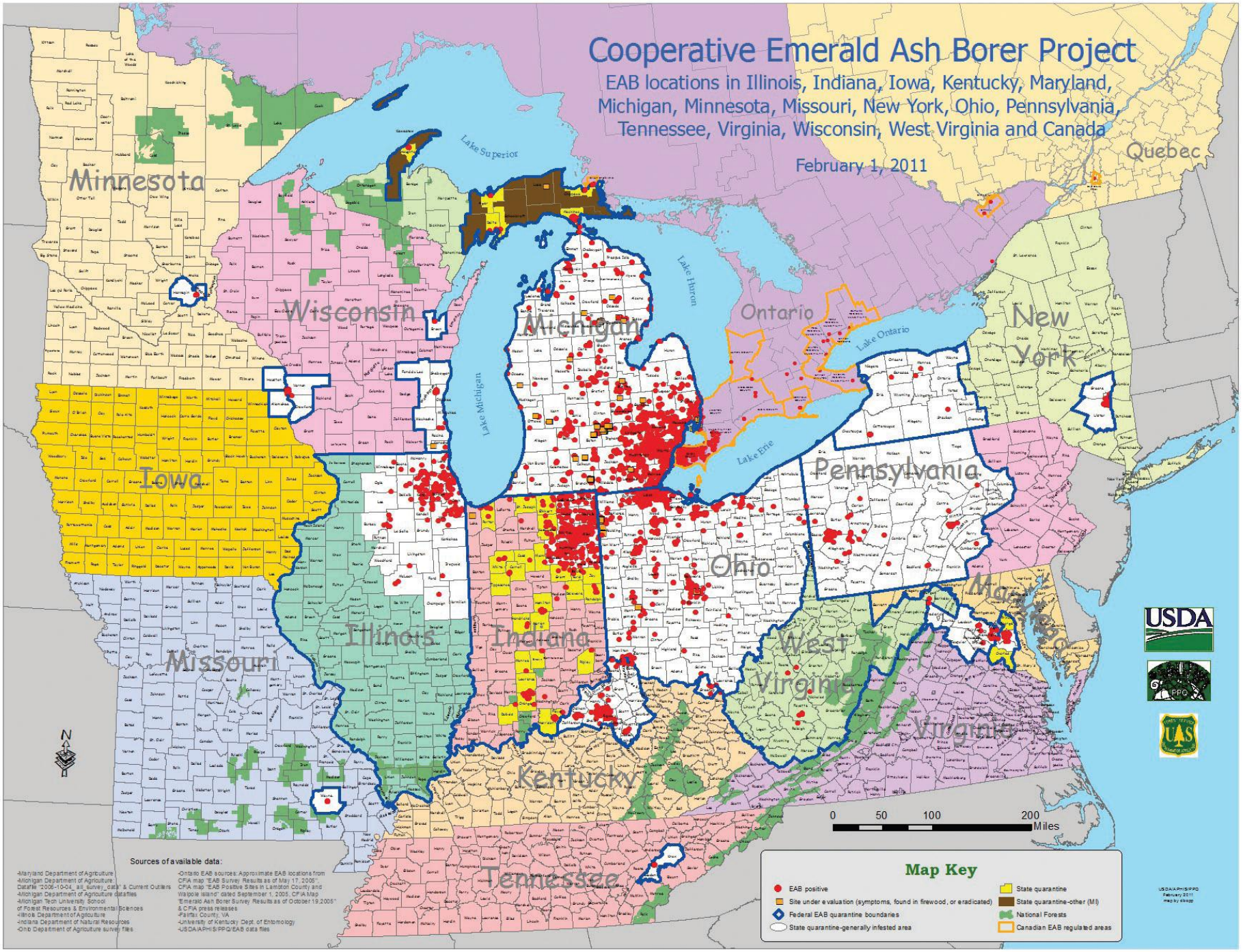
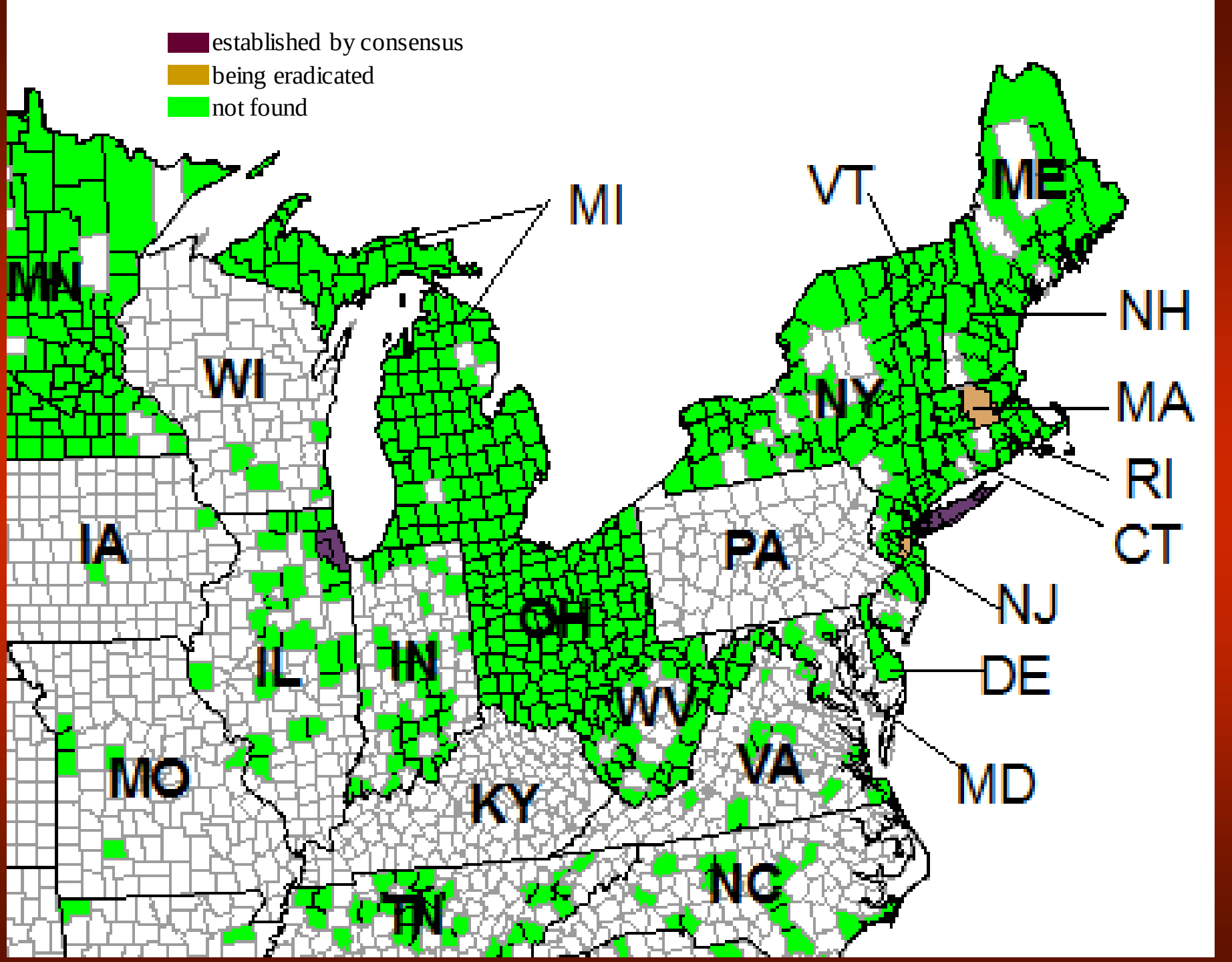
Emerald Ash Borer

- Discovered on Ash in Michigan in July 2002.
- Later discovered in Ohio, Indiana, Illinois, Missouri, and Maryland.
- Causes devastating damage to Ash trees by feeding in the cambium between bark and wood, girdles branches and can kill entire trees.
- Discovered in Pennsylvania and West Virginia of 2007, in Virginia in July of 2008, and in New York State on July 17, 2009.


Cooperative Emerald Ash Borer Project
EAB locations in Illinois, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, Wisconsin, West Virginia and Canada
February 1, 2011
Minnesota
Wisconsin
Michigan
Ontario
Quebec
New York
Iowa
Illinois
Indiana
Ohio
Pennsylvania
Missouri
West Virginia
Virginia
Kentucky
Tennessee
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
N
0 50 100 200 Miles
Map Key
EAB positive
Site under evaluation (symptoms, found in firewood, or eradicated)
Federal EAB quarantine boundaries
State quarantine-generally infested area
State quarantine
State quarantine-other (MI)
National Forests
Canadian EAB regulated areas
Sources of available data:
-Maryland Department of Agriculture
-Michigan Department of Agriculture Datafile "2006-10-04_all_survey_data" & Current Outliers
-Michigan Department of Agriculture datafiles
-Michigan Tech University, School of Forest Resources & Environmental Sciences
-Illinois Department of Agriculture
-Indiana Department of Natural Resources
-Ohio Department of Agriculture survey files
-Ontario EAB sources: Approximate EAB locations from CFIA map "EAB Survey Results as of May 17, 2005", CFIA map "EAB Positive Sites in Lambton County and Walpole Island" dated September 1, 2005, CFIA Map "Emerald Ash Borer Survey Results as of October 19,2005" & CFIA press releases
-Fairfax County, VA
-University of Kentucky Dept. of Entomology
-USDA/APHIS/PPQ/EAS data files
USDA/APHIS/PPQ
February 2011
map by sbapp

Asian Longhorned Beetle

- Discovered on several hardwood trees in Brooklyn , New York in 1996. Spread to Long Island, Queens, Manhatten and New Jersey.
- A separate introduction found in Chicago in 1998.
- Causes damage to trees by disrupting the vascular system and girdling the trees.
- Thought to be introduced on wood pallets from cargo shipments.
- Reported to be found in Massachusetts on August 6, 2008.


established by consensus
being eradicated
not found
MI
VT
ME
NH
MA
RI
CT
NJ
DE
MD
MN
WI
NY
IA
PA
OH
IL
IN
WV
VA
MO
KY
NC
TN

Sirex Woodwasp

- Sirex Woodwasp is native to Europe, Asia, and northern Africa, where it is generally considered to be a secondary pest.
- In 2005 it was found in a western New York county, other counties followed, later found in one Northern Pennsylvania county.
- It attacks pines almost exclusively.
- On June 6, 2007, identified from a trap in Michigan.

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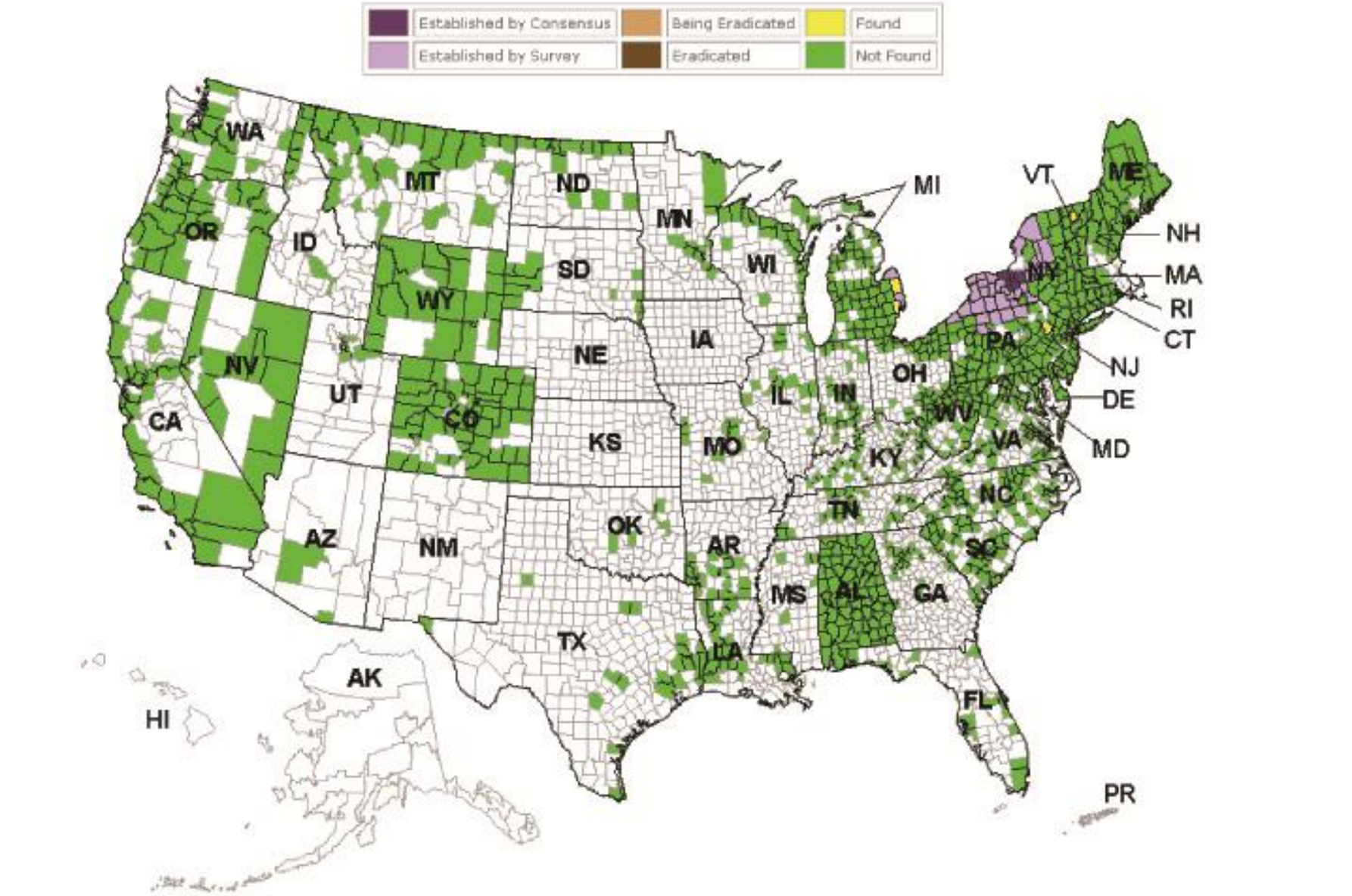
Reported Status of Sirex Woodwasp - Sirex noctilio



This map represents pest survey data submitted to the NAPIS database by participating states in the Cooperative Agricultural Pest Survey program with USDA, Animal and Plant Health Inspection Service.

Data is based on survey observation between 01/01/2006 and 09/07/2009 with the most recent recorded survey on 04/22/2009. CERIS does not certify the accuracy or completeness of this map.

Soybean Aphid

- The soybean aphid is native to Asia and was first reported in the U.S. in July 2000 in Wisconsin.
- Most researchers agree that soybean aphid probably existed prior to 2000 and was probably originally mistaken for cotton or melon aphid.
- By 2003, 21 U.S. states and three Canadian provinces had detected soybean aphid.

Pink Hibiscus Mealybug

- The pink hibiscus mealybug, is an exotic pest species that invaded Hawaii in 1983, California in 1999 and Florida in 2002.
- Worldwide, PHM has been recorded from over 300 host plant species, including citrus, ornamentals, and vegetables.
- A nursery in Homestead, FL, shipped 900,000 hibiscus plants from potentially infested stock to 36 states in the U.S. from January through July 2004.

Thank You!

Any Questions?

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