Diagnosis and Control of Problems on Idaho Urban & Woodland Trees

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The best way to control problems in trees, whether they be insect, disease or physiologically caused, is to prevent them. Healthy, vigorous plants will be able to withstand threats better than weakened, stressed plants. The aim in controlling a pest problem is to bring the damage below the economic threshold. Control of insect & disease problems is achieved by breaking the life cycle.

Common cultural control methods include:

- Plant selection – right tree for the right place, use of resistant varieties
- Proper planting techniques
- Meeting nutritional needs
- Sanitation
- Pruning

Chemical controls:

- Always recommend cultural controls along with chemical controls.
- Only recommend chemical controls listed in the PNW Management Handbooks.
- Also available on-line at:
    - Insects - http://insects.ippc.orst.edu/pnw/insects
    - Diseases - http://plant-disease.ippc.orst.edu/index.cfm
    - Weeds - http://insects.ippc.orst.edu/pnw/insects

Causes

Fungi are non-photosynthetic microscopic plants unable to produce their own food. They obtain food from higher plants that are able to produce their own food. Many fungi are beneficial to man - used industrially to produce antibiotics, cheeses, wine for example. They are also an important component of the nutrient cycle.
Fungi as a group cause more disease problems than any other group of disease causing organisms. Fungal strands penetrate healthy tissue if conditions are favorable.
Free moisture or high relative humidity, poor air circulation, and warm temperatures are generally the best conditions for fungal growth. Most fungi reproduce by the formation of spores. Fungi gain entrance to the plant through natural openings, such as stomata, wounds, or direct penetration.

Fungi live in the air, on fallen debris, or in cankers and wounds on plants and are spread by the movement of wind and water. Gain entry through natural openings such as stomata and wounds; are also able to penetrate healthy tissue in the right conditions. Conditions include free moisture or high relative humidity; poor air circulation; warm temperatures.

Bacteria are among the smallest living organisms, lack chlorophyll, and so are dependent on other organisms for food. Some bacteria, like fungi, are beneficial. They are aid in decomposition and soil building, and enable legumes to convert gaseous nitrogen to a form available to plants. Others have industrial uses. Bacteria live in the soil or on plant refuse and are spread by rain, man, animals, insects, equipment and plants. They do not actively penetrate healthy tissue like fungi, but do enter through natural openings, such as stomata, and wounds. Once the bacteria enters the plant, it begins to reproduce, killing plant cells as it goes. Some bacteria produce toxic chemicals that cause plant cells to grow abnormally, as in crown gall. Others poison plant tissue or plug vascular or water conducting tissues, causing wilt.

Viruses are infectious agents that are too small to be seen with an ordinary microscope. Known viruses are parasitic on plants or animals as well as man. The number of know virus diseases in woody plants small; includes tobacco mosaic virus and tobacco ring spot virus.
Viruses spread from plant-to-plant by mechanical transmission (pruning or grafting), nematodes (during feeding), fungi, insects (during feeding).

Physiological problems are caused by non-living agents, such as:

- adverse weather conditions;
- nutrient deficiencies;
- poor soil drainage;
- plant suitability;
- mechanical injury.
- pesticide misapplication.

In general, physiological problems

- Will produce uniform symptoms on plants
- affect all plants in a particular landscape, while insect and disease problems produce symptoms that are more variable and random in severity, and may affect only certain species.
- Will lack of evidence of a living pathogen.

Pesticide misapplication (direct or indirect) is a common problem. Damage can be caused by direct contact, drift, or volatilization.

Diagnostic Process

1. Identify the plant.
2. Gather information.
    a. The client.
    b. Weather conditions (past and present).
    c. Surrounding areas.
    d. Symptoms.

3. What did you miss? (Don't bluff!).
4. Diagnosis and control recommendations.

Symptoms

Symptoms can occur on:

leaves;
leaves and branches;
plants with no leaves;
roots.

Symptoms on leaves. Start by looking for abnormalities in size, color, glossiness, texture and shape.

Symptoms confined primarily to leaves that result from disease are:

leaf spots
blotches
needle-casts and blights
anthracnose
Tiny fruiting bodies in affected areas are good indications that fungi are present.

Causal agents can create similar symptoms. For example, this tree had red spots with yellow hallows. This symptom can be caused by an insect, a disease, or physiological cause (acid rain). Consider the atmospheric conditions present before the symptoms developed. Atmospheric pollutants can also cause leaf spotting or abnormalities - also spray damage from pesticides, fertilizers and nutrient imbalances.

Scorch & wilts can be caused by hot dry winds in the spring when leaves are tender or by disease such as Dutch elm disease.

Frost damage. Low temperatures in the spring can result in frost damage to tender leaves, resulting in browning.

Leaves with hole in them or irregular margins can be affected by insect feeding, bud damage due to low temperatures in spring, or some bacterial diseases which cause a 'shot-hole' effect.

Yellowing of leaves and/or veins is often associated with mineral deficiencies or toxicities. Soil sterilants can cause similar symptoms. A number of viral diseases can show leaf yellowing, as can spider mites and air pollutants, especially on narrow-leaved evergreens.

Major changes in leaf structure (twisting, cupping, irregular shape, reduced size and folding) can result from:

lack of an available nutrient
poor soil aeration
root injuries

diseases
mites
pesticide misapplication.

Symptoms on leaves & branches. Look for small holes, scars, ridges, bumps, pitch oozing, swelling.
Pitch oozing out of branches and the trunk. These are usually signs of insect problems, but can also indicate a disease like white pine blister rust.

Extensive browning of leaves on the entire branch can indicate major problems on the branch or in the trunk of the tree. Broken branches could indicate wind or storm damage, mechanical damage, insect girdling or canker.

Cankers are usually raised or sunken areas in the bark, and indicate injury to the tissue underneath.
Infections can be secondary. Fungal bodies in a sunken area do not necessarily mean that they are responsible for the problem. Many organisms can invade tissues once they are already weakened by another factor.

Cankers can be caused by:

- Bacterial or fungal infections
- High/low temperatures
- Mechanical damage

Diseased wood caused by a fungal attack shows a *gradual* change from diseased to healthy tissue. Temperature, mechanical, or insect injuries are usually *well defined*, with an abrupt line between affected and unaffected tissues.

Plants that experience rapid browning and drop of leaves are usually being affected by trunk or root-related problems. These can be caused by extensive canker, mechanical injury, severe borer problem,
girdling. Examination of the inner bark will tell you if the plant is dead or alive - brown & dry = dead; green to white & moist = alive. Streaking suggests presence of wilt fungus like DED.

Roots should be firm and a creamy color. Brown = dead tissue; spongy = decay. Look at soil structure, compactness, color, and odor, and weather conditions to find any diagnostic clues. Symptoms appear rapidly but problem may have been developing for years. Look for long-term stress - smaller yearly growth increments on branches. Tops dying out are often an indicator of bark beetle attack. A stress cone crop produced on a tree with thinning foliage and shortened terminal growth is an indication of root disease. Fruiting bodies and basal cankers also indicate something wrong with the root system

Factors most commonly involved in the rapid death of a tree include:

- infection by wilt fungi
- mechanical injury
- rodent damage
- gas line leaks
- lightening
- toxic chemicals

Causes for progressive decline include:

- girdling roots
- decay
- poor soil type
- poor drainage
- lack of nutrients
- soil grade changes
- improper planting

Common Disease & Insect Problems

Some are more commonly found in forested situations and others in urban environments. I usually do not recommend chemical controls for tree problems in forest situations, because of the cost involved, and also because of the number and size of trees involved. People are more willing to spend the time and money in controlling urban tree problems with chemical controls, and this type of control is more successful in urban environments. But I always encourage people to use the recommended cultural controls, along with other methods to increase the health and vigor of their trees and shrubs, whether they are going to use the chemical control or not.

Conifers are cone-bearing trees; most are evergreen; western larch & bald cypress are examples of exceptions.

Red-band needle cast
Cause: Fungal. *Mycosphaerella pini* (imperfect: *Dosthistroma septospora*). Formerly *Scirrhia pini* (imperfect *Dosthistroma pini*). The fungus attacks both current-season needles and needles produced in past seasons.
Susceptible species: all pines; especially serious in Christmas tree plantings.
Transmission: wind and rain.
Symptoms: Chlorotic spots appear on the infected needles during the fall and winter. The spots gradually spread, turn red-brown and girdle the needle, causing the tip to die while the rest of the needle remains green. Spores are produced on the needles in the spring, and have been disseminated by mid-August. Defoliation of trees may occur during the growing season, rendering the trees useless for sale.
Cultural Control:

- Prune out lower whorl of branches at first opportunity.
- Clean out debris from in and around tree.
- Avoid planting in low-lying areas with poor air drainage.
- Space, or thin plants, to encourage good air circulation.
- Control weeds around bases of trees.
- Shear trees during dry weather.

Tip Blight (Diplodia blight)
Cause: Fungal. *Sphaeropsis sapinea* (formerly *Diplodia pinea*). The disease normally does not kill trees, but allows other organisms (such as pine beetles) to gain entry, which then kills the tree.
Transmission: Spores produced on infected plant debris spread to new shoots during wet weather, usually confined to the spring. Tree wounds may also be an entry site for the fungus.
Susceptible species: Primarily on Ponderosa pine, but also on Austrian, Scots, red, and mugo pine.
Symptoms: Stunted, discolored needles develop on new growth in the spring. The tips have a characteristic downward bend. The shoot tip continues to die back to the main stem, killing older needles as it progresses. Several branches or whole portions of the tree may be affected. Dead needles often remain on the branches until the following spring.
Cultural Control:

- Landscape trees - keep trees well watered and stress-free.
- Forest trees - thinning stands is helpful.
- Christmas trees - do not shear in wet or humid weather.

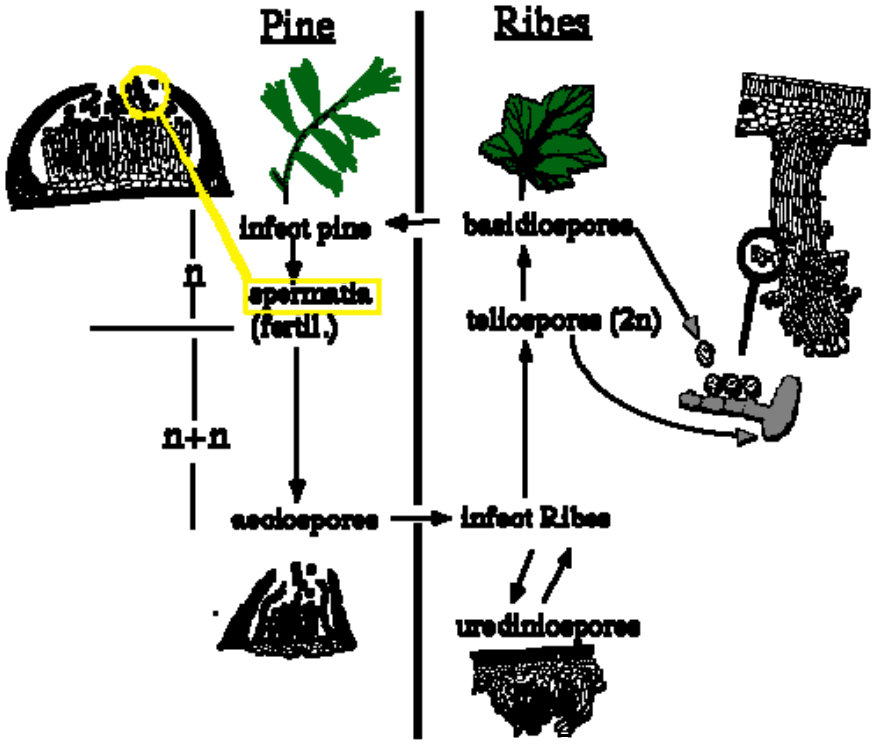
Rhizophaera needle cast on spruce
Cause: A fungus, *Rhizophaera kalkhoffii*.
Susceptible species: Colorado blue spruce and Engelmann spruce are highly susceptible; white spruce is intermediate; Norway spruce is relatively resistant. Other conifer hosts include pine, Douglas-fir, true fir and western hemlock.
Transmission: Rain splashed spores generally infect current-season needles.
Symptoms: First symptom is yellow mottling of current seasons needles in late summer. These soon turn brown or purplish-brown as is the case with Colorado blue spruce. Brown needles are shed the next spring and summer. Fruiting bodies occur in rows on the underside of needles. This disease has been a problem on Northwest nurseries and landscape trees.
Cultural control:

- Remove dead needles underneath and within tree.
- Avoid overhead (sprinkler) irrigation method.

Rusts

- Fungal
- Various species of rusts occur on spruce, fir, pine, etc.
- Most known is white pine blister rust
- Primarily in woodland situations
- Need alternate host to survive

- Example: white pine blister rust



Cytospora canker (*Cytospora kunzei var. piceae*)

Cause: Cytospora canker of spruce is caused by the fungus. Spores (conidia) are readily disseminated by splashing water, wind-driven rain, by man during pruning, and also very likely by insects and birds. The fungus generally becomes established through wounds.

Frequently found on Norway spruce and Colorado blue spruce and its cultivars. White spruce is also susceptible and there are a few reports on Serbian spruce. In addition to the spruces, Cytospora canker is sometimes found associated with Douglas fir, hemlocks, larches, and balsam fir.

Symptoms - Dying of a lower branch with subsequent needle browning is usually the first symptom. The brown needles may remain on the branches or they may fall off. As the disease progresses over several years, higher branches show damage. The actual cankers are often first seen at the base of branches near the main trunk of the tree. On the more susceptible species (Norway spruce), trunk cankers develop which may result in girdling and death of the tree.

The bark of the cankered areas is not visibly different in color, nor does it become sunken as in cankers on many deciduous trees. However, resin flow is usually associated with Cytospora canker and the white patches of dried resin are quite conspicuous on the bark. Resin flow can, however, be associated with any injury to branch tissue.

Cytospora canker is more common on trees over 15 years old. This disease is more prevalent on trees of low vigor. Those trees with shallow roots, weakened by drought, low fertility,

mechanical injury, or insect damage; and trees growing in an unfavorable site are more susceptible to Cytospora canker.

Control: The following practices lessen the likelihood of this disease:

- Avoid bark and stem injuries.
- Control insects and mites; especially spruce gall adelgids and spider mites.
- Fertilize according to horticulturists' recommendations.
- Water during extended dry periods. Water thoroughly so that soil is moistened 18 to 24 inches deep. A root irrigator may be needed to accomplish this.
- Follow accepted pruning practices.
- Vertically mulch to relieve soil compaction, poor aeration, and inadequate water penetration.
- Once established, the following may aid in suppressing disease development. Remember that affected branches cannot be saved.
- Prune and remove or destroy affected branches. To lessen the spread of the fungus, prune only when the trees are dry. Pruning tools should be disinfested with 70% alcohol between cuts. It will generally be necessary to prune back to the main trunk.
- No effective chemical control measures are available

Natural foliar shedding

- all conifers
- pines lose third year (2-yr old) needles
- arborvitae & related species with scalelike leaves shed oldest (interior) branchlets
- Spruce, fir, & Douglas-fir bear several age classes of needles along stems; shedding not confined to oldest age class

Mites

Most species of conifers; very common on Colorado blue spruce & arborvitae; primarily urban problem.

Mites are generally small, wingless, generally eight-legged creatures that resemble little spiders. Some suck juices from leaves, others prey upon or are otherwise associated with forest insects. Some are important contributors to decomposition, recycling nutrients back to forest soils. Others are pests of man and animals. More important on ornamentals than in woodland situations. Usually see webbing, often see mites or body parts, in spring and fall see red eggs. Like hot, dry, dusty environments. Most commonly seen in the clinic on Colorado blue spruce and arborvitae, during dry period of the summer.

Eriophyid mites

On many species, mostly Colorado blue spruce. Microscopic mites – small enough to dive in and out of the stomata of needles and leaves. Plantation/urban situations. Feed on both conifers and deciduous trees and shrubs, on leaves, buds, stems., flowers, fruits; one species cause galls on aspen and poplar.

See them mostly on Colorado blue spruce. Needles look like they are melted plastic; distorted; stunts tree growth. Very difficult to control.

Adelgids

Very similar to aphids; in a closely related family. Attack conifers only. Can be positively identified only by microscopic examination, so diagnosis by symptoms and species of conifer it is on. Complex life cycle – Sexual form, if present, always develops on spruce. Asexual forms feed on true firs, larch, pine, Douglas-fir and hemlock. Best results from chemical control is in spring when crawling stage is present.

Cooley spruce gall adelgid:

- Causes cone-shaped galls on spruce; most people think these are cones.
- Damage to ornamentals; can cause death of branch tips and tend to stunt growth.
- Galls start out green and turn hard, brown and dry after the insects have left the structure.
- Douglas-fir is alternate host; are white, cottony masses on new shoots, needles and cones; needles become twisted and yellowed.
- Entire life-cycle takes 2 years; galls on spruce are formed only when Douglas-fir is present.
- Spray either tree species for crawlers in early spring.

Balsam woolly adelgid

- On subalpine fir & other true firs.
- Both woodland & urban situations.
- European species that has become widely established in North America, where it is highly destructive to several species of true fir.
- A major forest pest in the west on subalpine fir.
- Feeds on stems, twigs, and branches.
- When feeding it injects a salivary substance into the tree which causes calluses and gall-like formations. Branch and twig infestations often cause gouting, which weakens a tree over long periods of time.
- Bole infestations can be quite sever and are easily identified by the white, wooly adelgids. Severe infestations usually kill trees in a few years.
- Distributed mostly by the wind.
- 2-4 generations per year; all individuals are female, so it only takes one to start a new infestation.
- Chemical control in urban areas useful, but not economically feasible in woodland situations.
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Tip & Shoot moths

Many kinds. Affects all pines; woodland & urban situations. We are mostly dealing with European pine shoot moth (*Rhyacionia buoliana*). Most two and three needle pines are susceptible (ponderosa, Austrian, Scots). Small, slender moths with an 18 mm wingspan. They have light orange-yellow heads and thoraces, grey abdomens and light reddish orange forewings mottled with silvery crosslines. Moths lay eggs on or near buds at the end of

terminal buds in spring and early summer. Larvae mine base of needles then burrow into a bud to overwinter. Mining damage is usually accompanied by webbing and a flow of resin. Most damage is done in the spring, secondary injury is in the form of deformation of the tree axis, forking and bushing. Hatch as pale yellow brown caterpillars, with black heads and thoracic shields, mature to dark brown and grow to 10 mm in length. Larvae bore into tips of terminals and laterals and kill them. Often causes flagging. Continued attack on terminal buds results in many secondary shoots which makes trees very bushy. Small trees can be killed.

Sequoia pitch moth

On pines; urban situations. Very common on urban and plantation trees. On pine and sometimes, Douglas-fir; does not feed on Sequoia. Significant pest of ornaments. Larvae bore into cambium, causing masses of pinkish pitch to form and can seriously damage young trees. Pitch masses also contribute to fire hazard – especially on trees growing around homes in the wildland/urban interface.

Attaches are more common around wounds and at junctions of limbs and bole; repeated attacks are common. Life cycle is 2 years.

Bark beetles

Nothing loves a stressed tree more than a bark beetle – unless it's thousands and thousands of bark beetles. Each conifer species has its attendant species of bark beetle(s). Bark beetles are tiny & conquer a tree by aggregating in large numbers. Tree species used to ID bark beetle species; galleries also distinctive. Historically a woodland problem, but populations have moved into urban areas via firewood from infested sites.

Bark beetles work inside the bark, cambium, and outer layers of the sapwood, and include bark beetles and some of the woodborers. All species of bark beetles are very small, usually 1/4" long. Life cycles vary among species, but all are a variation on the following example, using the Douglas-fir beetle.

Adult beetles attack injured or weakened trees in late spring or early summer. Once inside the tree, the adult beetles build tunnels (called galleries) under the bark, mining the cambium. Eggs are laid in galleries. Larvae mine outward from the egg galleries towards the outer bark. Most bark beetles overwinter as adults in the outer bark and reemerge in the spring to fly and infest new trees, when the cycle begins anew. The primary attack season for beetles that over-w9inter as adults is mid-April to June. Those beetles that overwintered as larvae emerge later, usually sometime in midsummer. In this area we usually only have one generation per year., though *Ips pini* can have 2-3.

Pine wilt

Primarily on Scots pine. Complex life cycle involving sawyer beetles and nematodes. Urban and woodland situations in the east. Pine wilt typically kills Scots pine within a few weeks to a few months. Needles initially turn grayish green, then tan-colored to brown. Resin flow from the wood also ceases as the tree declines. Needles remain on the dead tree for a year or more. Scattered branches on a tree may be affected initially, but the problem soon spreads to the remaining branches. In other situations, however, the entire tree turns brown all at once.

Great losses to pine have occurred in Japan. To see, take a sample from a lower limb of from the lower portion of the trunk. Submerge in water in a petri dish. Look for nematodes at 24, 48 hours. I have never confirmed a case in the Inland Northwest. This structure here, called a spicule, is a distinguishing feature of this nematode and should be used to tell it apart from other, harmless kinds.

Broad-leaved trees are deciduous, shedding their leaves after one growing season, others are evergreen or semi-evergreen.

Leaf and Shoot Blight on Aspen
Cause: A fungus - Venturia spp.
Susceptible species: aspen, hybrid poplar, black cottonwood, balsam poplar.
Transmission: Spores are produced during wet weather in spring, and carried by wind or rain. Spores overwinter in infected shoots but not in leaves. Immature and young shoots are susceptible to infection but become resistant with age.
Symptoms: Brown to black leaf spots and blights occur at the tips and margins of leaves. These necrotic areas expand rapidly, killing whole leaves and shoots. The shoot dieback has a characteristic "shepherds crook" appearance of the blackened terminals. Lesions generally do not extend into woody tissues. Affected tissues dry out and become brittle. Impact of this disease is greatest on young trees, with tissues becoming more resistant with age.
Cultural Control:

- Prune out infected shoots.
- Plant resistant clones.

Anthracnose
Cause: A fungus - different genera on different host plants.
Susceptible spp.: apple, ash, blackberry, blueberry, clover, currant, dogwood, gooseberry, lawn and turf, lettuce, maple, oak, pepper and eggplant, raspberry, statice, sycamore, tomato, walnut. Probably others.
Transmission: The various fungi responsible for anthracnose overwinter in fallen leaf litter and nuts, and in cankers. In the spring, spores are released and spread by rain and wind. Successive generations of spores are produced through the summer in primary and secondary lesions, and subsequently spread the disease.
Symptoms: varies with species under attack. Usually discolored (yellow, tan, brown, red, purple) blotches or contortion on leaves. Lesions or blotches may be vein associated. Early defoliation may occur in severely affected plants.
There are some specific cultural controls for individual species; orchard situations have much more extensive cultural and chemical controls.
Cultural control:

- Prune out and burn affected branches.
- Rake and burn fallen leaves and nuts.
- Avoid overhead irrigation.

Nectria canker

Cause: A fungus - Nectria cinnabarina and N. galligena.

Susceptible species: a cosmopolitan pathogen on many plant species, mostly angiosperms, worldwide.

Transmission: Invade trees through various wounds and injuries. This can include winter injury, damage from drought, sunscald, leaf scars, cracks in the twig axils, or senescent lower branches. Spores are disseminated during rainy weather.

Symptoms: vary with species affected. Nectria cinnabarina - usually girdling cankers form on twigs, limbs and sometimes trunks, followed by death of the affected parts. Cankers appear as sunken areas generally associated with wounds. These cankers are not obvious until striking orange red fruiting bodies develop in large numbers in the cankered area. N. galligena - symptoms same as above except, if tree or branch is not girdled, an elongate canker forms year after year. Branches become swollen and weakened, and may break in wind or ice storms.

Cultural control:

- Prune out and destroy affected branches during dry weather. Make cuts several inches below affected area.
- Sterilize pruning tools when pruning during wet weather.

Cytosporia canker

Cause: A fungus - Leucostroma cincta = Cytospora cincta.

Susceptible species: These fungi have a wide host range, and can infect all of the stone fruit and pome fruit trees. They can be devastating on cherry, peach and apricot orchards. Various ornamental trees and shrubs are susceptible also.

Transmission: All host can provide overwintering sites for this group of fungi. Cytosporia fungi does not destroy the structural strength of the tree, but other fungi commonly invade the same infection sites and cause rapid wood rotting, adding to the severity of the disease.

Symptoms: The first evidence of infection is usually dead twigs. Leaves above stem infections droop and discolor through shades of green to brown, and remain attached, sometimes through the winter. These "flags" are caused by stem invasions which has resulted in cankerous areas, which may or may not girdle the stem. The surfaces of these cankers develop pin-head sized bumps in otherwise smooth-barked trees. Cankers enlarge in an elliptical manner, sometimes streaking rapidly up and down the stem without immediate girdling. Where infected tissue does not die immediately, you will get a condition known as perennial canker.

Cultural control:

- Remove dead branches, cutting well below (at least a foot) any visible discoloration in the bark.
- Do not establish orchards close to or downwind from badly diseased orchards.
- Avoid overhead irrigation.
- Take special care to avoid wounding trees.
- Control all insect and disease problems, such as brown rot of stone fruits, even in the first non-bearing years.
- Avoid rodent injury.
  Avoid excessive nitrogen fertilization, nitrogen applications late in the growing season, or late-season cultivation or irrigation.

- Paint the south side of trees with white latex paint to avoid winter injury (sunscald - next).
- Prune as late as possible in the dormant season. Prune in dry weather.

Aphids

On all species of trees and shrubs; urban situations. Small, soft-bodies, generally gregarious insects; range from almost colorless to green, yellow, or black. Pair of tube-like structures (cornicles) on abdomen are identifying feature of most species. Adults may be wingless, or have 4 clear or cloudy wings with few veins. Typically have several generations per year, mostly parthenogenetic (female that can reproduce without a male; last generation per year is usually sexual. Most species overwinter in egg stage.; some species require 2 plant hosts. Have piercing and sucking moth parts; feed on sap and attack foliage, buds, flowers, fruit, twigs, and other insects. Secrete honeydew which is a food source for many other creatures, including ants; is also a fertile medium for growing sooty mold. Can transmit viral diseases in agricultural crops; few are important forest pests, but are a common problem on urban trees. Have many natural enemies, including green lace wings and labybugs.

Spider mites

Wide host range; urban situations. Are arachnids, not insects. Most are small, wingless, eight-legged creatures that resemble spiders. Some species suck juices from leaves of plants; others are predators on other insects including bark beetles. Affected leaves have a stipples, speckled look; webbing if often evident.

Scale

Wide host range; urban situations. Scale insects include mealybugs; are one of the most abundant and variable groups of sap-sucking insects. Cause great damage to agricultural as well as ornamental plants. The young are small, inconspicuous, and mobile, becoming sessile after they become attached to a plant. Once they become attached, most develop a waxy or shell-like covering and remain fixed in one position until they die. Females cause almost all of the injury to plants. Adult males usually have wings, antennae, eyes, and legs but no functional mouth parts so cannot feed; they are short lived and rarely seen. Most abundant on stressed trees. Dormant oil sprays are effective control; spray in spring for best coverage.

New Aspen Problem (2 slides)

- Bill Josey, Arborist-ArborCare Resources, Inc., initially collected samples of the scales and sent them to a scale expert at Colorado State University, Whitney Cranshaw. Whitney tentatively identified them as *Diaspidiotus gigas*, the willow scale, poplar scale, or armored poplar scale, many common names.
- Apparently, it is a European species but has been around the western US for awhile. The scales, moderately to densely spaced all the way up tree boles, are having a detrimental effect on the aspens.

- Symptoms noticed were: thinning crown, bending at mid-upper bole, extensive branch mortality and breakage. There were some issues with the proximity of the weakened trees to residences.
- So far, the scale has not been located on aspens on National Forest System lands, but they are infesting aspen growing in Ketchum. Possible explanations for the presence of this scale on subdivision and town trees could be that it was introduced by imported aspen and its proliferation could be attributed to overwatering and other stress issues associated with urban areas.

Borers

Often species specific; urban situations (here in the west). Many of those found on hardwoods are quite large and cause noticeable damage (flatheaded and roundheaded borers). Larger borers feed on wood, as opposed to tiny bark beetle that feed on cambium.

Poplar borer – *Saperda calcarata (2 slides)*

- Main hosts: quaking aspen, balsam poplar, eastern cottonwood
- The insect has a long life cycle, extending over 3 to 4 years. The adults feed on the foliage and the tender bark of twigs. The females lay their eggs in slits they have cut in the bark. After hatching, the larvae begin feeding in the cambium and then penetrate into the heartwood by creating deep galleries. In the spring of the last year of larval development, the larvae change into pupae and then into adults.
- The poplar borer is a species native to North America. It is found throughout the geographic range of poplar in Canada and the United States. The borer usually attacks poplars growing on poor sites.
- Damage results in swollen bark areas, sap run and piles of frass around the entrance to galleries near the base of the trunk and the roots are signs of the poplar borer's presence. Bark swelling caused by larval activity is more visible in young poplars. Cankers can be quite large and often resemble raw meat with sap running down from the wound.
- This particular attack was on urban trees in Ketchum – all quaking aspen.

Emerald ash borer (*Agrilus planipennis* or *Agrilus marcopoli*)

- Shiny green beetle and an invasive species known for killing ash trees in the United States.
- Southeastern Michigan is a quarantine zone from which ash trees or even firewood cannot be removed. Large fines have been imposed on a few companies that violated the ban, including one that was removing ash trees from southeast Michigan and is believed to be responsible for spreading the beetle to another county. The USDA has committed at least $40 million dollars for eradication in 2004 and expects to spend over $350 million in the next twelve years.
- The insect is unusually difficult to kill. More than seven billion ash trees are currently at risk. Nearly 114 million board feet (33,000 m^3) of ash saw timber with a value of $25.1 billion is grown in the eastern United States each year.

- Michigan officials announced September 14, 2005 that ash borer infestation had crossed the Mackinac Strait and was now in the Upper Peninsula for the first time. Wisconsin environmental officials considered it a grave threat and began preparations for surveys in northern counties. Currently twelve counties in Indiana are under quarantine. However, states and cities are running out of money to combat the problem and many authorities feel that the borer will spread throughout North America.
- On June 13, 2006, the Associated Press reported that ash borers were found at a home near Lily Lake, in Kane County, Illinois. Illinois officials plan to conduct a survey of the region, and will later hold a hearing to determine if a quarantine is necessary. In July, 2006, further infestations were discovered in Northern Cook County, Illinois, including Wilmette, Evanston, and Winnetka.

Asian long-horned beetle – *Anoplophora glabripennis*

- The Asian long-horned beetle (*Anoplophora glabripennis*), sometimes called Starry Sky (Sky Oxen in China) beetle, is native to China and where it causes widespread mortality of poplar, willow, elm, and maple throughout vast areas of eastern Asia.
- Asian longhorned beetles are big, showy insects: shiny and coal black with white spots. Adults are about 1 inch (2.5 cm) long. On their head is a pair of very long antennae that are alternately ringed in black and white. The antennae are longer than the insect's body.
- An invasive species in the United States, the larva of this beetle has a voracious appetite for wood. It is especially damaging to maple trees: Norway, sugar, silver, and red maple are among its preferred foods. The species also feeds on horse-chestnut, poplar, willow, and elm.
- Females of this species chew into the bark and lay eggs. When the eggs hatch, the immature beetles, which look like big white worms, chew their way farther into the tree. When they mature, the full-grown beetles chew their way out of the tree. The beetle life cycle leaves trees riddled with holes, oozing sap. The USDA believes this beetle can probably survive and reproduce in most sections of the country where suitable host trees exist. The beetle has also invaded Britain, Austria and Germany.
- The Asian Longhorned Beetle can be seen from late spring to fall, depending on the climate. Host trees include: *Acer* (maple, boxelder), *Aesculus* (horsechestnut, buckeye), *Salix* (willow), and *Ulmus* (elm.)
- The Asian Longhorned Beetle (ALB) was first discovered in the United States in Greenpoint, Brooklyn and soon after in Amityville Long Island in 1996. Since then, infestations were found in and around New York City, including on Long Island and in Queens and Flushing Park. Several infested trees were removed around Central Park, where over 20,000 potential host trees grow. The Asian longhorned beetle was believed to have arrived in New York City in the 1980s from wooden packing material. According to the Director of the Animal and Plant Health Inspection Service Laboratory of Cape Cod, MA Victor Mastro, the center of the infection zone was a warehouse which imported plumbing supplies from China. The infestations in New Jersey and on Long

Island are believed to have spread from the Brooklyn point of entry. Chicago's infestation was believed to come from a separate point of entry.

- At present, it has been found in several areas in New York City and Long Island, the Chicago area (the quarantine being lifted on July 12, 2006), New Jersey, and Toronto, Canada. Longhorned beetles have also been found in warehouses in CA, FL, IL, IN, MI, NC, NJ, NY, OH, PA, SC, TX, WA, WI and in BC, ON in Canada, but has been prevented from getting outdoors.
- Over 6,000 infested trees have been cut down and destroyed to eradicate ALB from New York and over 1,550 trees in Chicago and almost 23,000 trees in New Jersey, more than 15,000 in the Linden area alone. Infested trees continue to be discovered.
- The government is trying to eradicate this species primarily because of two reasons:
- Impact. If it becomes established in this country it could significantly impact our natural forest and urban environment.
- Limited Infestation Size. Infestations are limited in size at this time, and the federal government still believes ALB can be eliminated completely if action is taken now.
- The steps that have been taken to eliminate the Asian Longhorned Beetle include:
- Quarantines. Quarantines have been established around infested areas to prevent accidental spread of ALB by people. Infested trees cut, chipped and burned. All infested trees are being removed, chipped in place, and the chips are being burned. The stumps of infested trees are ground to below the soil level. All tree removal is done by certified tree care personnel to ensure that the process is completed properly.
- Insecticide treatments. Research is underway way to determine the effectiveness of certain insecticides such as imidacloprid against ALB. Insecticidal treatments have begun in New York and Chicago in hopes of preventing and containing infestations. Chicago's program of imidacloprid treatments for healthy trees of potential host species within a one-eighth to one-half mile radius of infested trees successfully removed Illinois from quarantine in August 2006. As of December 2006, New Jersey's policy was to cut down all healthy trees of the potential host species within a one-eighth to one-quarter mile radius of infested trees.
- Extensive surveys. All host trees on public and private property located within an established distance from an infested area are surveyed by trained local, state, or federal personnel. Infested areas will be re-surveyed at least once per year for 3-5 years after the last beetle or infested tree is found.
- Serviceberry or Shadbush, Ironwood, Southern catalpa, Hackberry, Turkish filbert, Ginkgo, honeylocust, Kentucky coffeetree, Tuliptree, Dawn redwood, White oak, Swamp white oak, Bur oak, English oak, Japanese lilac, Bald cypress, Basswood, Littleleaf linden are trees that are being planted to replace host trees.
- US customs regulations were changed on September 18, 1998 (effective December 17, 1998) to require wooden packing materials from China be chemically treated or dried via kiln to prevent further infestations of the Asian long-horned beetle from arriving. Pest inspection, new rules, and public awareness are the key steps to prevention of the spread of the Asian longhorned beetle, a beetle which could have devastating effects on our environment.

1000 Canker Disease on walnut (2 slides)

- This story begins in the summer of 2005. A landowner I work with in Meridian called saying his walnuts were starting to die. I also had a call from Will Cook over in Emmett – same thing. I called the City of Boise and talked to the forester. They didn't know what was happening, but mature walnut trees that were healthy on July 1 were completely dead on August 1.
- They said they were finding a lot of ambrosia beetles in the trees, but thought it was drought stress killing the trees. This didn't make sense to me because the 'problem' was spreading from west to east and was occurring on both irrigated and un-irrigated sites. The wilt thing really bothered me as well – didn't fit the pattern for trees dying from drought stress.
- Went to Meridian and collected samples from Roger William's place. There were indeed a lot of little bitty holes in the stems of the smaller trees, which were completely dead. Brought sample back to Moscow.
- Had Steve Cook, our Forest Entomologist have a look and he said,*"those are not ambrosia beetle holes, too small. I think that is walnut twig beetle (Pityophthorus juglandis)"*. We went to confirm the identification with Frank Merickel, the curators of the Entomology Museum at the College of Ag. It turns out he had identified about 100 walnut twig beetles from samples sent to him in 2003 from the Boise/Meridian area.
- When I got back to my office I 'Googled' walnut twig beetle and came across some folks at Colorado State University, Whitney Cranshaw and Ned Tissant, who were working on the same mystery. They had identified the twig beetle and were linking it and drought stress, with perhaps a pathogen, as well. Stated in an email from Ned:
    - *As early as 2003 foresters in Boulder County began to notice a decline and mortality of black walnut. Trees initially showed branch dieback, but rapidly declined and died, often within one year. Mortality was initially attributed to drought, but the problem continued unabated even in years with normal precipitation and on sites not prone to drought stress. By September 2007, over 250 black walnuts had been killed. This represented a majority of the total black walnut population in that city. Walnut mortality also has been noted in Colorado Springs and other cities in the Denver Metro area.*
    - *In 2003 the walnut twig beetle (Pityophthorus juglandis) was observed on declining black walnut trees in Colorado Springs. This was a new report for Colorado. In 2004 the beetle was recovered from dying walnut trees in Boulder and by 2006 it was consistently found in declining trees. This beetle is native to the Southwestern United States and is apparently a minor pest, causing dieback of twigs and small diameter branches on stressed trees. Black walnut is not a natural host of this beetle. However, the activity of the beetle on black walnut in Colorado is much more aggressive than previously reported on native hosts. The beetles successfully attack branches in excess of 3 inches in diameter, causing major branch dieback on J. nigra. The behavior of these beetles is alarming.*

- *In 2006 and 2007 we observed long vertical trunk cankers caused by the fungus Fusarium solani during the final stages of tree decline. This fungus is widespread in North America on J. nigra and typically colonizes and causes cankers following tree injury or stress (e.g. low temperature damage). F. solani was not isolated from beetle galleries or the walnut twig beetle and we do not believe P. juglandis is a vector of this pathogen.*
- *Prior to the 2001 black walnut die-off in the Espanola Valley of New Mexico (Anonymous 2002) the insect was apparently never been associated with tree mortality and in this first report it was speculated that it was associated with drought. The more recent confirmed captures in several eastern Colorado locations, and the suspected presence in Utah, Idaho and Oregon, would involve substantial range extensions of the insect.*
- *Although minute (1.5-1.9 mm), attacks by adults P. juglandis are not confined to twigs. Nuptial galleries produced by colonizing males have been commonly seen large diameter branches of >5 cm diameter. At the point where beetles enter, stained wood typically develops around the beetle tunnel. This staining apparently is produced by colonization of the wound by a fungal associate, producing small cankers, often >1 cm diameter. Where multiple attacks by adult bark beetles are made, the cumulative effects of such cankers and beetle wounding become so extensive that they may largely girdle the branch. Larvae have also been observed in the trunk, although only along margins of trunk cankers.*

- Work continued. We were all pretty sure by now that there was a fungal associate that produced the wilt-like symptoms and rapid death. In an email dated May 9, 2008 Ned wrote:
  - *We are calling this disease thousand cankers because trees literally die from beetle attacks and the formation of thousands of cankers on the tree. In my opinion this canker/pest complex poses a major threat to black walnut should it be introduced into its native range.*
- So, thanks to Ned, we now had a name to go by. Ned was successful in isolating a fungus, *Geosmithia* spp. He wrote:
  - *In fall 2007 a fungus called Geosmithia (identification based on morphological characteristics and rDNA ITS sequence similarity of 98%) was consistently isolated from branch and twig cankers surrounding beetle galleries and directly from the beetles by Ned Tissant and group. Geosmithia spp., are associates of bark beetles of hardwood trees, but have not previously been reported as a pathogen of Juglans or an associate of P. juglandis. We inoculated one-year-old black walnut seedlings with two Geosmithia isolates in the greenhouse. The fungus aggressively colonized the bark and cankers were formed three weeks after inoculations. We (Ned Tissant and group) currently have no information on the origin of the Geosmithia fungus, but are collaborating with entomologists in California to determine the flora associated with P. juglandis in its native range and working with a researcher in the Czech Republic on fungal taxonomy.*

- I went to Boise in March 2008 and met with the folks at Boise Park and Rec. and Jim Hoffman, Forest Pathologist with the Forest Service. Took more samples, but it was too early and too cold to get anything from them.
- Jim went back later in the spring, took new samples using a bucket truck and sent them off to Colorado.
- In June I received an email from Ned stating:
    - *We have isolated the Geosmithia fungus from the cankers associated with the beetle galleries and confirmed its presence in Idaho. We now believe that the beetle is vectoring this fungus and that this combination, in possible association with another fungus (Fusarium) is causing the decline. We have no idea how to control this. Whitney Cranshaw and I are going to try some Merit insecticide preventive treatments. However, other curative insecticide treatments have been a failure.*
- 1000 cankers disease on walnut is now entered as a new state record for *Geosmithia* sp. in the National Agricultural Pest Information System (NAPIS).
- We have a name and we know what is happening. Sanitation (pruning out affected branches and removing them from the site) and deep watering, especially during hot weather could help, but to date we have no recommendations for control

Dutch elm disease (DED)

Cause: A fungus - Ceratocystis ulmi.

Susceptible spp.: all American species of elm. The Chinese and Siberian elms are not seriously affected by this disease. Diseased trees were first found on the Pacific Northwest in Boise, in 1968. Since then Dutch elm disease has spread to locations in Oregon and Washington, and other locations in Idaho. Reported in 1990 in Moscow and Weiser.

Transmission: Dutch elm disease is spread in two ways:

- the elm bark beetle. This bark beetle breeds in diseased trees, but feed on healthy trees. The fungus produces spores in the beetle galleries beneath the bark. The spores are then carried to healthy trees on or in the bodies of the beetles during feeding. Beetles overwinter as larvae under the bark of trees or logs. They complete their growth in the spring and emerge as adults, who fly a short distance and feed on the bark of small branches on healthy elms. They are usually active in this stage from mid-May to early October. After feeding on healthy trees, the adults seek breeding sites under the bark of dead or weakened trees or logs, overwintering there to continue the cycle in the spring.
- root grafts. Elms that grow within 40 feet of one another are susceptible to Dutch elm disease through root grafting. The fungus in the vascular system of one tree can thereby invade adjoining trees through these natural grafts.

Symptoms: Early symptoms are wilting leaves and sparse foliage, first on single limbs but later the entire tree becomes infected. Yellowing and premature defoliation follow. Symptoms may show after only a few days after infection has occurred. Initial infection high in the tree may spread slowly, infection in main limbs move very rapidly, with the tree wilting and dying in a very short period of time. Infected sap wood shows brown streaking, especially in the current season's growth. A cross-section will show a broken or continuous brown ring in the outer

growth rings of the wood. The only positive way of identifying the fungus is by isolating and culturing.

Cultural control:

- The best way to control susceptible trees is to rapidly detect and remove diseased trees. Communities without this disease or with low disease incidence should map all susceptible trees and regularly scout these trees for symptoms of the disease.
- Remove and burn all dead wood and branches before beetles emerge in spring. If this is not practical, remove the bark - beetles complete their life cycle only in logs with bark intact. Do not save branches or logs for firewood unless bark is completely removed.
- Protect nearby trees by severing root graphs with a mechanical trencher or soil fumigants.
- Plant resistant cultivars including 'Sapporo Autumn Gold', 'Regal', 'New Horizon', 'Independence', 'Cathedral', 'Homestead', and 'Pioneer'.

Banded elm bark beetle – *Scolytus schevyrewi* (Pronunciation: Sko-li-tus chevy-rev) - **An Asian Bark Beetle New to the United States**

- *Scolytus schevyrewi*, the banded elm bark beetle, was first collected in insect traps set in Aurora, CO (a suburb of Denver), and Ogden, UT, in April 2003. Dr. James LeBonte, Oregon Department of Agriculture, first identified the beetle as new to the United States.
- By the fall of 2003 this bark beetle had been collected in the following states: Arizona, California, Colorado, Idaho, Illinois, Kansas, Nebraska, New Mexico, Oklahoma, Oregon, South Dakota, Utah, and Wyoming. Recent examination of the state insect collection in New Mexico revealed that *S. schevyrewi* was present in Clovis, New Mexico, as far back as 1998.
- The beetle was observed attacking and killing drought stressed Siberian elms. The Animal and Plant Health Inspection Service (APHIS), state forestry organizations, and the U.S. Forest Service are currently working together to map out the range and impacts of this exotic bark beetle.
- *S. schevyrewi* is native to Asia, where its hosts include a variety of native elm species, willows (*Salix* spp.), fruit trees such as apricot, cherry, and peach (*Prunus* spp.), and Russian olive (*Elaeagnus angustifolia*).
- In the United States, the banded elm bark beetle has been found infesting and breeding in American, English, rock, and Siberian elms only. The beetle has been collected from broken elm branches, fallen elm trees, stacks of elm firewood, and elm trees stressed by drought.
- *S. schevyrewi* also has been reported to be present in trees dying from Dutch elm disease. The biology of *S. schevyrewi* is similar to that of *S. multistriatus*, another exotic bark beetle native to Europe, which is the principle vector of Dutch elm disease in the United States.
- The banded elm bark beetle completes a generation in two months or less. *S. schevyrewi* probably completes a minimum of 2–3 generations per year in the Denver area. The egg galleries of these two species of bark beetles are very similar.

- The literature suggests that newly emerged brood beetles of *S. schevyrewi* have a period of feeding at branch junctions in the canopies of living elms, like that reported for *S. multistriatus*. This is important because feeding by *S. multistriatus* on branch junctions in the canopies of elm trees is one mode of transmission of the Dutch elm disease fungus to uninfected trees
- Studies of the banded elm bark beetle indicate that some brood larvae may burrow into the outer bark of infested elms to pupate and transform into adults. This behavior may explain how this Asian bark beetle was introduced into the U.S. via wood pallets or shipping containers constructed with beetle-infested elm wood with the bark attached.
- At this time, the banded elm bark beetle appears to pose a moderate risk to elms planted as shade trees or as windbreaks throughout the inland West, particularly during periods of drought. This species appears to be more aggressive than the ubiquitous *S. multistriatus*. In areas where the banded elm bark beetle has become well established, like Denver, this beetle is much more abundant in dying elms than is *S. multistriatus*.

Birch dieback
Cause: Environmental - drought stress + bronze birch borer
Susceptible species: birch.
Symptoms: Gradual decline of tree from the top down, faster decline during extended periods of drought. Leaves turn tan, and become brittle, while remaining attached to the tree. Quickly becomes associated with the bronze birch borer, accelerating the decline.
Cultural control:

- Avoid planting birch in areas without sufficient water.
- Deep water trees throughout summer months - dead branches will not come back to life.

In summary...

The best way to control plant problems is to ensure that the plants in your landscape are healthy and vigorous. Appropriate plant selection, proper planting techniques, deep watering, fertilization, sanitation, proper pruning techniques, good air circulation, avoid sprinkler irrigation will all contribute to the health and vigor of the landscape.

When making a diagnosis:

Identify the plant.
Gather as much information as possible, including a review of weather conditions and the surrounding area.
Review the information and see if there is something you may have missed.
Don't bluff.

The cultural control is as important, if not more so, than the chemical control. Increasing the health and vigor of the plant will always help with prevention and cure.