

## Annex II

### Frequently asked questions on Brown Root Rot Disease

#### **Biological Background:**

#### **Q1. What is *Phellinus noxius*?**

**A1.** *Phellinus noxius* is a fungus that causes BRR disease on trees. Belonging to the genus *Phellinus*, *P. noxius* is placed under the family of Hymenochaetaceae within the Phylum Basidiomycota. Most of the species within the genus *Phellinus* act as saprotrophs in nature or as weak pathogens on trees. Only very few species are pathogenic with strong virulence, and *P. noxius* is one of the strongest among them. It prefers acidic, hot and humid conditions. It is characterised by its brownish black fruiting bodies (which will turn black with a drop of 3-5%KOH) with no clamp connections in its vegetative hyphae. The species within *Phellinus* are the typical white rotters, which can release enzymes through the action of microhyphae and decompose lignin and polysaccharides such as cellulose, hemicellulose and pectic substance, resulting in wood decay. *Phellinus noxius* causes white simultaneous rot in which the major components of wood (i.e. cellulose, hemicellulose and lignin) degrade at approximately the same rate.

#### **Q2. What is the host range of *Phellinus noxius*?**

**A2.** It has been reported that over 200 plant species in 59 families are hosts to *Phellinus noxius*. In Hong Kong, we know that trees species such as *Aleurities moluccana*, *Bombax ceiba*, *Celtis sinensis*, *Delonix regia*, *Ficus microcarpa*, *Ficus benjamina*, *Gleditsia fera*, *Lophostemon confertus*, and *Mangifera indica* are host to BRR disease.

#### **Q3. What are the potential infection routes of BRR disease in tree?**

**A3.** The disease mainly spreads through root-to-root contact or through infested wood debris in soil, though there may be the possibility of spreading of the disease through the dissemination of basidiospores from fruiting bodies. According to literature, mature fruiting bodies of *Phellinus noxius* seldom form in nature, though their basidiospores may assist in the long range dissemination of the fungus. In Hong Kong, there were observations that fruiting bodies of *Phellinus noxius* produced massive basidiospores on infected trees. The prevalence of the fruiting bodies in this region remains unknown. **The potential infection route of BRR disease in trees is shown**

in diagram 1.

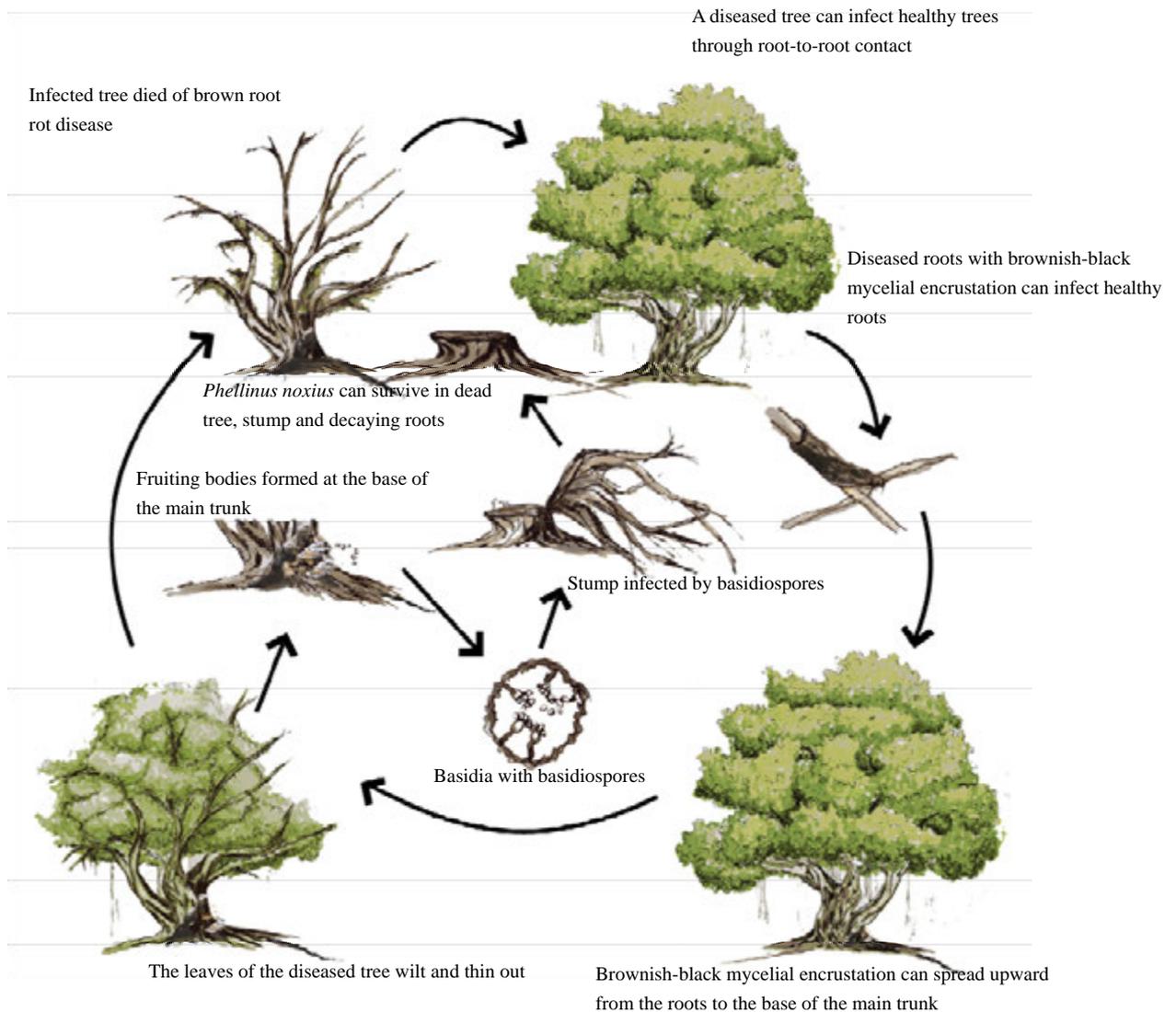


Diagram 1. The potential infection routes of brown root rot disease in trees (Based on Brooks, F.E. 2002. Brown root rot. The Plant Health Instructor).

**Q4. What are the geographical ranges of BRR disease?**

**A4.** The disease is prevalent in tropical and subtropical regions in different part of the world and has been found in Asian countries & regions such as Japan, Mainland China, Hong Kong, Taiwan, Malaysia, Singapore as well as Central America, Africa and Oceania.

**Q5. Is there an effective cure to BRR disease?**

**A5.** According to literatures and expert opinion, there is yet to be an effective cure for BRR disease.

**Diagnostic Methods:**

**Q6. What are the methods available for diagnosis of BRR disease on trees?**

**A6.** There are currently two main levels of diagnostic methods available for determination of BRR disease in trees, namely **field diagnosis through visual tree assessment** and **laboratory diagnosis through fungal isolation method and/or molecular diagnosis**.

**Q7. How is BRR disease detected through field diagnosis?**

**A7.** Field diagnosis through visual tree assessment is based on observable symptoms and signs of BRR. There are two steps. Step 1: Identify abnormal crown symptoms (e.g. sparse foliage density, abnormal foliage colour (chlorosis), abnormal leaf size, dieback twigs) as these are exhibited in infected trees. Step 2: examine the entire lower trunk, root collar and individual roots of the trees to look for typical signs of BRR disease, i.e. a) fruiting bodies of *Phellinus noxius*, b) mycelial encrustation, c) soil aggregates and d) mycelial nets. If a tree with a crown abnormality contains one or more of the typical signs of BRR disease under step 2 examination, the tree is considered infected with BRR disease.

**Q8. What crown symptoms are observed on trees with BRR disease?**

**A8.** Symptoms of the disease are of two types, namely slow decline and rapid decline. For trees experiencing slow decline, the most noticeable symptoms may include crown thinning out gradually and turning yellowish and their leaves reduced in size or even dropped as a result of early senescence. The trees could be dead in months or one to two years and structurally become unstable. Trees suffering from quick decline will wilt rapidly. Their leaves become brownish in color and the trees will die within weeks. The leaves of the dead trees will not fall immediately but remain attached on the branches for months. **Please refer to section A of Annex I in pictorial guide for general symptom of trees infected with BRR disease.**

**Q9. Are the general symptoms observed on tree crown unique to BRR disease?**

**A9.** No, the abnormal crown symptoms are commonly associated with root diseases and malfunctions, and are not unique to BRR disease. Thus, it is important to further examine the lower trunk, root collar and roots for typical signs of BRR disease.

**Q10. Elaborate on the typical signs of BRR disease to look for at the lower trunk, root collar and individual roots of the trees.**

**A10.** The typical signs of BRR disease are a) fruiting bodies of *Phellinus noxius*, b) mycelial encrustation, c) soil aggregates and d) mycelial nets.

(a) The appearance, on lower trunk or roots, of brownish-black/dark greyish-brown colored imbricate or resupinate fruiting bodies of *Phellinus noxius* with their characteristic porous hymenium surface up-facing is an obvious sign of BRR infection. The sizes of fruiting bodies vary greatly ranging from 3-10 cm in length to 8-20 cm in width. The fruiting bodies of *Phellinus noxius* are the sexual stage of the fungal lifecycle and their development, under the right conditions, begin with the formation of the primordial stage. The developing fruiting bodies would continue to grow in size, reach a stage of maturity in bracket and/or resupinate forms from which basidiospores are formed for dissemination, and end at senescence. There are occasions where the developing fruiting bodies become abortive and reach premature senescence without forming basidiospores. **Please refer to section B of Annex I in the Pictorial Guide for fruiting bodies of *Phellinus noxius* on infected trees.**

(b) If the mycelia of *Phellinus noxius* are spreading under the bark, or under the outer layer of roots, these parts can peel off easily. The diseased parts look rough with flaky appearance on their surfaces covered by a brownish-black mycelial encrustation. Normally, the mycelial encrustation can extend from the root collar to 1 m high on the tree trunk. There are also reported cases from the literature that mycelial encrustation can reach 2-3 m in height. **Please refer to section C of Annex I in the Pictorial Guide for mycelial encrustation.**

(c) and (d) If fruiting bodies of *Phellinus noxius* and mycelial encrustation cannot be found, the bark of the entire lower trunk/root collar and the outer layer of all the roots of the suspected diseased tree should be examined. If necessary, cut open with appropriate tools (e.g. handheld adze, knife, etc.) upon soil

excavation to check for soil aggregates and yellow, dark brown or brownish-black mycelial netting on the inner surface between the bark and the wood tissues. **Please refer to sections D and E of Annex I in Pictorial Guide for soil aggregates and mycelial nets.**

**Q11. Are tools required in checking the lower trunk, root collar and individual roots of trees?**

**A11.** Yes, root excavation with appropriate tools (e.g. handheld adze, digger, air spade, etc.) may be required to expose the root collar and roots. The exposed root collar and roots could subsequently be examined for the typical signs of BRR disease. Scraping off of bark tissue should only be conducted on decayed, damaged or dead wood/roots. Mallets may be used to differentiate healthy wood/roots from decayed, damaged or dead wood/roots. Damage to healthy wood/roots should be avoided as this may cause unnecessary damage to the tree, which may also create open wound for fungal invasion.

**Q12. Is it difficult to diagnose BRR disease on trees in early stage of infection?**

**A12.** Yes, early diagnostic symptoms of BRR disease are often difficult to detect, despite the fact that the disease can cause a rapid decline in tree growth conditions within a short time. More often than not, obvious symptoms will only be visible at a late stage of infection. Once symptoms such as abnormal crown symptoms (e.g. sparse foliage density, abnormal foliage colour (chlorosis), abnormal leaf size, dieback twigs are discernible in the above ground portion of the tree, the majority of its roots are likely to have been infected and the tree basically cannot be cured.

**Q13. Under what circumstances are laboratory diagnosis used in BRR detection?**

**A13.** Laboratory diagnosis would be required to confirm disease status of trees exhibiting no detectable symptoms and signs of BRR disease (i.e. trees in the root zone area of another tree infected with BRR). Laboratory diagnosis would also serve as a tool to verify the findings of field diagnosis on trees of special significance (i.e. Old and Valuable Trees).

## **Management Strategy of BRR Disease**

### **Q14. What are the management strategies of BRR disease in Hong Kong?**

**A14.** We adopt a dual-pronged management strategy comprising precautionary and preventive measures. The objectives of this approach are to keep our trees healthy, and at the same time to minimize the source of BRR inoculum as far as possible.

### **Q15. What are the precautionary measures for BRR disease management?**

**A15.** Proper tree planting and maintenance practices are the best precaution one can take against BRR disease. These practices include planting the right tree at the right place, providing sufficient growing space, planting at the right depth, proper irrigation and fertilization regimes, and mulching of root zone, not to mention regular and proper pruning. In particular, number and size of pruning wounds as well as damage to the roots should be kept to a minimum. This reduces the surface area where infection may start off.

### **Q16. What are the preventive measures for BRR disease management?**

**A16.** Preventive measures are necessary to minimize the source of BRR inoculum and control the spread of the BRR through removal of diseased parts. Trees in the Category I of Tree Risk Management Zone (i.e. areas of high traffic flow and high pedestrian flow such as public parks, playgrounds, roadside etc) infected with BRR disease should be removed entirely, including fruiting bodies, stumps, wood debris and associated fine roots in soil medium.

### **Q17. How are trees of special value and significance infected by BRR disease treated?**

**A17.** There are occasions where preservation of a tree warrants retention (e.g. Old and Valuable Trees or trees that draw strong public sentiment for preservation). In these circumstances, the structural stability of the infected tree should be ascertained by conducting a thorough tree risk assessment, followed by soil excavation with proper tools (e.g. adze, digger or air spade, if applicable) to examine the extent of the infection and decay at critical locations, such as at the root collar and subsoil surface levels. The use of advanced examination techniques such as tomography and resistography will offer additional information about the extent of internal decay at

the root collar and sub-soil levels. Trees that are structurally unstable should be cordoned off and removed as soon as possible. Trees that are justified for retention from a structural stand point should be closely monitored on a quarterly basis to re-assess their structural integrity/stability.

**Q18. How the stability of trees infected with BRR disease may be ascertained?**

**A18.** Since BRR disease causes root rot at the lower trunk above grade level (e.g. it could be observed up to 2 m in some tree species) and/or root collar and/or roots at the sub-soil level, it is essential to evaluate the thickness of sound wood of the tree at horizontal plane at critical levels (i.e. area showing decay and/or specific signs/symptoms of BRR disease) of the lower trunk, as well as at the trunk base, through the use of tomography and/or resistography. For sub-soil level evaluation, the trunk base or even at lower levels (e.g. after soil excavation using spade and/or air spade without affecting tree stability) could be assessed using resistography drilling at an angle (45 degree) downwards which could provide some indication on the relative soundness of tree roots.

**Q19. What is the effectiveness of chemical control on BRR infected trees?**

**A19.** Treatment through chemical means is only an interim measure. It will not revitalize a tree or improve its structural stability. Interim measures may include applying fungicides to trees at the early stage of BRR infection showing no foliage abnormality or major symptoms of BRR.

**Removal Procedures of BRR Infected Trees**

**Q20. Is the installation of trench recommended to prevent spread of BRR disease to neighboring trees?**

**A20.** Yes, this is because root to root contact is still the main route of transmission of BRR disease. It is important to prevent the spread of the disease through digging of a trench ideally of 1 m depth by 1 m width at the dripline of an infected tree, followed by application of a root barrier to separate it from healthy ones. Such application, however, may not be feasible for trees with restricted root zone such as trees on planter or trees grown on slopes.

**Q21. Will annuals and shrubs be carriers of BRR disease?**

**A21.** Yes, annuals and shrubs may be carriers of BRR disease. As such, it is advisable to avoid planting such vegetation near the root zone, particularly under Old and Valuable Trees or mature trees in confined, restricted or graded areas. This is to minimize the inoculum of BRR disease. Please also refer to “Proper planting Practice-Keep Sufficient Space Clear of Vegetation at the base of Tree” available at [www.greening.gov.hk](http://www.greening.gov.hk)

**Q22. Is the removal of fruiting bodies of *Phellinus noxius* an effective way to prevent the spread of the disease?**

**A22.** While fruiting bodies of *Phellinus noxius* should be removed and properly disposed of as soon as possible, they are the sexual stage of fungi and their removal can only prevent the dissemination of basidiospores, but could not remove the mycelia that are present in the infected trees.

**Q23. How should the soil medium containing the infected debris be handled?**

**A23.** Depending on the amount of soil that needs to be handled, the soil medium could either be disposed of at landfills or disinfected with a soil fumigant on-site. For instance, if a manageable amount of soil could be replaced (i.e. in a planting strip or confined planter), the contaminated soil should be disposed of at landfills.

**Q24. Do we need to sterilise the tools after examining trees with BRR disease?**

**A24.** Yes, tools like adze, knives, scissors, shovels etc. and transportation equipment (such as hopper car etc.) used in the infected area should be disinfected (e.g. with 70% ethanol or 1:49 bleach) after operation.