Plant and Truffle Health considerations for truffles and truffle trees in British Columbia

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1 Introduction

This document is an introduction for actual and prospective truffle farmers of British Columbia to the diseases and other concerns that may affect the trees and truffles in their truffières. This document is not to be considered the final authority, as situations change and the information here may become obsolete. For authoritative, specific and current information, consult the Canadian Food Inspection Agency and the British Columbia Ministry of Agriculture and Land Plant Diagnostic Laboratory.

After a brief introduction to the two European truffle species being introduced into the province, we discuss the three major diseases affecting truffle tree species and then touch upon some of the lesser diseases. We then explore a bit about the trees that associate with truffles. Finally we address concerns related to the truffles themselves.

1.1 The Truffle Fungi

Although there are many truffle species in the world, only a dozen or so are currently commercially harvested and fewer still can be cultivated. Because of climate limitations in British Columbia, it may be that only 2 commercially cultivated species have potential here, *Tuber melanosporum* and *Tuber aestivum*, and the commercial production of even these two species has yet to be demonstrated in the province.

Tuber species are ectomycorrhizal (i.e., mutually beneficial or symbiotic with the roots of specific trees) and therefore are dependant on association with healthy host trees.

1.1.1 Périgord Black Truffle

The Périgord black truffle (*Tuber melanosporum*) is a famous product of the broad oak forests of central and southern France, central and eastern Spain, central and northern Italy, and other parts of Europe. It is a gastronomic delight that has inspired chefs for centuries. A true Périgord black truffle can cost in excess of $1,400 per kilogram in a scarce year such as 2005 and remains

Figure 1 - Black Perigord Truffle – cut in half

one of the most expensive food products around. The Périgord black truffle has a reddish-brown to brown or black exterior when fresh and black interior when fully mature. This is the species that many commercial growers are now cultivating in orchards or truffières in Europe, New Zealand, Australia and the United States of America by planting seedlings inoculated with the truffle spores. The inoculated trees are grown to maturity in the truffière all the while maintaining conditions favourable to the mychorrizal fungus on its roots. Roughly 95% of the truffle trees now growing in British Columbia are inoculated with this species.

1.1.2 Burgundy or Summer Truffle

The Burgundy truffle (*Tuber aestivum*) has an intense aroma and mimics the Périgord black truffle with its brown to black exterior and dark brown interior at maturity in the fall. When it fruits in the summer, this fungus is called the summer truffle and the aroma is less intense. This truffle is native to Europe from southern Sweden to France, Italy, Spain and the United Kingdom. Because relatively few trees inoculated with this fungus have been planted in the province, the rest of this document focuses on the Périgord black truffle. However, many of the pathology and pest concerns of these two truffle species overlap.

Figure 2 - Summer

1.2 The Truffle Trees

There are a number of tree species with which *Tuber melanosporum* will form an ectomycorrhizal association, but only a few species currently have commercial importance in British Columbia. These are the Common Hazel (*Corylus avellana*), the English Oak (*Quercus robur*), and the Holly Oak (*Quercus ilex*).

Although there are many fungal diseases that can affect truffle trees (including foliar spots, rusts, cankers, root rots, collar rots, and wood rots according to Hall et al. 2007), our research to date has revealed three diseases of consequence for truffière owners in the province. *Anisogramma anomala* (Eastern Filbert Blight) and *Xanthomonas campestris* (bacterial blight) attack *Corylus avellana* (Common Hazelnut) and *Phytophthora ramorum* (Sudden Oak Death) can attack *Quercus robur* (English Oak) and *Quercus ilex* (Holly Oak).

2 Eastern Filbert Blight

Eastern filbert blight is a disease of hazelnut trees caused by the fungus *Anisogramma anomala*. In spring, spores are released from mature cankers in infected hazelnut trees. Wind-driven rain spreads spores to young, developing shoots, where infection occurs. The second summer following infection, the fungus starts to produce the spore-producing structures that are used for identification. These structures will release spores the following spring. Vigour and productivity decline significantly when trees are infected with this fungus, resulting in an economically unproductive orchard and poor support for the mychorrizal truffle fungus.

Figure 3 Eastern Filbert Blight

Figure 4 Eastern Filbert Blight in the Fraser Valley, 2008

2.1 Detection or Scouting

Scout orchards for disease and submit samples to the Plant Diagnostic Lab (see Section 8 for contact information) if you suspect your orchard may have the disease. Microscopy is needed to confirm any suspects. Most often, cankers are found in the tops of trees. Inspect dying branches for the fruiting bodies. Note that no symptoms are visible for approximately 15 months after infection.

When planting a hazelnut orchard or replacing trees, it is best to use a blight resistant or immune variety. However, in British Columbia the choice of hazelnut variety inoculated with truffle fungi will be limited to the varieties selected by nurseries doing inoculations.

Resistant varieties	**Immune Varieties**
Clark	Gasaway
Lewis	Santiam
Gem	Yamhill
TdG	VR series
	Gamma
	Delta
	Epsilon
	Zeta

Source: Oregon State University, Eastern Filbert Blight Help Page, Plant resistant cultivars (see Section 8 for details on this source)

2.2 Use of Fungicides for control

There are some fungicides approved for use against eastern filbert blight in the province. However, be aware that fungicides can attack the mycorrhizal fungi associated with the host tree if the fungicide is systemic or it is allowed to drip onto the soil under the canopy.

Copper sprays registered for control of filbert blight in Canada include Guardsman Copper Oxychloride 50 (PCP #13245) and UAP Copper Spray (PCP #19146). Up to 3 applications of copper may be applied per year.

Quadris flow-able Fungicide, PCP # 26153 is approved for control of eastern filbert blight in Canada. Protective applications may be applied from bud swell to bud break (approximately mid March to mid May), when tissues are susceptible. The label recommends two sequential applications followed by two or more

applications of fungicides with different modes of action (copper). Do not use within 45 days of hazelnut harvest. Do not allow drift onto apple or crabapple. For more information, consult the British Columbia government pamphlet entitled *Hazelnut Pest Management Guide for BC Commercial Growers* (see Section 8).

2.3 Removal of Cankers

Because pruning will be more benign for the mycorrhizal fungi than the use of fungicides, pruning should be employed actively and aggressively in truffières at the first sign of this disease. Prune out any diseased cankers about 2-3 feet below the site of infection and burn the diseased wood.

2.4 Tree Destruction

Severely infected trees should be removed and burned.

3 Bacterial Blight

Bacterial blight is caused by a bacterium, *Xanthomonas campestris* pv. *Corylina*, that attacks buds, leaves, branches, and trunks of hazelnut trees. Tree mortality due to this disease is commonly found in orchards the first few years after planting. The most serious phase of the disease is trunk girdling and killing of trees up to 8 or 10 years old.

A BC Ministry of Agriculture and Lands paper entitled *Control of Bacterial Blight of Hazelnut* was the principal source for this section (see Section 8).

Additional description and treatments described by University of Oregon Extension may be found in their on-line guide entitled *Hazelnut (Corylus avellana) -- Bacterial Blight* (see Section 8).

3.1 Description of Bacterial Blight

Bacterial blight is easiest to detect during the spring. Leaves can develop small spots (usually less than 3 mm in diameter) that are reddish-brown and surrounded by a yellowish-green zone. The disease can also cause small, dark brown or black spots on the green nut, although this is quite rare.

Leaf buds and pistillate-flower bearing buds are also susceptible. The outer bud scales are infected first and then the bacteria move into the bud itself. Buds may be completely killed or only partially damaged. Shoots emerging from buds generally become infected from infected bud scales.

Bacterial blight can cause lesions that encircle the trunk of young trees and cause them to die. These lesions can be difficult to detect, but close examination shows the bark to be slightly sunken and reddish-purple in colour. If you remove the bark at the crown with a knife, the tissue beneath is brown. A sticky liquid containing many bacterial cells may ooze out of the lesions during periods of high humidity, and dead leaves will generally cling to the girdled trunks for some time.

Figure 5 - Hazelnut Bacterial

3.2 Process of Infection

The bacterial pathogen enters through open stomata (on leaves) and wounds on the plant. It survives from one season to another in cankers and infected buds, surviving better in the large branch and trunk lesions than in the smaller twig lesions (less than 8 mm in diameter). It generally does not attack and kill branches that are more than 3 years old. Trunk lesions develop from pruning wounds or migration of the bacteria from adjacent infected buds or shoots. Pruning and suckering young trees with unsterilized pruners will spread the disease.

3.3 Disease Management

Although bacterial blight is widespread in the Pacific Northwest, it can be managed. Identification is the first step in controlling this disease. Scout orchards for disease and submit samples to the BC MAL Plant Diagnostic Lab (see Section 8 for contact information). Sometimes bacterial blight can be confused with other diseases such as sunscald and winter damage, but lab tests can confirm the presence of the bacterial pathogen. It is easiest to test for the bacterium during the spring.

Buds can be infected but not show symptoms for over 200 days. This means that healthy looking trees can be infected. All young trees (planting stock) should be handled as though they were infected.

Healthy trees are less susceptible than weakened trees so growers should encourage good growing conditions.

Trials conducted in Oregon showed that the removal of infected plant material helped reduce the spread of disease but did not eliminate it. Sprays of Bordeaux mixtures (6-3-100) in late summer (August) were sufficient to control the disease. However, in exceptionally rainy years, three sprays - in late summer, late fall when leaves were about three-quarters off the tree, and early spring when the buds were opening - were necessary to control the disease.

The Oregon trials showed that fixed copper with a spreader sticker was also an effective deterrent. Guardsman copper oxychloride 50% (PCP No. 13245) and UAP Copper Spray (copper oxychloride 50%, PCP No. 19146) are registered in Canada.

Use 3-9 kg of copper oxychloride per hectare. Make the first application in August/September before fall rains, the second application when 3/4 of leaves have fallen, and the third in early spring before bud set. Use the low rate on small trees and the high rate on large trees. Apply in 1000 L water/ha by ground spray only. There is a maximum of three applications per year.

Disinfect pruners between cuts.

Disinfectant Treatments for Cutting Knives	
Best Disinfectants	**Treatment Time**
5% Virkon	Quick Dip
10% Bleach*	Quick Dip
DCD Floralife (16 mL/L)	Quick Dip
Ethanol 70%	20 seconds

* Household Strength (5.25% sodium hypochlorite)

Prune out infected branches, making cuts 60 to 100 cm below the infected branches. Burn the branches or dispose of them off site.

4 Sudden Oak Death

Sudden Oak Death is a highly contagious disease that is particularly devastating to oak trees and their relatives. The disease is caused by the fungus-like organism *Phytophthora ramorum*.

4.1 Range and Species

The pathogen has a wide host range, with at least 97 species in 31 plant families confirmed as susceptible. In Canada, all species of 57 genera are currently regulated for *P. ramorum* by the CFIA, including *Quercus, Abies, Acer, Arbutus, Camellia, Corylus, Fagus, Pseudotsuga, Rhododendron, Rubus, Vaccinium* and *Viburnum.*

4.2 Process of Infection

When *P. ramorum* spores infect a tree, they work their way inward, secreting enzymes that break down the structure of cells in the tree's outer and inner layers of bark. This produces wounds on the outside of the tree called cankers, from which flows reddish-brown sap. The diseased tissue ultimately blocks the flow of water and other nutrients through the tree.

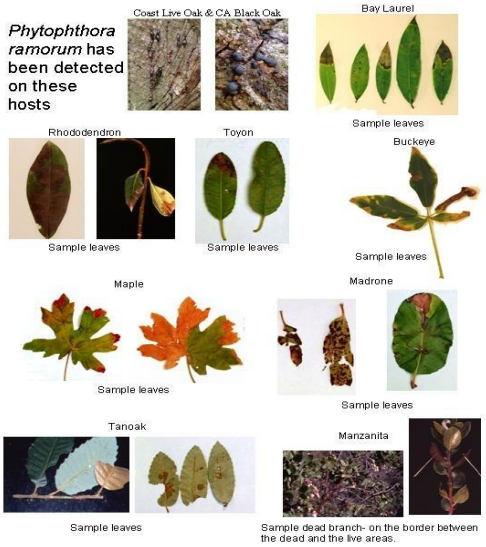

Figure 6 - Sudden Oak Death

The weakened tree becomes prone to infestation by other types of fungi and by certain species of beetles that bore damaging tunnels throughout the tree. In fatal cases, after a period of infection that may last years, the foliage turns from green to brown and the tree dies. The disease is particularly dangerous to tan oaks (*Lithocarpus densiflorus*): 100 percent of those infected die. In species of true oak, the infection causes death in 40 to 80 percent of cases.

4.3 Range of Destruction

Figure 7 Sudden Oak death in California

Since sudden oak death disease was first identified in the United States in 1995, it has killed thousands of native oak trees in coastal areas of California and Oregon. Three species of trees have been most severely affected: the coast live oak, the black oak, and the tan oak, an evergreen tree closely related to true oaks. In the fall of 2002, researchers in California discovered that the fungus had also infected young saplings of two other prominent tree species: Douglas firs and redwoods.

In the spring of 2004, thousands of potentially *P. ramorum* infected camellias were unknowingly distributed across North America. In BC, the landscape and nursery industry took up a large-scale public recall of possibly infected camellias, and collected and disposed of them safely. This quick action was the only public recall of camellias in North America and minimized the risk of *P. ramorum* coming into BC. The Canadian Food Inspection Agency (CFIA) directive D-01-01 (*Phytosanitary Requirements to Prevent the Entry and Spread of Phytophthora ramorum*) can be found on their web site (see Section 8).

All nurseries in the United States are required to have all known hosts for *P. ramorum* sampled each year to certify the nursery free of the disease. In addition, Canada requires phytosanitary certificates for importation.

However, further outbreaks are to be expected. A new infection (since contained, and eradicated) was found at a North Vancouver landscaping project in 2007.

4.4 Control

Preventing the introduction and spread of *P. ramorum* is the key to minimize the impact in the nursery and the truffière. Commercial nurseries including those producing truffle-inoculated seedlings are advised to adopt the recommended Best Management Practices (BMPs) and the *Phytophthora ramorum* Nursery Certification Program developed by the BCLNA and CNLA in conjunction with the Canadian Food Inspection Agency (CFIA), Agriculture & Agri-Food Canada and the BC Ministry of Agriculture, Food & Fisheries, and implemented by the Canadian Nursery Certification Institute (CNCI).

Scout for visible symptoms, particularly during spring, early summer and fall when the pathogen is active. If suspected, immediately notify the local office of the Canadian Food Inspection Agency or BC Ministry of Agriculture and Lands (see Section 8 for contact information).

5 The major truffle trees

5.1 *Corylus avellana* – Common Hazel

The source of our general hazelnut information is Wikipedia (see Section 8).

5.1.1 Description

The Common Hazel (*Corylus avellana*) is a small deciduous tree, usually with multiple stems and a spreading habit. It is hardy, moderately shade-tolerant and grows best on heavy but well drained soil. It typically reaches 3-8 m tall, but can reach 15 m on occasion. The leaves are deciduous, rounded, 6-12 cm long and across, softly hairy on both surfaces, and with a double-serrate margin.

Figure 8 - Common Hazel

The flowers are produced very early in spring before the leaves and are monoecious, with single-sex catkins, the male pale yellow, the female very small and largely concealed in the buds, with only the bright red styles visible. The fruit is a nut produced in clusters of one to five together, each nut held in a short leafy involucre or husk that encloses about three quarters of the nut. The nut falls out of the involucre when ripe, about 7-8 months after pollination.

As a tree its maximum life span is about 60 years, however, it can live much longer if it is coppiced frequently.

5.1.2 Native distribution

C. avellana is widely distributed throughout much of Europe, from Britain and Scandinavia eastwards to the Ural Mountains in Russia, and as far south as Spain, Italy and Greece. It also occurs in Morocco, Algeria, Turkey, Iran and the Caucasus region.

Figure 9 - Hazelnut Orchard in the Willamette Valley

5.1.3 Usage

Common hazel is cultivated for its nuts in commercial orchards in the United States, Canada, Europe, China and Australia. It is also the first and most widely planted tree species inoculated with Périgord black truffles. Generally nuts are not harvested in truffières because of concerns that harvesting equipment could compact the soil right when the truffles are developing.

5.1.4 Diseases

By far the most common and deadly of diseases of *Corylus avellana* are the eastern filbert blight and hazelnut bacterial blight described above. However, there are many other diseases of lesser concern as noted below.

Bacterial diseases include bacterial blight, bacterial canker, and crown gall. Fungal diseases include anthracnose, Armillaria root disease, borro sec, Cytospora canker, kernel mold, kernel spot, leaf blister, leaf spots Nectria canker,

Texas root rot, powdery mildew, and rust. The viral disease hazelnut mosaic is caused by and *Ilarvirus.* Finally, there are phytoplasmal and spiroplasmal diseases (source Wikipedia, see Section 8).

5.1.5 Hazelnut Pest Management

A *Hazelnut Pest Management Guide for BC Commercial Growers* is available from the BC Ministry of Agriculture and Lands (see Section 8).

5.1.6 Restrictions on Common Hazelnut

The Government of Canada through the Canadian Food Inspection Agency creates prohibitions and restrictions on plant movement in the interests of disease containment.

The importation of *Corylus avellana* seedlings or trees into British Columbia is restricted by Canadian law, due to concerns over eastern filbert blight. It is possible to obtain a phyto-sanitary certificate for importation *Corylus avellana* from non-infected states in the United States. Details of regulation D-00-03 (*Import requirements from the United States and domestic movement requirements for material to prevent the introduction of Eastern filbert blight into British Columbia*) can be found at the CFIA web site (see Section 8). Currently, the most common way to obtain common hazelnut stock in our province is to grow it from seed or by layering. This includes hazelnuts inoculated with truffle fungi.

However, in recent discussions with the department of agriculture, we learned that the CFIA may grant an import permit for any of the blight immune hazelnut varieties as listed in section 2.1. Contact the CFIA for details.

5.2 *Quercus robur* - English Oak

5.2.1 Description

The English Oak (*Quercus robur)* is known by at least three common names: English oak, common oak and Pendunculate oak.

It is a large deciduous 25–35 m tall (exceptionally to 40 m), with lobed and very short-stalked leaves. Flowering takes place in mid spring, and their fruit, called acorns, ripen by autumn of the same year.

It is a long-lived tree, with a large wide spreading head of rugged branches. While it may naturally live to an age of a few centuries, there are known examples of 1000 to 1500 year old English Oaks.

Figure 10 - *Quercus robur* at Baginton, England

5.2.2 Native distribution

The English Oak is native to most of Europe and to Asia Minor to the Caucasus, and also to parts of North Africa. It is also the most common oak in the British Isles.

Figure 11 - Leaves and Acorn of English Oak

5.2.3 Usage

Quercus robur is planted for forestry in Europe and produces long-lasting and durable heartwood, much in demand for interior and furniture work. It is also one of the top three trees used in the establishment of truffle orchards or truffières. *Q. robur* obtained as truffle orchard trees are generally imported from the United States. Each batch is accompanied by a phytosanitary certificate, certifying it free from Sudden Oak Death.

Q. robur is used as a shade tree or a specimen tree in larger landscapes. Within its native range it is valued for its importance to insects and other wildlife. Numerous insects live on the leaves, buds, and in the acorns. The acorns form a valuable food resource for several small mammals and some birds.

5.2.4 Diseases

All members of the *Quercus* genus are susceptible to *P. ramorum* (Sudden Oak Death). However, the European oaks suffer much less than their California cousins, and Sudden Oak death is not present in British Columbia at this time, due to industry and government efforts.

English oak can be affected by powdery mildew, anthracnose, canker diseases, leaf blister, leafs spots and *Armillaria* root rot. Oak apples are galls on oaks made by the gall wasp.

5.2.5 Restrictions on English Oaks

These trees may be imported into Canada from the United States provided that they are accompanied by a phytosanitary certificate issued by CFIA (Policy directives D-0101) (see Section 8).

5.3 *Quercus ilex* – Holly Oak

5.3.1 Description

The holly oak (*Quercus ilex*), also called Holm oak or evergreen oak, is a large evergreen oak. It is a member of the white oak section. It is a medium-size tree 20-27 m tall with finely square-fissured blackish bark and leathery evergreen leaves. The old leaves fall 1-2 years after new leaves emerge. The leaves are

dark green above, and pale whitish-grey with dense short hairs below. The leaf shape is variable, the adult leaves are entire, 4-8 cm long and 1-3 cm broad, while those on the lower branches of young trees are often larger (to 10 cm long), and are toothed or somewhat spiny. This is presumed to be for protection from grazing animals. In this, the foliage resembles that of the common European holly tree, and this resemblance has led to its common and botanic names. The longevity of holly oak is about 50 to 60 years.

Figure 12 – Overview of Quercus ilex growing in Spain

5.3.2 Native distribution

Quercus ilex is native to the Mediterranean region.

5.3.3 Usage

The wood is hard and tough, used for general construction purposes, firewood, and charcoal manufacture. *Quercus ilex* is among the best hosts for truffles, particularly in warmer and dryer climates. Whether it is suitable for growth in British Columbia is not certain.

5.3.4 Restrictions on Holly Oaks

These trees may be imported into Canada from the United States provided that they are accompanied by a Phytosanitary certificate issued by CFIA (Policy directives D-0101) (see Section 8).

6 Truffle Concerns

6.1 Diseases, pests, browsers

Truffles can be attacked by various organisms, just like any other living creature (Hall et al. 2007). In Europe, truffle flies (*Suillia gigantea* and *Suillia fuscicornis*) detect the presence of mature truffles belowground and lay their eggs on the truffles if they can get to them. The eggs hatch and the larvae bore into the truffles, emerging a few weeks later as mature flies. The tunnel created by the larvae can open the truffles to penetration by fungi and bacteria that can cause the truffle to rot. On the up side, the presence of these truffle flies hovering over cracks in the ground can be used by truffle growers without a truffle dog or truffle pig to find mature truffles. We do not know whether our local mushroom flies would cause similar problems on truffles here.

Slugs, rats, mice, and moles also eat truffles.

6.2 Transport restrictions on truffles

CFIA directive D-94-26 (*Plant protection import requirements for edible roots for consumption or processing*) states that all imported truffles (and edible roots)

must be free from soil (see Section 8). Thus if truffles to be imported are soil free, presumably, their importation is allowed.

6.3 Confusion with less valuable truffle species

The Périgord black truffle has look-alikes that are worth very little compared to the Périgord black truffle. Primary among the look-alikes is *Tuber brumale*, the winter truffle. Also of concern are various Asian truffle species that closely resemble the Périgord black truffle. Even the most experienced truffle expert cannot distinguish among these species without detailed morphological examination of truffle tissues and spores and without DNA sequencing analysis. Even the most experienced truffle expert can be shocked to discover winter truffles in a batch of supposed black truffles purchased from Europe to be used to inoculate seedlings.

We must avoid at all cost the mistaken introduction of these look-alikes into truffières in BC. Once one of these low-value look-alikes is in your truffière, there will be no getting it out and little chance of good production of the Périgord black truffle. In France, scientists and nursery managers who failed to distinguish between the winter truffle and the Périgord black truffle inadvertently introduced the winter truffle into truffières. According to Ian Hall, Gordon Brown, and Alessandra Zambonelli in their 2007 book entitled *Taming the truffle. The history, lore, and science of the ultimate mushroom* (page 152), “its spread through the truffle-producing regions has been regarded as a catastrophe”.

There are major concerns about fraudulent use of these look-alikes in the truffle trade. The production of low-value Chinese truffles has recently been reported in what was supposed to be a Périgord black truffle orchard in Italy (Murat et al 2008). Samples of soil and tree roots in the unnamed plantation in the Italian Piedmont revealed DNA from the Chinese black truffle, *Tuber indicum*, according to the scientists involved. Soil samples also contained DNA from the desired Périgord truffle and the scientists could only speculate on whether the nursery that inoculated the seedlings got the similar-looking species mixed up or intentionally substituted the cheaper Chinese truffle to cut corners.

To avoid this situation in BC, we need to be vigilant. Vigilance involves having inoculated seedlings independently examined before planting using morphological and molecular methods (DNA) to confirm the identity of the truffle species on the roots.

6.4 Other problems and mitigation

The other major problem for the inoculated stock producers is contamination of the truffle trees by other ectomycorrhizal fungi. Inoculated seedlings should be independently examined before planting using morphological and molecular methods (DNA) to confirm the identity of the truffle species on the roots and the absence of too many other ectomycorrhizal fungi.

7 Truffières: General Procedures to Follow

- Truffières must be regularly surveyed for signs of disease.

- Any suspected disease, especially signs of eastern filbert blight or sudden oak death, must be reported to the MAL Plant Diagnostic Lab (see Section 8).

- Aggressive pruning is the first line of defense against eastern filbert blight combined with destruction of infected material.

- Several fungicides can be used to treat eastern filbert blight. However, fungicides should be used with caution in a truffière because of the possible threat to the truffle fungus.

8 Sources and contacts

BCMAL Plant Diagnostic Laboratory
"The BCMAL Plant Diagnostic Lab provides identification of pathogenic and non-pathogenic disorders affecting commercial crops in B.C. and promotes reduced pesticide use by making control recommendations which emphasize IPM (Integrated Pest Management). The Plant Diagnostic Lab is part of the Plant Health Unit in the Food Safety and Quality Branch. Its services help growers protect the production capability and marketability of their crops."

Plant Diagnostic Lab,
B.C. Ministry of Agriculture and Lands
Abbotsford Agriculture Centre,
1767 Angus Campbell Road,
Abbotsford B.C., V3G 2M3
Tel: 604 556-3126 (directly) or 1-800-661-9903 (main office)
Fax: 604 556-3154
http://www.agf.gov.bc.ca/cropprot/lab.htm

Canadian Food Inspection Agency
"At the Canadian Food Inspection Agency (CFIA), the safety of Canada's food supply is central to everything we do. That's why the CFIA works from the farm gate to the consumer's plate to protect public health. We safeguard not just the food supply but also the plants and animals upon which safe and high quality food depends."

Canadian Food Inspection Agency
BC Coastal, Mainland, Interior
4321 Still Creek Dr., Suite 400
Burnaby, British Columbia
V5C 6S7
Tel: 604-666-6513
Fax: 604-666-1261
http://www.inspection.gc.ca/english/agen/agene.shtml

Eastern Filbert Blight Help Page
Oregon State University
http://oregonstate.edu/dept/botany/epp/EFB/index.htm

Hazelnut Pest Management Guide for BC Commercial Growers
September 2004 Edition
BC Ministry of Agriculture and Lands,
Pest Management
http://www.agf.gov.bc.ca/cropprot/hazelnut.htm

Control of Bacterial Blight of Hazelnut
BC Ministry of Agriculture and Lands,
Pest Management
http://www.agf.gov.bc.ca/cropprot/hazelnutblight.htm

Hazelnut (*Corylus avellana*) -- Bacterial Blight
An Online Guide to Plant Disease Control
Oregon State University Extension
http://plant-disease.ippc.orst.edu/factsheet.cfm?RecordID=573&rec_type=disease

Wikipedia, the free encyclopedia that anyone can edit.
http://en.wikipedia.org/wiki/Main_Page

9 Photographs

9.1 Photo Page Index

9.2 Source of Photos

1. *Tuber melanosporum*: public domain: http://en.wikipedia.org/wiki/Image:Truffe_coup%C3%A9e.jpg.
2. Black Summer Truffle (in Italian: Tartufi Neri Estivi) *Tuber aestivum* in a shop window in Rome, Italy. Photographed by Adrian Pingstone in June 2007 and placed in the public domain.
3. Eastern filbert blight, USDA photo
4. Original photograph by Peter Andres
5. Hazelnut bacterial blight from Forestry Images at www.forestryimages.org/images/192x128/0454011.jpg
6. Sudden oak death symptoms, USDA ceris.purdue.edu/napis/pests/sod/
7. Sudden oak death in California http://www.forestryimages.org/browse/detail.cfm?imgnum=5044024
8. Common hazel http://en.wikipedia.org/wiki/Image:Corylus_avellana.jpg
9. From the photo journal of HV Green http://pages.prodigy.net/hvgreen1/day5.htm
10. The Baginton Oak tree in late July 2006 one evening in en:Baginton, Warwickshire. Creative commons licence.
11. Leaves and acorn of English oak – Wikipedia http://en.wikipedia.org/wiki/Image:Quercusrobur.jpg