

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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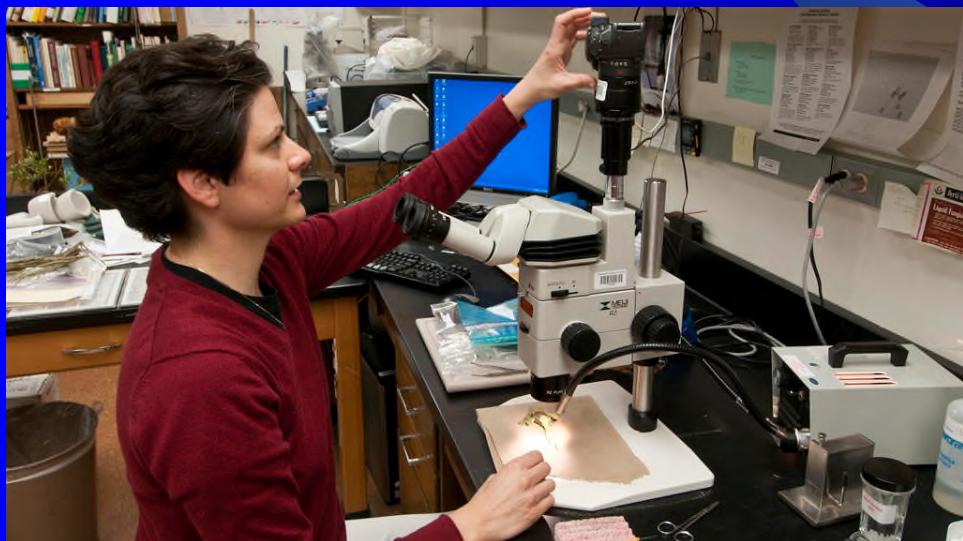
Identify Pathogen & Hosts

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

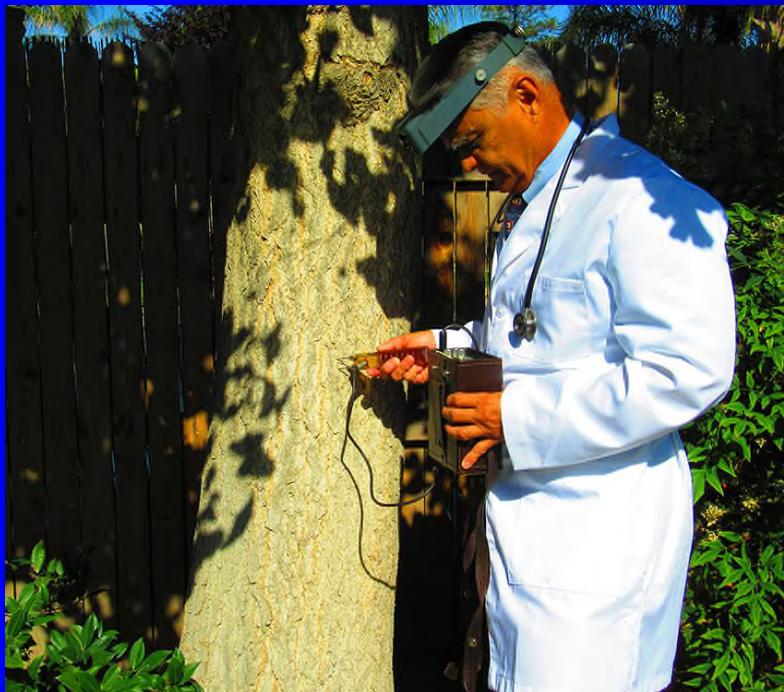


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Identify Pathogen & Hosts

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



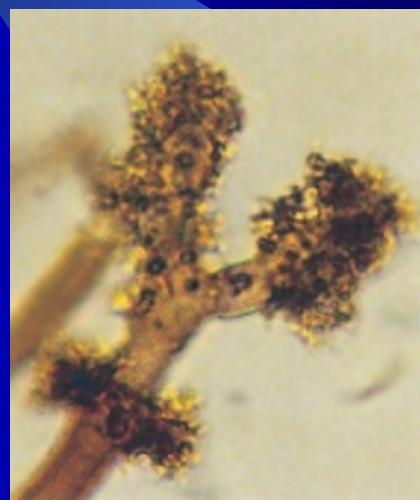
Ensure correct field identification and reporting

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.

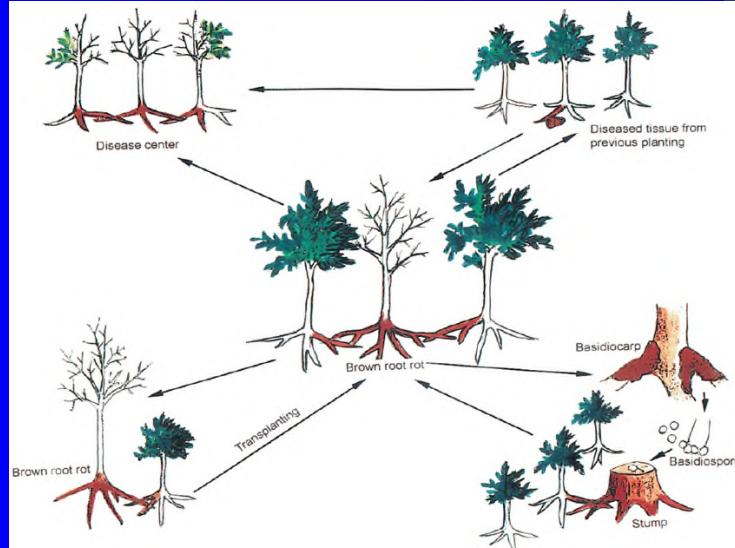


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BRR Identification Characteristics

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



Plant Disease Identification Form
University of Kentucky
College of Agriculture, Food and Environment
Plant Diagnostic Laboratory
Lexington, KY 40546-0091
Plant Disease Diagnostic Laboratory
Lexington, KY 40546-0245

County: _____
County Extension Agent: _____
County sample number: _____
County sample date: _____
Lab test date: _____
Lab file no.: _____
Diagnosis: _____
Date completed: _____

Grower: _____
Address: _____
City: _____
State: _____
Zip: _____
Small: _____
Large: _____
Phone: _____

Commercial sample: _____
Parts diseased: Root Trunk Flowers Fruits Leaves/needles Roots Stems Stems/leaves/needles Flowers Fruits Stems/leaves/needles and flowers/fruit Flowers and fruit Stems and leaves/needles Stems and flowers/fruit Stems and leaves/needles and flowers/fruit Other _____

Percent of planting affected: _____
Date problem first noticed: _____
Planting date or age of plant: _____
Soil type: _____
Soil drainage: _____
Previous cropping: _____
Irrigation practices: _____
Recent weather and irrigation practices: _____

Chemicals applied to this crop (check one, name and date of application):
Insecticide: _____
Herbicide: _____
Fungicide: _____
Insecticide: _____
Additional information: _____

At the time of diagnosis, report will be sent to the local County Extension Office and to the state of arrival if applicable.
Name _____
Address _____
City _____
State _____
Zip _____

1) What is the distribution of affected branches? Indicate location of damage on the diagrams below.
 Scattered branches all over tree/club
 One portion of tree/club only
 Several portions of tree/club
 Entire plant
 None

2) What is the progression of symptoms throughout the tree/club (e.g. from lower branches to top; from branch tips towards trunk; from one side to another; etc.)?

3) What is the progression of symptoms on leaves/needles? (e.g. leaf margin/needle tips inward; between leaf veins)
 Leaf margin/needle tips inward
 Between leaf veins

4) Has problem occurred: already or rather suddenly? How rapidly? _____
5) Are any other diseases, or injuries (insects, strong winds, etc.) present on main limbs or trunk? Yes No
Describe site and location: _____

How old are cankers or injuries indicated above? _____ Is there any evidence of "bleeding" (leakage)? Yes No

6) Does tree have a girdling root up near trunk, at soil level, or below soil level? Yes No
(use for a large root forming a "knot" around trunk within 12 inches of soil surface. Major trees (5 years or more) that are girdled lack a normal flow of fuel between root and canopy, causing the tree to drop out of the ground (a "windleene" point).)

(continued on reverse side)



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Requires Detective Work

Careful observation

- Analytical process
- Application of knowledge & experience



Observe

Stay vigilant

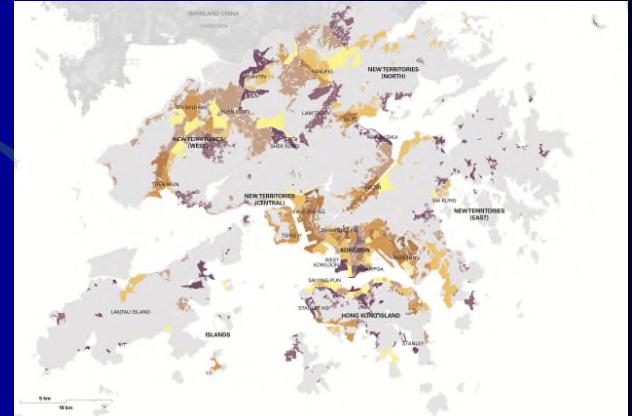
- **Broad host spectrum**
- **Multiple signs and symptoms**
 - Appearance may be different in various locations
 - Easy to see in some locations, but difficult in others
 - Trees that appear healthy may have disease



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Maintain Awareness of Current Status

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



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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?

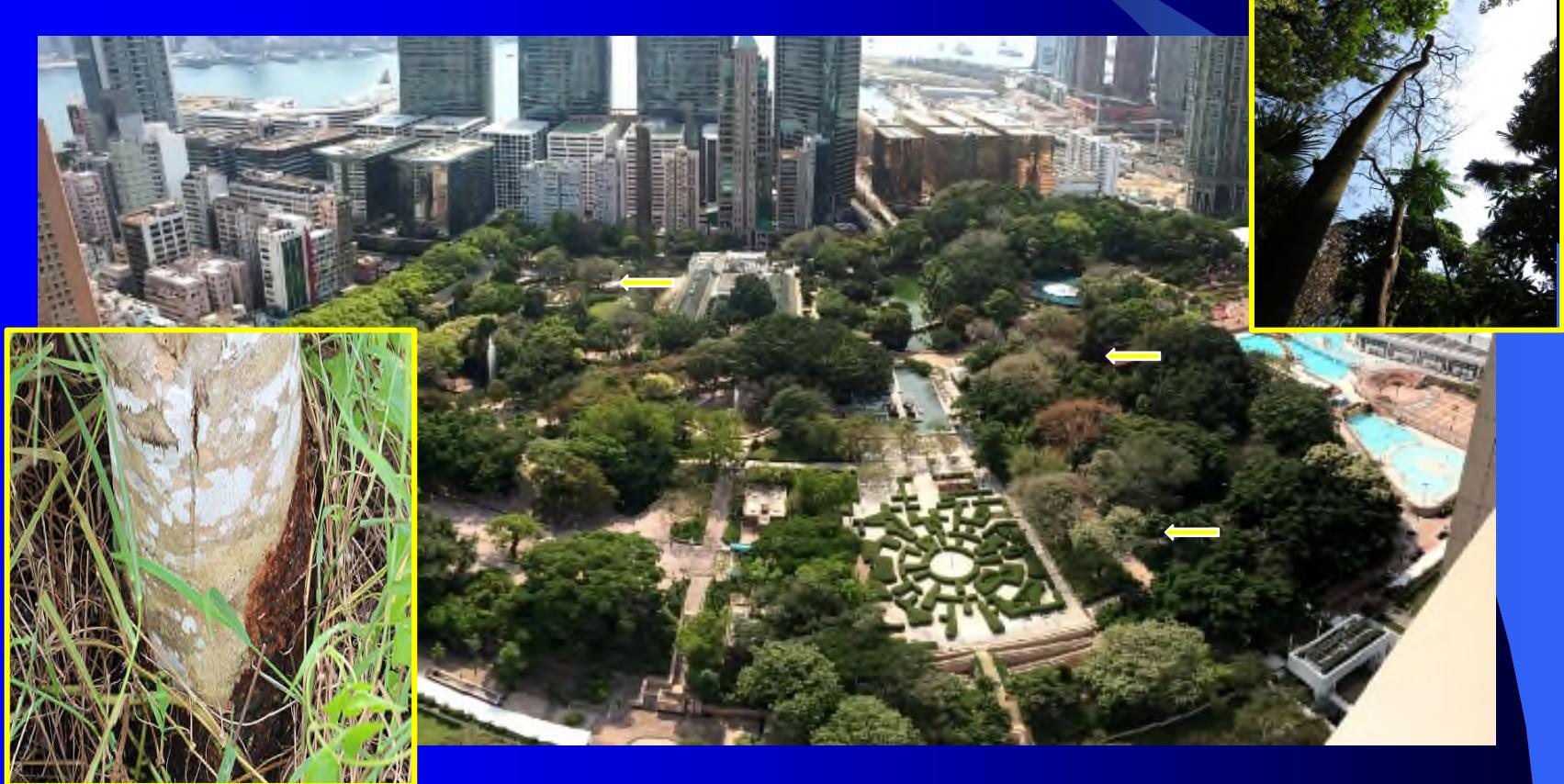


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General BRR Characteristics

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



Fruit bodies on *Ficus microcarpa*, Chinese banyan



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



Senescent fruiting body



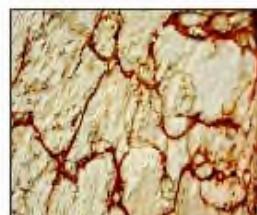
Primordial stage of fruiting bodies (with white advancing margin and drops of exudates)



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



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



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



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
- Kwi Tsing
- Tai Po (Tai Po Kau nature reserve)
- Northern
- Lantau (Tung Chung)
- Kam Shan Country Park*

*suspected infection

Source: Tree Management Office

SCMP



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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



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Mycelial Encrustation



Delonix regia (OVT LCSD S/39)



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Mycelial Encrustation

During dry season - no growth and dry up.



Mallotus paniculatus



Bombax ceiba



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Soil Aggregates



Ficus microcarpa



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Soil Aggregates



Scolopia saeva (OVT LCSD E/13)



Melia azedarach



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Mycelial Nets



Melia azedarach



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Mycelial Nets



Aleurites moluccana



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Mycelial Nets



Ficus microcarpa



Scolopia saeva (OVT LCSD E/13)



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Fruiting Bodies

Conks



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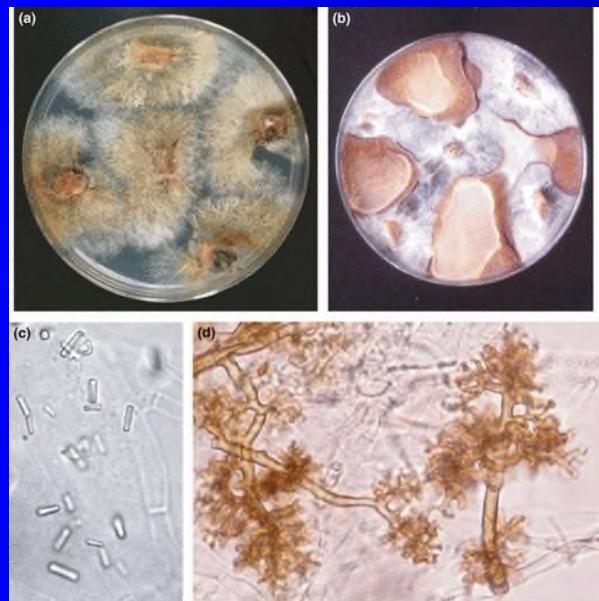
Dog!



BRR Suspected?

Confirm:

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



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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



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.

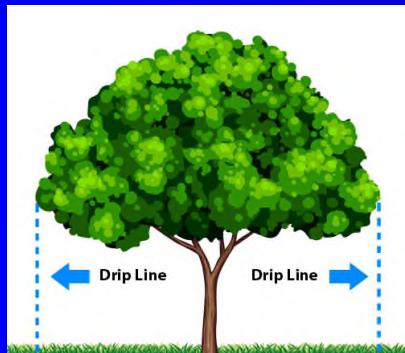


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Quarantine

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



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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



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Tree Felling

Fell tree using conventional, safe felling practices



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Tree Debris Management

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

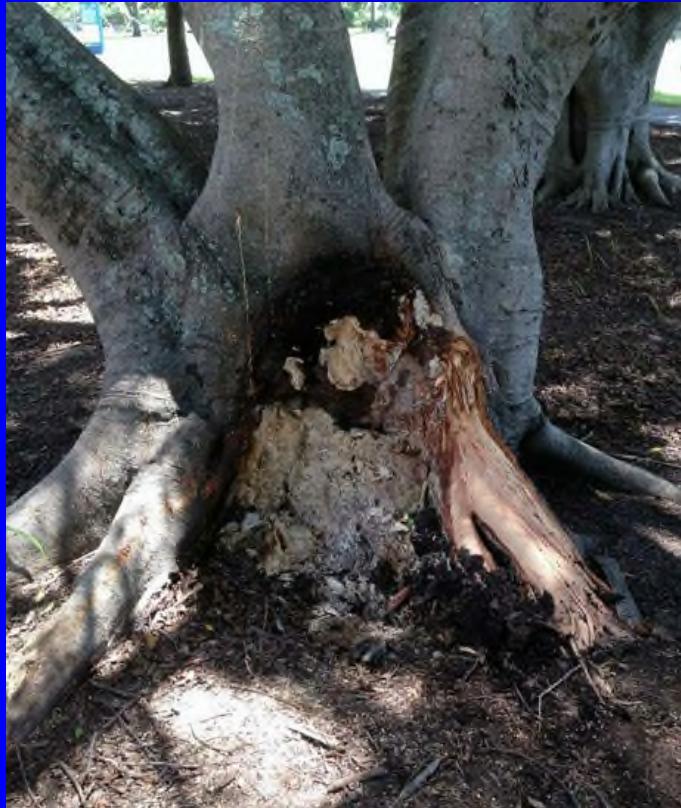
- Manage debris as standard tree removal



Tree Debris Management

Lower, infected portions of trunk/stems isolated

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



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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



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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



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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

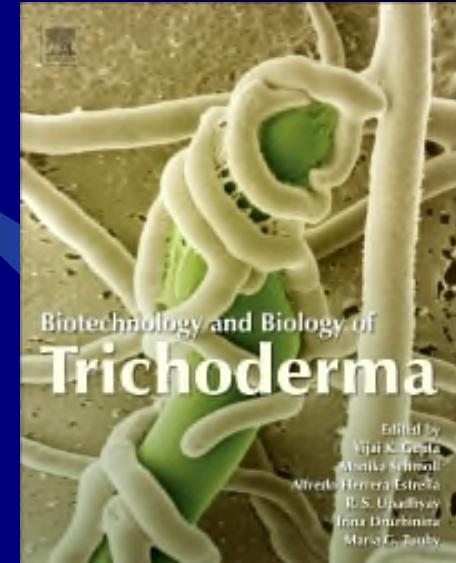


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Soil Sanitation

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.



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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

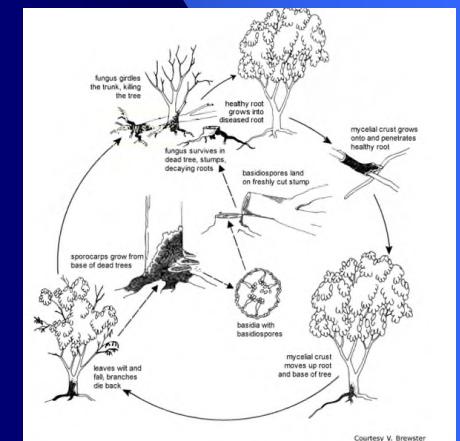


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Ongoing Monitoring & Research

Knowledge = Power

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



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唔該!

Questions?



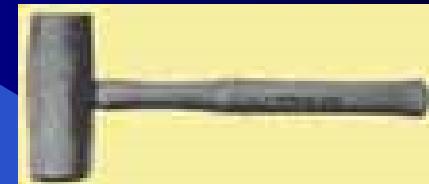
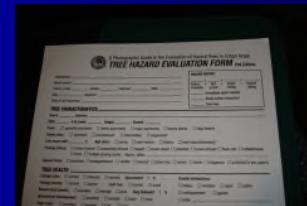
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Assessment Tools

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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