

Practical Management of Brown Root Rot (*Phellinus noxious*) Field Standards and Practices

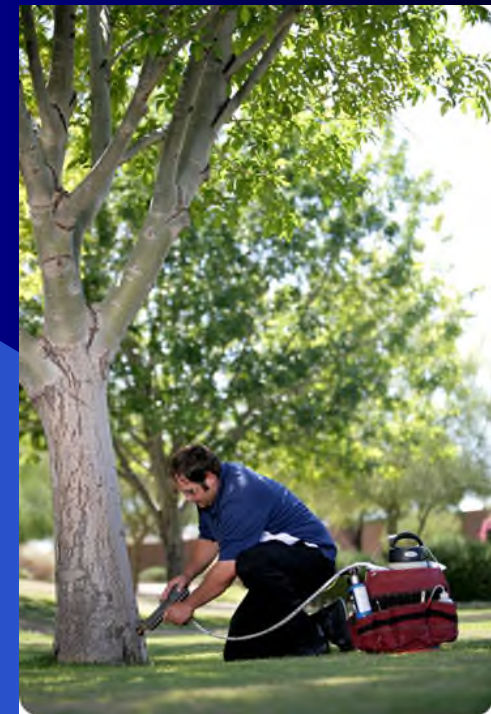


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Basic Requirements

To effectively manage any disease or condition, including BRR:

- **Identify disease and hosts**
- **Understand pathogen character and condition**
- **Develop practical treatment/control/management practices & tools**
- **Educate stakeholders**
- **Train field teams**
- **Audit field operations to ensure conformance**
- **Monitor efficacy and modify if/as appropriate**



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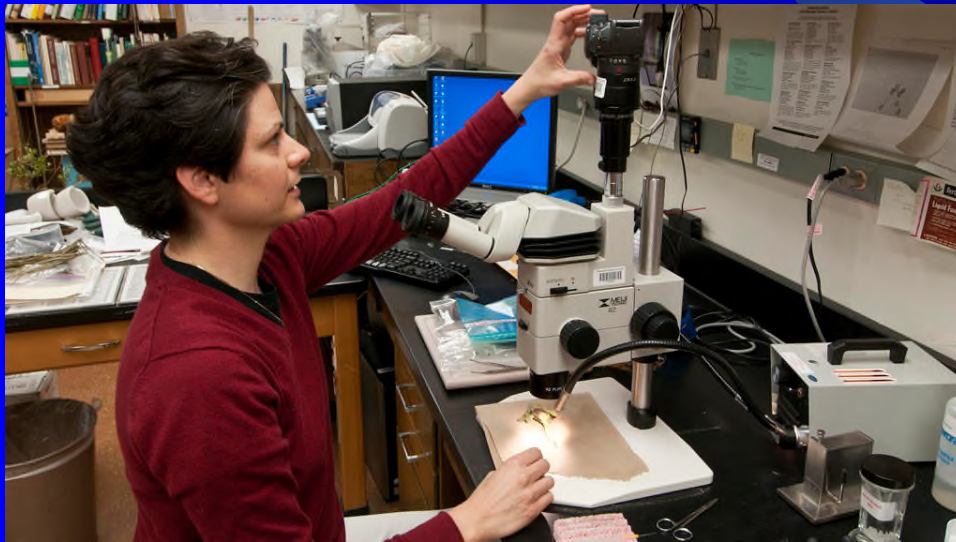
Identify Pathogen & Hosts

Correctly & Timely

Technically, accomplished:

- Greening, Landscape and Tree Management Section, DevB
- Government Departments
- Local and international pathologists
- Arboricultural professionals

New, faster methodologies and tools being developed



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Identify Pathogen & Hosts

Field identification should be enhanced

- Increase number of qualified personnel
- Ensure correct and positive field identification case-by-case
- Develop accurate, rapid-response, field analytical tools



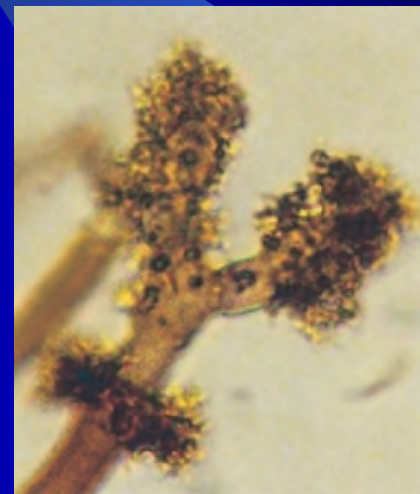
Ensure correct field identification and reporting

Pathogen Character

Basic, working understanding:

- **Mode of Action**
- **Mobility**
 - **Root contact**
 - **Soil borne**
- **Vectors**
 - **People and animals?**
 - **Air and water?**

Ongoing research required....



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Practical Treatment/Control/Management

Basic, working understanding:

- Experience with BRR in other jurisdictions
 - Successful and unsuccessful
- Model actions based on comparable diseases
- Monitor current treatments

Ongoing monitoring and research....



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Educate Stakeholders

Publicize problem, solutions and roles:

- **Public media**
- **Public and professional seminars/workshops - BRR Symposium!**
- **Routine observations by Arborists and Landscape professionals**



- **Expand eyes and ears to identify potential infections more timely**
- **Develop public/political support for solutions**
- **Develop public/political support for resources = capacity**



Ongoing outreach required....



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Train/Maintain Qualified Professionals

Adequate number of qualified professionals conducting work:

- Understand basic tree anatomy and physiology
- Recognize tree species characteristics and patterns of abnormality
- Competent to inspect and diagnose BRR signs and symptoms
- Understand and skilled in selection/application of BRR BMP

Ongoing capacity development and refreshers....



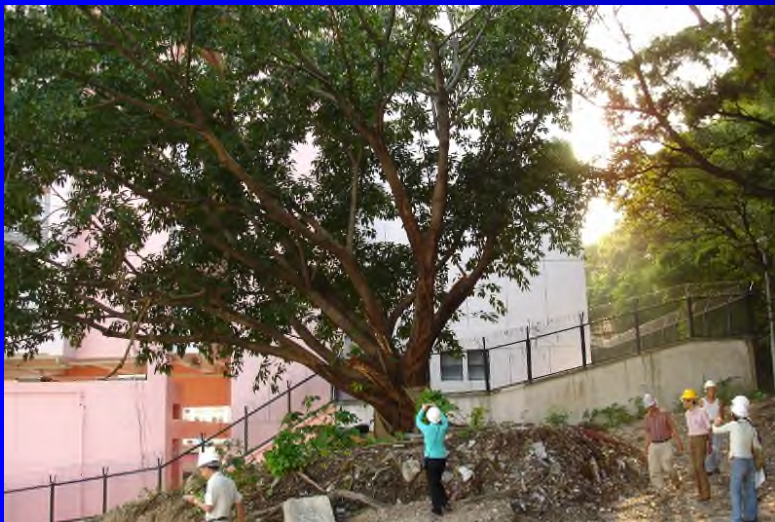
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Monitor/Audit Field Work

Quality Control

- Identify field nonconformance in timely manner
- Observe efficacy of treatments/controls
- Conducted by qualified professionals:
 - Active, effective field team communication
 - Authority and ability to implement modifications


Ongoing: Ensure work quality/Improve performance.

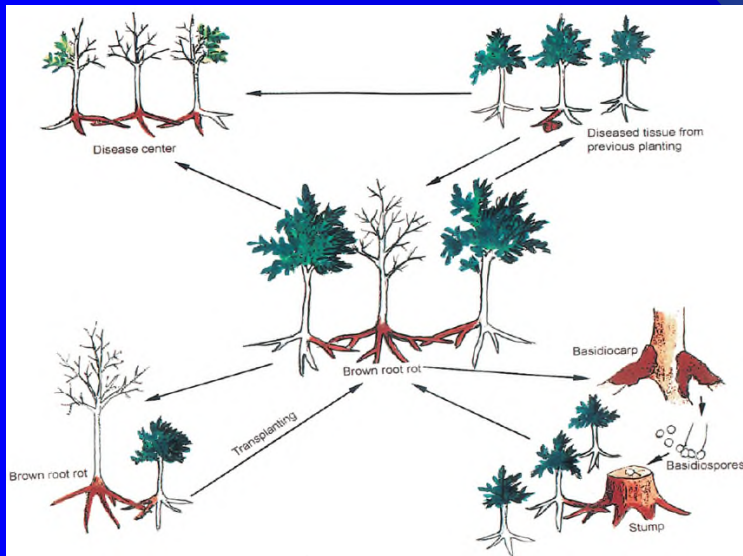


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BRR Identification Characteristics

To effectively diagnose tree condition and prescribe effective treatments:

- **Conduct comprehensive inspection and assessment of entire tree**
 - **BRR signs and symptoms**
 - **Effective, systematic inspection protocol**
 - **Standard inspection progression**
 - **Checklist**
 - **Guide**
 - **Record observations**
- 
- A photograph of a person wearing a yellow hard hat and safety glasses, holding a clipboard and looking up at a tree. They are standing in a field of tall grass and trees, likely conducting an inspection.

[illegible]

Requires Detective Work

Careful observation

- Analytical process
- Application of knowledge & experience



Observe

Stay vigilant

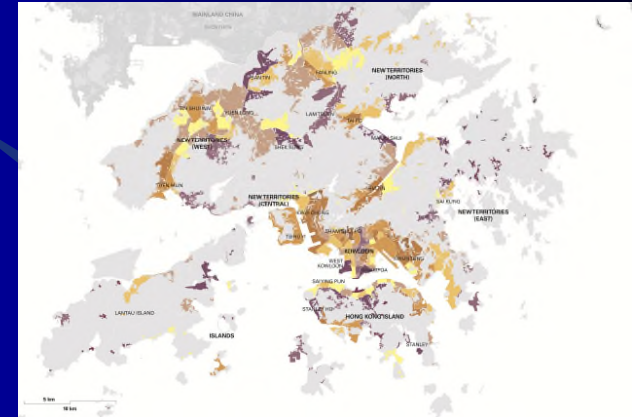
- Broad host spectrum
- Multiple signs and symptoms
 - Appearance may be different in various locations
 - Easy to see in some locations, but difficult in others
 - Trees that appear healthy may have disease



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Maintain Awareness of Current Status

- Identified disease centers
- Susceptible tree species
- Conditions most likely to find BRR



Pathogen Infection Routes

Primarily soil and root borne

- Mobile with water
 - Soil movement dependent on water movement
- Advances through root system contacts - grafting
 - Variable with species and site conditions



Pathogen Movement in Tree

Internal advance inside standing tree slow until tree death

- **Trunk may remain sound for extended period**
- **After tree death, fungus can move very quickly inside trunk**
- **When tree falls, fungus grows very quickly inside and out**
 - **1 meter/month?**



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General BRR Characteristics

Look for clusters of dead trees:

- **Inspect trunk and root crown for fruiting structures**



General BRR Characteristics

Focus on common HK symptoms

Phellinus noxius

Brown root rot disease and its infection of Hong Kong trees



Fruiting bodies on *Ficus microcarpa*, Chinese banyan



Ficus microcarpa: yellowing, leaf size reduction on the upper portion of the tree, defoliation and dieback

Sources: Tree Management Office



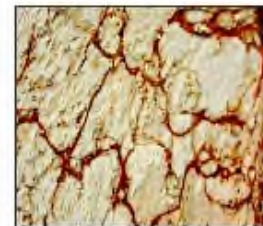
Senescent fruiting body



Primordial stage of fruiting bodies (with white advancing margin and drops of exudates)



Mature fruiting bodies on dead stump and root of *Ficus microcarpa*



Inner bark of *Ficus microcarpa* covered with brownish mycelial nets



Mycelial encrustation on root collar of *Delonix regia*, Flame tree



Soil aggregates on roots of *Ficus microcarpa*

Locations of trees infected with brown root rot disease

- Central and Western (Hong Kong Park, Pok Fu Lam)
- Wan Chai
- Eastern
- Southern
- Yau Tsim Mong (Observatory Headquarters, Kowloon Park)
- Kwun Tong
- Sham Shui Po
- Kwai Tsing
- Tai Po (Tai Po Kau nature reserve)
- Northern
- Lantau (Tung Chung)
- Kam Sham Country Park*

*suspected infection



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Tree Crown

Foliage characteristics

- Sparse density
- Dead leaves
- Small leaf size



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Tree Crown

Dieback

- Tips of branches die
- Epicormic sprouts increase



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Lower Trunk/Root Collar

BRR grows best in wet conditions

- Associated with free water collecting from stem flow
- Fungus height up trunk depends on presence of free water
- Fruiting bodies usually low and even below ground
 - Restricted to root collar to 3 meters high?



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BRR Suspected?

Conduct root/RC excavation with appropriate tools



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Fruiting Bodies

Black stocking mycelial form



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Mycelial Encrustation



Ficus microcarpa



Liquidambar formosana



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Mycelial Encrustation



Bauhinia



Celtis sinensis

Mycelial Encrustation



Delonix regia (OVT LCSD S/39)

Mycelial Encrustation

During dry season - no growth and dry up.



Mallotus paniculatus



Bombax ceiba

Soil Aggregates



Ficus microcarpa

Soil Aggregates



Scolopia saeva (OVT LCSD E/13)



Melia azedarach

Mycelial Nets



Melia azedarach



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Mycelial Nets



Aleurites moluccana

Mycelial Nets



Ficus microcarpa



Scolopia saeva (OVT LCSD E/13)

Fruiting Bodies

Conks



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Dog!

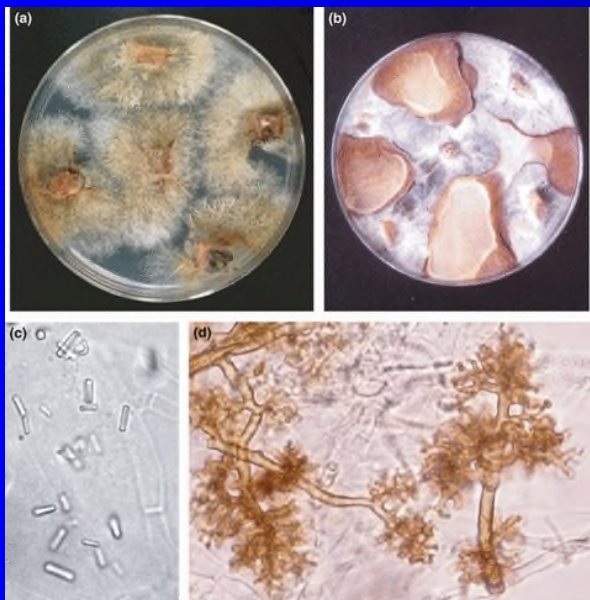


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BRR Suspected?

Confirm:

- **Laboratory diagnosis**
 - culture and/or
 - molecular techniques
- **Correct sampling procedure**
 - Soil
 - Wood/root material
 - Fruiting bodies.



Infected Tree 1 - Action Timeline

Trees confirmed with BRR, but appear in good health

- **Immediate site Quarantine and Physical Root Isolation**
- **Retain and monitor for decline and signs of BRR fruiting**



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Infected Tree 2 - Action Timeline

Decline/confirmed BRR and/or fungal fruiting bodies present:

Immediately remove tree

*** Decline = Loss of > 30% of healthy crown**



Approximately 75% Decline

Action Timeline Justification

Safety & Disease management

- Moves very quickly when tree starts to decline
- Structural integrity of tree declines at base
 - Critical load center = Significant > likelihood of failure
- Tree dies = disease moves faster.

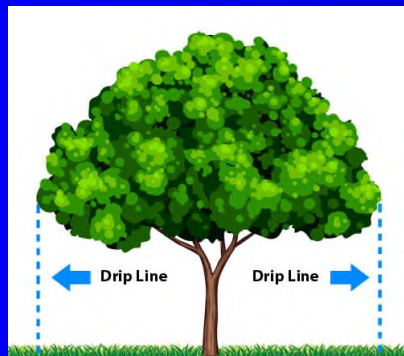


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Quarantine

Barricade site:

- Tree dripline where soil exposed; and
- Subject tree surface roots present



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Quarantine

Prohibit access of unauthorized personnel

- Only trained and demonstrated skill to conform to quarantine requirements



Quarantine

Prohibit soil, wood or plant movement out of site

- Including off-site soil erosion



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Physical Root Isolation

Install physical and chemical trench:

- **Location:**
 - At least dripline for decurrent and 4X dripline for excurrent; or if roots restricted; or
 - Estimated extent of significant root system



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Physical Root Isolation

Width: Wide enough to sever and separate roots

- **Trench treatment:** Apply urea/lime or fungicide along walls of trench



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Physical Root Isolation

Physical trench not practical =
urea-lime/fungicide “chemical trench”



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Manage Fruiting Bodies

Remove fruiting bodies that can be practically removed (e.g. conks) from tree and bag for disposal.



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Infected Tree Removal/Disposal

Great care to avoid contamination of nearby sites:

- During tree removal; and
- Transport of debris



Tree Felling

Fell tree using conventional, safe felling practices



Tree Debris Management

Tree crown/upper trunk of live trees likely not BRR infected

- **Manage debris as standard tree removal**



Tree Debris Management

Lower, infected portions of trunk/stems isolated

- Approximately 2 meters above black sock/other fructification/infected parts



Stump Removal

Stump and large roots should be removed as practical

- Size
- Site restrictions



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Root Removal

All roots must be removed

- *P. noxious* may colonize root system very quickly
- Major structural roots should be removed as practical based on size and site conditions



Root Removal

**Smaller structural roots may be removed through use of a pick
(Cannon Method)**



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Root Removal

Nursery soil screen: Small root and root parts removal

- Screen site soil
- Filter and separate root parts for disposal

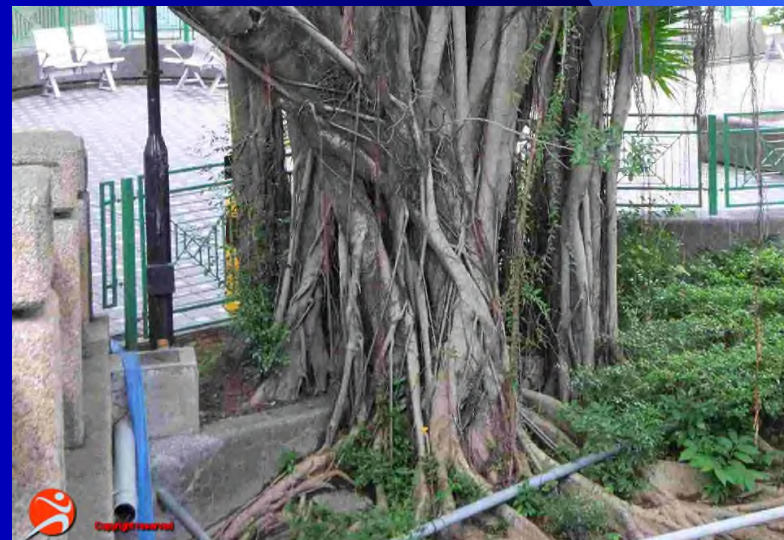


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Manage Vegetation Within Infected Site

Vegetation near infected tree

- Shrubs, perennials, herbaceous
- Within the active root zone
- Remove and properly dispose



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Debris Transport

Infected tree parts in covered lorry

- Upper, uninfected portions of tree transported through traditional methods, but recommended in covered lorry



Disposal

Incineration or landfill

- Fungal fruiting bodies
- Lower, potentially infected portion of trunk
- All roots

Upper portion does not require special handling and may be transported and disposed as convenient



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Tool and Equipment Sanitation

Tools/equipment used to cut and handle infected tree parts/soil must be thoroughly disinfected after operation and prior to leaving site

- **Recommended: 70% ethanol or 2% bleach solution**



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Soil Sanitation

Treat with *Trichoderma* and urea/lime mix?

- Research required to validate this technique



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Soil Sanitation

Excavate soil/dispose and refill with clean soil?

- Research required to validate this technique.



Post-Removal Site Management

Maintain accurate records

- *P. noxious* foci and infected area identified
- Number and size of trees infected
- Treatment(s) applied



Replanting?

May not be advised for up to 40 years without treatment?

- Site treatments will dictate site recovery
- *P. noxious* site monitoring conducted before site replanted.



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Preventive Measures

Best Management Practices (BMP)

- Prior to infection or transmittal
- Most cost-effective



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Timely Identification/Management of BRR Infected Trees and Sites

Remove infected trees as appropriate

- Monitor trees and plants near to infected trees
 - Within 4X of dripline of decurrent trees (*Ficus?*); and
 - 8X dripline of excurrent trees



Identify/Map Disease Centers

Enhance identification and management

- Industry and public participation encouraged
- Process:
 - Identify infected tree(s)
 - Walk area with GPS approximately 10 meters from foci
 - Pathogen should expand approximately 3 meters' per year depending on tree species, soils and rain



Minimize Source of BRR Inoculum

Maintain healthy soils

- Prevent movement of infected plants, wood and soils
 - Test prior to tree/soil transport



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Proper Tree Planting/Maintenance

Goal: vigorous trees with some BRR resistance

- Right tree at the right place
- Sufficient growing space
- Plant at correct depth
- Proper irrigation and nutrition management
- Mulch root zone
- Proper pruning
- Protect trees – wounds open to exposure

Stressed trees are most susceptible

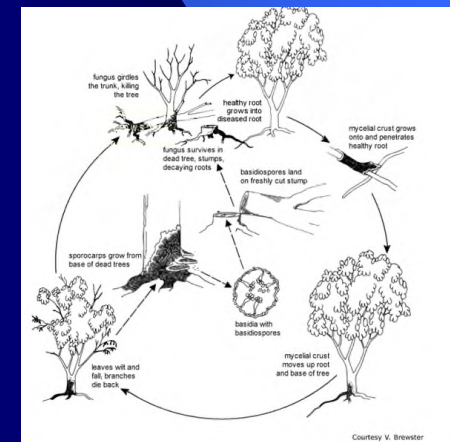
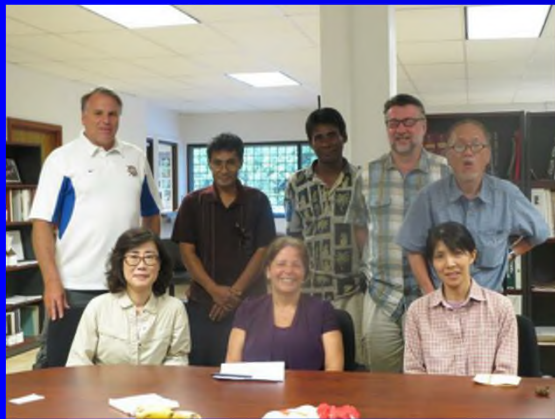
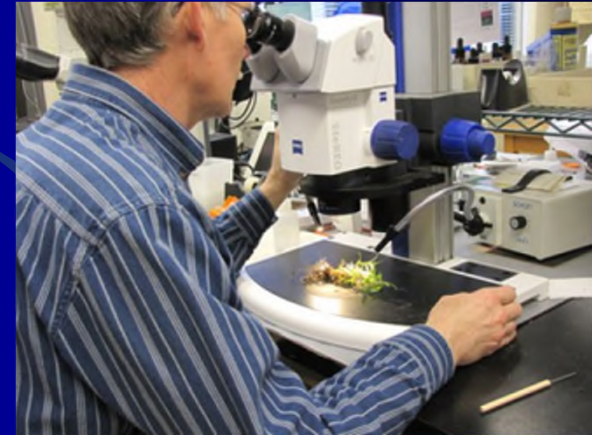


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Ongoing Monitoring & Research

Knowledge = Power

- Enhance understanding
- Develop better tools and techniques
- Ensure maximum reasonable control



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Questions?

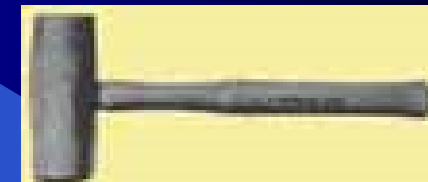
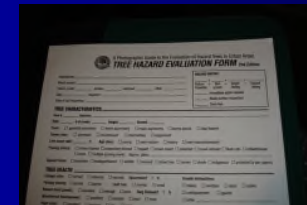


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Assessment Tools

Minimum tools and equipment required:

- Camera
- Weather-resistant clipboard
- At least 2 pencils with sharpener
- Standard inspection/assessment forms
- Tree diameter tape
- Binoculars
- Small, sharp knife
- Large mallet
- Hand drill
- Sharp metal probe
- Hand pruner
- Shovel
- Marking paint and/or flagging
- Paper towels
- Ziploc plastic bags



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Site Inspection

Site disturbance

- **Tree support structure adapted to conditions during tree growth**
- **Poor conditions and changes disrupt or destroy roots or growth**



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Tree Inspection

Inspect and analyze tree health and condition:

- General tree characteristics
- Tree crown
- Root system
- Root collar
- Trunk(s)
- Limbs and branches
- Insects and diseases



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Tree Inspection

Tip dieback

- **Relative percentage of crown**
- **Significant percentage indicates health problems**
- **Usually symptom of root disorders**



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