UBC Social Ecological Economic Development Studies (SEEDS) Student Report

# UBC SEEDS Project: Examination of *Quercus rubra* Along Main Mall at the University of British Columbia

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For UBC SEEDS Project

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## INDIVIDUALS CONTACTED

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Dr. Brian Holl, Professor Emeritus in the Faculty of Agricultural Sciences (Agroecology)
Dr. Murray Isman, Professor in the Faculty of Agricultural Sciences (Agroecology)
Doug Justice, Curator of Collections at the University of British Columbia Botanical Garden
David Smith, Supervisor Landscape, Plant Operations at the University of British Columbia
Dr. Bart Van Der Kamp, Professor/ Head of the Faculty of Forest Sciences
Collin Varner, Arborist/Horticulturist at the University of British Columbia (Plant Operations Nursery)

## ABSTRACT

The declining health of the oak trees along Main Mall can be attributed to several factors. Pre-existing stresses such as soil compaction, lack of water and nutrients, salt damage, construction damage and human disturbance have weakened these trees. Oak anthracnose (*Discula umbrinella*), a fungal disease, has been identified as a major concern. At times, aphid populations exceed acceptable thresholds. As well, honeydew excreted from aphids has resulted in aesthetic problems. Currently, only minimal maintenance and monitoring has been done. In order to prevent further damage to the trees, a proper monitoring program for controlling oak anthracnose and aphids must be developed and implemented immediately. Continual monitoring is critical for retaining the anesthetic appeal of the oak trees.

## CURRENT AND PAST PRACTICES

In 1927/1928, Mr. M.A. McCoy planted the oak trees along Main Mall. Turfgrass used to cover most of the landscape. Since then, numerous buildings have been erected. Construction damage, a climate ideal for oak anthracnose, and a dramatic reduction in permeable surfaces have all contributed to the declining health of these trees. In the past, Benomyl, a systemic fungicide has been sprayed after bud break with a second application 10-14 days later. The last time this product was used was in 2000. Only severely infected trees were sprayed. Dimethoate, *Cygon*, a systemic organophosphorous has been applied as an insecticide to control aphids. In 2000, a mop application of 21L of concentrated insecticide was used. Recently, this product has not been used at all. The bark tends to become burned in areas where *Cygon* has been applied**.**

Fallen leaves are removed several times a year. A ride-on blower is used to push the debris into piles while labours collect them. During the warmer months, a ride-on mower is used to cut the grass. Grass growing near the trees is cut with weed eaters. The grass clippings and leaves are sent to South Campus where the materials are turned into compost. During the winter, salt is applied to de-ice the pavement. Minimum applications are done. Heavy rainfalls tend to leach the excess salt into the ground. Presently, there is no irrigation system specifically for the oak trees. Some trees receive secondary irrigation when the perennial (i.e. rhododendron beds) or annual plants are watered. No nutrients are directly applied to the trees, but some receive secondary nutrients from fertilizers that are added to the turfgrass or surrounding shrubs. Nothing has been done to help reduce soil compaction. In the summer of 2001, extensive pruning was done to improve air

circulation, to remove dead and damaged branches, and to decrease disease spread. This summer, 2002, the remaining 10-15 trees will be pruned. Cherry picker baskets were used.

A consistent monitoring program has not been used Collin Varner, the Arborist/ Horticulturist for Plant Operations at U.B.C., does monitor the trees along Main Mall on a bimonthly basis, but no records have been kept. Records of what the landscape crew had done in the past to maintain these trees have been recorded. (i.e. when they apply salt for de-icing, mowing dates). The chemical's name, its usage, and date applied are recorded and kept on file. Spraying for aphid control and oak anthracnose is done on a year-to-year basis. Two recommendation reports were developed in the past. In August 19, 1993, a report by M. McNair, an Arborist from Arbour-Care Tree Services, was filed (McNair, 1993, pp. 12-16). It detailed ways to deal with the fungal disease, oak anthracnose. In 2000, Collin Varner prepared a comprehensive report on his observations of the oak trees, recommendations to ease the problem, and estimated cost for maintenance. A soil analysis confirmed several nutrient deficiencies and a low pH. Leaf samples were submitted and revealed the presence of *Discula* species.

**OAK ANTHRACNOSE**

Oak anthracnose is a fungal disease caused by *Apiognomonia umbrinella* (*Discula umbrinella*). Different oak species are susceptible to varying degrees. White oak, *Quercus alba*, is especially prone to infection. Other hardwoods like sycamore, maple and ash are also affected by anthracnose. Anthracnose outbreaks are favored by wet weather with moderate temperatures. Vancouver's rainy climate makes it ideal for this disease to thrive. Typically oak anthracnose does not cause serious concerns. Aesthetically, dead, defoliated branches may not look appealing, but the disease usually does not cause permanent damage. A healthy tree should recover from the damage encountered on the leaves. New leaves eventually replace the defoliated ones. However, if plants are weakened by pre-existing factors or are under continual stress, the plants do not have time to recuperate. The disease amplifies the stress on the trees, and the trees' health continues to decline.

**Symptoms**

Leaves, which remain wet, and areas with high humidity levels tend to be more prone to infection. At 20-28$^{O}$C, symptoms form quickly, but symptom severity occurs greatest during 16-20 $^{O}$C (McNair, 1993, p. 13). Symptoms include leaf spots, lesions, scorching, and necrosis. On newly emerging leaves, randomly produced, irregularly shaped spots form and may become necrotic. Leaf margins can be deformed or appear curled. New buds and shoots may be deformed or do not break open properly. However, as the leaves mature, they usually become more disease resistant. In extreme situations, dieback or defoliation of entire branches can occur. Symptoms typically are worse on lower, inside branches because humidity levels tend to be higher.

**Lifecycle**

Overwintering fungal spores can be found on infected buds, leaves, and branches on the tree or ground. In late winter and early spring, cankers can form (Tattar, 1989, p. 93). Cankers, which are sunken, dead areas on branches and twigs, can cause girdling to occur (Tattar, 1989, p. 93). Girdling kills branches by restricting nutrients from flowing into that branch. Conidia spores, in special fruiting structures called acervuli, are formed within the leaf lesions (McNair, 1993, p. 12). In the spring and summer, spores dispersed by wind and splashing rain land on nearby plant tissues. The spores germinate and cause defoliation, distortion, and leaf spots. New fruiting bodies are

formed on these diseased plant parts. Throughout the year, but mainly in fall, leaves fall to the ground. Fungal spores overwinter and the lifecycle repeats.

**APHIDS**

Aphids are soft-bodied, small, sap-sucking insects that attack a wide range of crops and trees. However, each species usually only attacks a few plant species. They vary in size from 1.8-3mm and colour. They possess pear-shaped bodies. Depending on the season, aphids can be winged or wingless adults. They predominately live in clumps/colonies on the underside of leaves. Two major problems associated with them are their sticky excretion and their ability to transmit viruses.

**Injury**

As phloem feeders, aphids suck sap out of the plants. While feeding, viruses can be transmitted via aphid salvia. If enough of them are present, leaves can become distorted, discoloured and drop prematurely, and developing buds can become damaged. Aphids also produce aesthetic problems. Honeydew excreted by aphids is very sticky. Pavements and tree parts can become coated with this. People walking pass these trees do not want to be sticking to the pavement or have sticky substances on their clothing. Black sooty mold can grow in the honeydew, thereby, further reducing the aesthetic appearance of trees. Black mold can decrease light penetration, and thereby, reduces growth. Ants are attracted to the sugary dew. These crawling insects protect the aphids from being eliminated.

**Lifecycle**

Lifecycles range from 6 to 14 days. Under warm and moist conditions, populations can explode and exceed their tolerable threshold capacity. Some aphid species alternate between woody and herbaceous plants depending on the season. Overwintering eggs hatch and nymphs are formed. During springtime, only wingless female adults develop. These adults produce more eggs that turn into nymphs. Winged, female adults form during the summertime. This allows the aphids to travel from one location to another. Males, which are only produced in the fall, mate with the adult females. Overwintering eggs are laid.

**RECOMMENDATIONS**
**General (To be done in 2002/2003)**

a) Education is very important. People who are informed are more willing and understanding when something dramatic must happen. The public can be educated through workshops, providing articles in newspapers (e.g. The Ubyssey, UBC Report), or postings.

b) **Mulch with organic matter. Where possible, remove turfgrass around the trees. This will help reduce mechanical damage (i.e. mowing, line trimming) to the tree trunk, and reduce nutrient and water competition with the turfgrass. Replace with 4 to 7 inches (10 to 18cm) of fully decomposed compost/organic matter. To control weeds, bark mulch can be applied. Replace mulch and organic matter every few years.

c) **Mulch lawn with organic matter. Top dress with 1 to 2 inches (2.5 to 5cm) of completely decomposed compost/ organic matter or steer manure. Repeat every year or every few years.

d) **Reduce compaction. Since the soil is composed mainly of native, glacial till, it may be hard to penetrate. However, core aerating the soil will allow water and air to infiltrate into the severely compacted soil. Microorganism populations will thrive. Air spades, which pump high-pressure air into the ground, are another alternative. Compacted, horizontal layers of soil shatter and crumble. Spiking or other aeration methods can be used. Core aerate once a year or every few years at a depth of 12 to 24 inches (30 to 60cm).

e) **Adjust pH level with dolomite lime. Soil samples in June 2000 revealed a very acidic soil with a pH of 4.3 (Varner, 2000, p. 9). The pH must be raised to about 5.5-6.0. With the addition of lime, the low calcium and magnesium levels will be alleviated (Varner, 2000, p. 9). Spreading 3-4 pounds per year should be enough.

f) **Apply fertilizers. Organic fertilizers are preferential to chemical ones, but either will help increase the nutrient level. To combat nutrient deficiencies a broadcast application of Evergro Total 23-3-23 at 6lbs per $1000ft_2$ should be applied twice during the growing season (Varner, 2000, p. 3). In April, add zinc sulfate and iron sulfate at manufactures rate (Varner, 2000, p. 3).

NOTE: The ones marked with ** should be done immediately. Many problems associated with the oak trees will be significantly reduced. This will decrease the stress on the trees.

**Oak Anthracnose**

a) Remove severely weakened trees. The ones near the Walter C. Koerner Library and Henry Angus building are showing definite signs of stress. The trees are stunted, thin, with few strong lateral branches. Some trees outside the library are profusely producing leaves. If another *Quercus* species must be planted, care must be used to eliminate as much of the old roots and tree material. This is to prevent further spread of the fungal disease.

b) Prune regularly. Pruning should only be done during extended periods of dry weather. Damaged, and diseased branches should be cut off. If the branch is diseased, one must cut until there is healthy tissue. Frequent sterilization of pruning tools is necessary to prevent spreading the disease. The crown must be opened to aid in good air circulation. This will reduce the time the leaves remain wet, thereby decreasing potential for infection.

c) Prune some trees extensively to reduce the crown size. This will restore some balance between the crown and root ratio. The roots will have an easier time supporting the tree.

d) Remove and destroy fallen leaves, twigs, and branches. They could potentially contain spores that can further spread anthracnose. Removing debris can also add to the aesthetic quality and increases safety.

e) Water regularly. During extended periods of dry, watering should be done to promote vigorous, healthy trees. Mature trees tend to cope better with minimal water than younger trees. The 75- 80 years old oak should not need irrigation, but since many are under stress, water would be beneficial.

f) Mulch every few years. Mulch should be placed over the root system to retain moisture, provide nutrients, and buffer against extreme temperature differences.

g) Apply chemical control with caution. On severely infected, stressed trees, spraying fungicides may be more practical in controlling the problem. Systemic fungicide like Benomyl can be added. To ensure complete coverage apply during bud break, then re-apply until dry weather. The instructions must be read with great care and followed accordingly.

h) Avoid wounds or construction damage. Wounds can be sources for fungal entry. Plastic guards, like 'ArborGard,' protect the tree base from mechanical damage (i.e. lawn mower, line trimmers). Guards must be added to all young trees because their barks are thin and are easily prone to injury. If construction is done close to the trees, care must be taken to prevent piling material near the tree base, and too much site disturbance.

i) Reduce traffic disturbance. Oak trees do not like site disturbance. Planting shrubs and ground covers will help to discourage people from walking over the roots. If pathways must be created, use permeable surface materials like interlocking permeable bricks. This will permit water to still penetrate into the ground.

**Aphids**

Since aphid populations vary year to year, monitoring is essential. Control methods may not be necessary every year.

a) Promote natural predators. Other insects like lacewings, and lady birds keep aphid populations in check through predator and prey interactions. Growing shrubs and vegetation of different heights provide different habitats for other insects and organisms.

b) Apply chemical insecticides. Insecticides, like Dimethoate, can be used to lower aphid populations at certain or all stages in the lifecycle. When using chemicals, one must carefully read all instructions and follow the manufactures rates. When inorganic/toxic chemicals are used, beneficial natural predators can be adversely affected. This may trigger additional problems. Spot treatments can lower the amount of chemicals required.

c) Apply oils and soaps. Narrow-range oils, like horticulture oil, or insecticidal soaps are less harmful to the environment. Applications occur in the winter or spring. These products kill the aphids by smothering them. Use lower concentrations whenever possible. A 2% dilution of Sunspray 6E, a horticulture oil, was just as effective as a 3% oil concentration to control aphids on red oaks (Baxendale & Johnson, 1989, p. 51). The downfall is that they require complete coverage to be effective. On a mature tree, it is impractical to spray due to the cost and quantity required. However, it may be economical if sprayed on young trees.

d) Prune out infested branches. This may be more practical on younger trees than mature ones.

e) Release a commercial aphid predator, *Aphidoletes aphidimyza*. In 1994, the City of Vancouver tested *Aphidoletes aphidimyza* to control aphid honeydew on boulevard trees (Government of British Columbia, pp. 8-9). Although research on this commercially produced product is still relatively new, early findings have been promising. Test trials can be done by comparing the trees along Main Mall that have this product released on them with trees in East Mall and Thunderbird Boulevard.

f) Control ants. Ants protect aphids because they collect the aphids' honeydew. Natural enemies have a more difficult time attacking aphids when ants are present. Methods have

been tested to discourage ants. Sticky tape or sticky glue has been added around the tree trunk to prevent ants from climbing. Early results show little to no effect on aphid control, but more tests need to be conducted.

**Salt**

Currently there is no buffer zone between the hard concrete pavement and the turfgrass or area around the trees. Road salt is often used in de-icing roadways and other hard surfaces. Although often overlooked, excess salt that leaches into the ground can be detrimental to plant health. All chloride de-icers negatively impact the environment by developing toxic effects (City of Vancouver, 1998, p. 4), which can lead to early tree mortality. In March 1998, the Vancouver City Council was presented with a report on the cost and benefits of using alternative de-icing chemicals besides sodium chloride (City of Vancouver, 1998, pp. 2,4). The use of calcium magnesium acetate (CMA) had the most potential due to its lower toxicity damage than sodium chloride. However, current bulk cost per tonne for materials far exceeded that of sodium chloride. A 20% higher application rate had to be applied as well. Currently, there is very few chemical alternatives or cultural practices to reduce salt damage caused by winter de-icing.

a) A low ledge or shoulder should be built to act as a buffer zone. The will help block the salt from entering into the ground around the trees. Salt should be promoted to going towards the roadway or drainage ditches.

b) Some areas in the USA, apply fine grit instead of sand. However, people must be hired to remove the grit to prevent injuries from occurring.

c) Flush/leach salt out. Since Vancouver receives a lot of rain, excess salt should naturally flush itself out. Applying irrigation can be done, but is often impractical.

**MONITORING AND CONTROL**

Monitoring the trees require a through all understanding of the area. An assessment of the entire region must be done. Appendix 1 has the beginning of an evaluation done on April 2nd, 2002. Other types of evaluation form can be used to assess the trees. Recorded notes should be kept in an easily accessible but safe place. The notes should be legible, easy to follow and understand, and contains the date, time, weather condition, and location. When chemicals are applied, the date, time, location, chemical name, use, and concentration/rate must be recorded. After the initial assessment, the trees should be monitored on a regular basis. Weekly assessments should be done in the spring and summer because anthracnose symptoms and aphid injuries are most noticeable during these times. Less frequent checks can be done during the wintertime. Monitoring should be done after a control action is conducted to assess its effectiveness. Any changes or unusual finding must be documented. The evaluation can determine which trees should be replaced and which ones require extra care. Thresholds, of when control actions must be implemented, should be created. Depending on the tolerance level, the plants may endure a high injury level before actions are taken. If aesthetics is a major factor, lower injury levels may be tolerated. Treatments can be biological, chemical, or cultural.

**Oak Anthracnose**

When monitoring, one must first be familiar with the disease. The person must understand the lifecycle, recognize symptoms, and learn to detect early infestations and warning signs. In the monitoring program, care procedures for mature and young trees may differ. A set of guidelines for

each should be established. A sampling method that is appropriate for the situation must be determined. Since this fungal disease affects the leaves and twigs, closely examine the trees during the spring and summertime. On younger trees, randomly examine an X number of leaves and branches. Record the date, time, number of leaves sampled, location, growth stage, and symptoms detected (i.e. deformed leaf margins, irregularly shaped spots, chlorosis). Examine the budding leaves for deformities. On mature trees, dieback may be an indication of anthracnose. However, one must remember other diseases can cause dieback.

The oak trees in front of the Henry Angus Commerce building should be completely removed and replaced with younger, healthier trees. They are grown in concrete planters or in a hole surrounded by hard surface. Very little growing space has been allowed for these trees. Human disturbance may be high from students walking over the exposed areas. The trees planted near the Chemistry building are similar in age to the ones near Henry Angus. However, the oaks along the Chemistry building have thicker, longer lateral branches, are taller and appear fuller. The trunk diameters differ significantly. The oak trees planted in cement barriers around Walter C. Koerner Library also require special attention. Planted in 1997, these trees are demonstrating sever signs of stress. Some are profusely producing leaves while others appear stunted and thin. Very little perennial or annual vegetation exist inside these containers. The ground is covered in bark mulch. With the surrounding area being predominately hard pavement/concrete, the temperature around the trees must become quite hot during the summertime. With no to minimal irrigation during the hot, dry months, the plants will be undergoing stress. In both cases, water running off the pavement cannot penetrate into the underground surface because the material is impermeable. The soil underneath is essentially dry all year and therefore becomes anaerobic (without oxygen). If a tree is young they may adapt, but older trees have a more difficult time adjusting. Most of these oak trees have been there since 1927/1928. When the buildings went up, the amount of permeable surface significantly decreased. As well, the trees at both sites have had construction damage.

**Aphids**

First, one must appreciate the complex interaction that aphids play in the environment. Under a natural, polyculture setting, aphids are not a major problem because a diverse number of natural predators exist. Biological enemies such as lady beetles, lacewings, syrphid larvae, and parasitic wasps all aid in naturally controlling aphids (British Columbia Ministry of Agriculture and Food, 1998, p. 83). Since aphid populations are lower, the sticky excrement are not a significant concern. If the trees are not stressed, they are better able to cope with insect damage. The tree has enough energy to reproduce new foliage and heal wounds.

To monitor, randomly select a certain number of leaves per tree and visually inspect them. Check for discolouration, curled leaves, and distorted foliage and buds. Gently turn the leaves to their underside and inspect the aphid colonies. A hand lens or magnifier will aid in looking for these clusters. Also inspect and record the number and type of predators, and the amount of parasitized aphids. On young oak trees an option would be to visually examine them, but on mature plants this may be too labour intensive or too difficult to do. Checking the ground for sticky substances can indicate aphids. Yellow honeydew cards can be used for monitoring. Clear acetate sheets with grid patterns can be made as a cheap, reusable alternative to yellow sampling cards (Adams & Gilkeson, 2000, p. 5). The cards can be placed on the pavement or tied to lower branches for a certain time period. Distinctive blue spots appear. The number of droplets per card is counted or an estimate can be taken. To determine the average honeydew density per card, all the drops are counted and divided by the card area (Card area = length in inches x card width) (Clark & Dreistadt, 1994, p. 98). The overall average can be discovered by adding the individual average density from each card and dividing by the total card number (Clark & Dreistadt, 1994, pp. 98).

Visually comparing the honeydew density of each card with previously determined reference cards can also be done. Record the average density of that reference card. To determine the overall average density, follow the above method (Clark & Dreistadt, 1994, pp. 98). This method can be used on both mature and young trees. Not all the trees must be done, but a sample from each area should be done. Different trees in that area should be sampled each time. People must be informed to prevent vandalism from occurring on the sampling cards.

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## Appendix 1: Assessing the Oak Trees Along Main Mall (Starting from the Agronomy Road, looking towards the Rose Parkade)

Assessment done: April 2nd, 2002
Conditions: Sunny day with clouds, cold, no/little wind

**Area**

1. **Centre for Integrated Computer Systems Research Building, 2366 Main Mall (Compsci)**
   -3 out of 5 have plastic 'ArborGard around the base of the tree
   -Guard: 2mm thick; flexible beige with holes evenly spaced; each piece is approximately 26 cm, not continuous but 4 pieces joined together; sticking out approximately 21cm. from the ground
   - Tree base about 21cm
   -Paved path on both sides (1 side is Main Mall, the other is a pathway); each is about 11/2m away from the tree
   -Turf planted right up to the tree; lawn is short, green with clover, fairly evenly covering the ground but have some balding spots
   -Fairly open canopy; not very many thick lateral branches, branches spread out to the pavements
   -Seems to be no major pruning problem (easier to determine when leaves formed)
   -Traffic damage appears minimal except between the last 2 trees; a path seems to forming (balding, dirt showing through, turf is spotty)
   -Grass grows to edge of pavement

2. **Near Landscape Architecture Building, 2371 Main Mall**
   -2 young trees start the boulevard
   -1 side (Main Mall) paved; other side covered with turfgrass
   -Turf planted to base of tree
   -1st tree (near Agronomy Road) has a missing ArborGard section
   -Trees appear taller and larger than in **area 1**
   -Fairly open canopy, 1 main leader
   -Fairly green, short turfgrass grown to paved road
   -No apparent pruning damage, no wounds @ tree base
   -Between tree 2 and 3, an undercover telephone/pop/bike area exists; paved with concrete; has a dome roof; 2 concrete, planters on either side of the structure exist; plants in planters
   -3rd tree: significantly larger than first two
   -Road 1m from tree; telephone area 11/2m from tree; rest of tree surrounded by turf
   -Turf appears to be green, short with some moss

3. **Outside HR MacMillian Building, 2357 Main Mall (Agsc)**

-4th tree fairly young; base about 21cm
-Ground above tree is slightly raised
-Turfgrass up to tree base
-Road 1m from tree; surrounded by turfgrass then encased with pavement or brick on three sides
-Open canopy; lowest young branch points outwards; no obvious pruning damage
-Seems to be no/very minimal wounds, cankers, scars
-Some balding (dirt showing) areas near brick

-5th tree in brick pavement; with bark mulch on top of growing space; seems to have some top soil under the mulch
-Growing in area about 3-4m (square like box); no edging (like a hole cut into the brick)
-Road on 1 side; rest covered in brick; from road, the surface seems to be sloping downwards towards the building
-1 side of tree has very little branches; unevenly spaced lateral branches
-Bottom two large branches cut off (facing building)
Tree base about 21cm
Nothing growing in mulch; no weeds