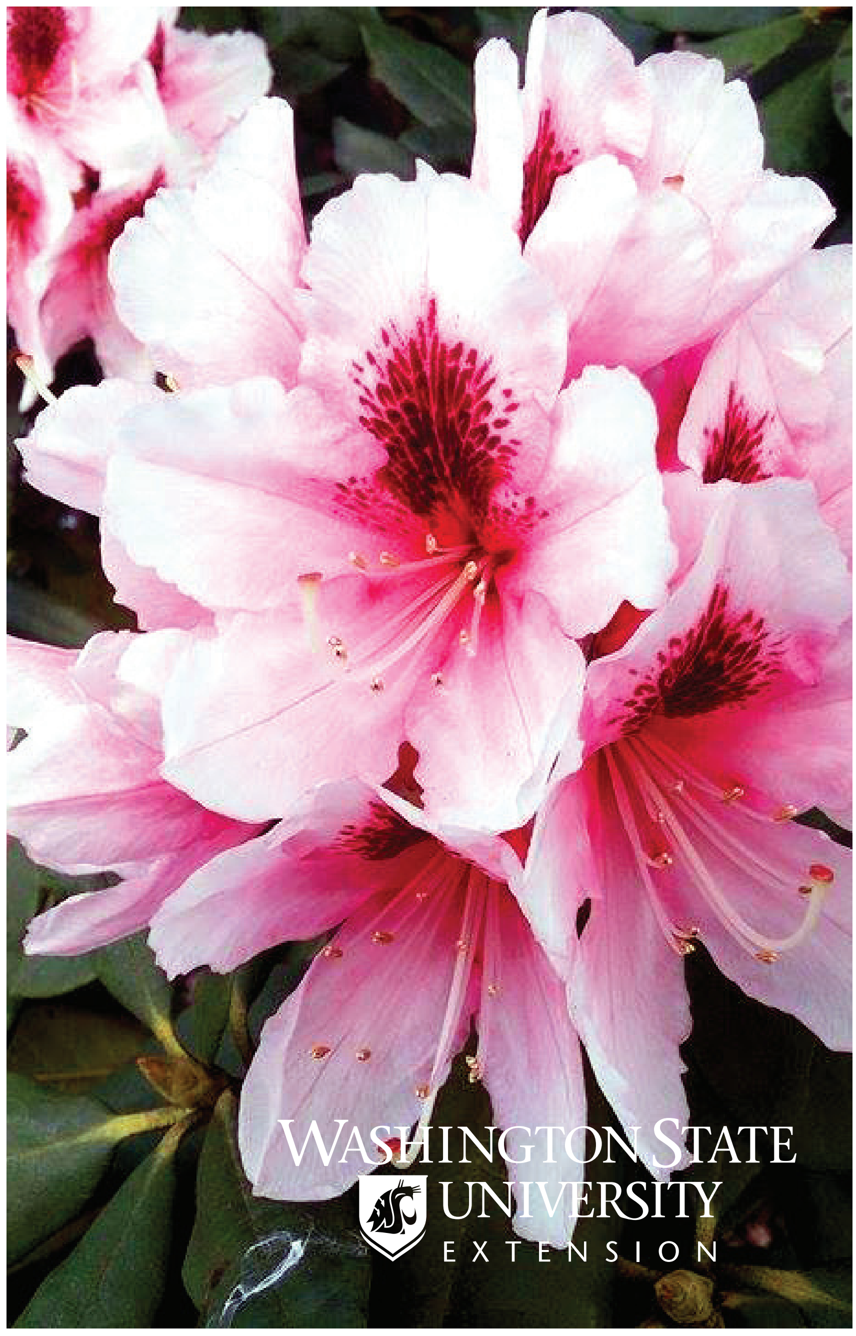
Identifying, Treating, and Avoiding Azalea and Rhododendron Problems

WASHINGTON STATE UNIVERSITY EXTENSION • EM091



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Introduction

Azaleas and rhododendrons belong to the genus *Rhododendron*, a member of the Ericaceae or heath family. This diverse plant family includes many common landscape plants such as andromeda, blueberry, heather, heath, huckleberry, and madrone, as well as botanical oddities like Indian pipe and pinedrops. While there are only two native species of *Rhododendron* in Washington State (*R. macrophyllum* and *R. occidentale*), there are many members of this genus which can be easily grown in our Pacific Northwest climate. Since azaleas are actually a subgenus of *Rhododendron*, this manual will refer to them collectively as rhododendrons.

There are hundreds of *Rhododendron* species, subspecies, varieties, and **cultivars** with a diverse range of cultural requirements. In general, rhododendrons and azaleas grow best in well-drained, acidic soil conditions with a **pH** range of 4.5 to 6.0. Soils that are too alkaline, such as many eastern Washington soils, may need to be chemically adjusted. While rhododendrons don't do well in soggy soils, they will need consistent summer irrigation for successful flower bud production and perform best when humidity, soil moisture content, and annual rainfall are high (Zhou et al. 1992).

Rhododendron root systems tend to be shallow, and soil compaction from vehicles, foot traffic, or heavy equipment will lead to decline **symptoms** (Yokobori et al. 1992). Keep the root zone covered with at least 4 inches of a coarse organic mulch, such as wood chips, but keep the mulch from contacting the base of the plant, as this could provide a suitable environment for *Phytophthora* root rot. A thick woody mulch layer will prevent and alleviate compaction, reduce weeds, moderate soil temperatures, and conserve water (Chalker-Scott 2007). Woody mulches also support the growth of **ericoid mycorrhizal** species, which are required for rhododendron and azalea survival (Zhong and Yu 2012).

While the cultural needs of rhododendrons are similar in terms of soil conditions, their tolerance of other environmental variables are not. Cold hardiness, for example, can vary from none (in the case of some tropical species) to far below freezing. Some species, such as *R. brachycarpum* subsp. *tigerstedtii*, will tolerate temperatures as low as –49°F, while others are damaged or killed by mild frosts. Likewise, sun and shade requirements and drought resistance vary among cultivars. Rhododendrons and azaleas that are planted in areas that don't match their environmental needs will become stressed—and stressed plants are more susceptible to opportunistic pests and diseases (Malciūtė and Naujalis 2010).

Decades of research have allowed scientists to provide cold hardiness ratings for hundreds of rhododendron species and cultivars (Gilkey 1996a; Richer et al. 2006). But new cultivars of rhododendrons and azaleas are constantly being introduced to nurseries, so lists of hardy varieties quickly become dated. Instead, check nursery tags for the plant's low temperature tolerance. Be sure this number is at least as low as the lowest temperatures in your region. Regional low temperatures can be easily found on the USDAs cold hardiness map http://planthardiness.ars.usda.gov/PHZMWeb/#.

Identifying Azalea and Rhododendron Problems

Collecting Information. Diagnosing plant problems is a science, so it's important to take a methodical approach. Before taking any irreversible action, like applying pesticides or digging up the plant, use the following table to help you collect the information you need to make a complete diagnosis.

Table 1. Information needed to diagnose rhododendron problems

1. **Plant and landscape details**
   A. Correctly identify the species or cultivar of rhododendron and determine its natural appearance.
   B. Examine the entire plant and its surrounding environment.
   C. What's been done to the soil in the last several years? Include significant excavations, soil amendments, and fertilizer and pesticide usage.
   D. How was the plant installed? Is the **root crown** buried or at soil level? Were all materials removed from the roots?
   E. What unusual weather events occured in the last year?
2. **Damage details**
   A. Write down the damage you observe on the plant.
   B. Did the damage appear suddenly (acute damage)?
   C. Did the damage appear slowly (chronic damage)? Recurring chronic damage (e.g., leaves are fine in the spring but become damaged over the growing season) is usually due to nonliving factors. Damage that appears slowly but progressively worsens over a period of years may be due to diseased or poorly established root systems.
   D. Nonliving causes MAY be indicated if:
      - Damage is uniform and on more than one plant.
      - Damage does not continue to spread throughout the plant or to other plants.
   E. Living causes MAY be indicated if:
      - Damage is irregular or random.
      - Damage progressively spreads through the plant to adjacent plants.

Normal Morphology and Development of Rhododendrons. Before assuming your rhododendron is unhealthy, look at these normal variations first.

Some rhododendron leaves, especially young ones, are naturally covered with a wooly mat of hairs that may be white, orange, or brown. This mat is called an **indumentum** (Figures 1a and b), and it is a prized feature of certain species of rhododendrons. The indumentum protects leaves from environmental stress and from some diseases. It should be left intact rather than rubbed off.

After new shoots and leaves have emerged, they begin to mature. Often the indumentum will be replaced by a waxy cuticle on the upper leaf surface, and green shoots will turn brown as bark develops (Figure 2). This natural color change should not cause alarm as it is not associated with any sort of disease development.

Figures 1a and 1b. Indumentum on upper and lower leaf surfaces. While these rhododendrons have a white indumentum, other species may have orange or brown.

Figure 2. Normal bark development. Younger stems are green, while older ones are brown.

Figure 3. Normal leaf senescence.

Although many rhododendrons are evergreen, their leaves do not live forever and after a few years they will naturally die. This is called **senescence** and only the oldest leaves will turn yellow or brown and finally fall (Figure 3). This process happens at the same time of year, though the actual season can vary among species.

A Key to Symptoms

If you have eliminated any natural and harmless causes of your rhododendron's unusual appearance, the following key can be used to identify the possible pests, diseases, or environmental factors responsible for the symptoms commonly found in Washington State. Remember, many pests and diseases appear when plants are already stressed, so they may not be the underlying cause of your rhododendron's problems.

Unusual Branching Pattern

1. Are there multiple shoots arising from the base of a bud?
   If yes, see ***Witches' Broom*** in the ***Pests and Diseases*** section.
   If no, go to 2.

Portions of Leaves Missing

2. Are there portions of leaves missing?
   If yes, go to 3.
   If no, go to 5.
3. Are there small, irregular or semi-circular notches in the leaves? Under severe infestations, damage may be extensive and include injury to buds and twigs as well as leaves.
   If yes, see ***Root Weevils: Adults*** in the ***Pests and Diseases*** section.
   If no, go to 4.
4. Are leaves badly chewed, often down to the midrib? There will be no evidence of notching.
   If yes, see ***Sawfly Larvae*** in the ***Pests and Diseases*** section.
   If no, see ***Caterpillars, Cutworms and Loopers*** in the ***Pests and Diseases*** section.

Unusual Material on Leaves or Branches

5. Is there unusual material on leaves and/or branches?
   If yes, go to 6.
   If no, go to 14.
6. Is there a green powdery substance on the upper leaf surface?
   If yes, see ***Algae*** in the ***Pests and Diseases*** section.
   If no, go to 7.
7. Is there a papery or leathery substance on the bark?
   If yes, see ***Lichens*** in the ***Pests and Diseases*** section.
   If no, go to 8.
8. Are there misshapen and fleshy white, yellow, green, or pink growths on new leaves?
   If yes, see ***Azalea Leaf Gall*** in the ***Pests and Diseases*** section.
   If no, go to 9.
9. Are there white or brown bumps on the stems or leaves that can be dislodged with a cotton swab?
   If yes, see ***Lecanium Scale*** in the ***Pests and Diseases*** section.
   If no, go to 10.
10. Are there small white cottony masses apparent on the bark?
    If yes, see ***Azalea Bark Scale*** in the ***Pests and Diseases*** section.
    If no, go to 11.
11. Are the leaves covered with a powdery substance?
    If yes, go to 12.
    If no, go to 13.
12. If the powder is white, see ***Powdery Mildew*** in the ***Pests and Diseases*** section.
    If the powder is gray, see ***Botrytis Blight*** in the ***Pests and Diseases*** section.

13. Are leaves covered with a black, sticky, soot-like material?
    If yes, see ***Sooty Mold*** in the ***Pests and Diseases*** section.
    If no, go to 14.

Leaves Curled, Distorted, or Misshapen

14. Are leaves curled, distorted, or misshapen?
    If yes, go to 15.
    If no, go to 21.
15. Are young leaves distorted with fleshy white, green, or pink growths?
    If yes, see ***Azalea Leaf Gall*** in the ***Pests and Diseases*** section.
    If no, go to 16.
16. Are young leaves twisted, puckered, or curled, and is there evidence of cast skins, honeydew, or sooty mold?
    If yes, see ***Aphids*** in the ***Pests and Diseases*** section.
    If no, go to 17.
17. Are young leaves distorted, with randomly occurring necrotic patches but no evidence of insect pests?
    If yes, go to 18.
    If no, go to 19.
18. Has there been a period of unusually cold or hot weather while leaves were growing?
    If cold weather, see ***Cold Injury: Vegetative Buds and Leaves*** in the ***Environmental Stresses*** section.
    If hot weather, see ***Heat Injury: Leaves*** in the ***Environmental Stresses*** section.
19. Are mature leaves curled lengthwise into cigar-like cylinders?
    If yes, go to 20.
    If no, go to 22.
20. Is webbing present within the rolled leaves?
    If yes, see ***Leaf Rollers*** in the ***Pests and Diseases*** section.
    If no, go to 21.
21. If temperature is below freezing, see ***Cold Response: Leaves*** in the ***Environmental Stresses*** section.
    If temperature is above freezing, see ***Drought*** or ***Root Rots*** in the ***Environmental Stresses*** section.

Discolored or Dead Areas on Leaves

22. Are leaves or portions of leaves white, red, orange, yellow, brown or black?
    If yes, go to 23.
    If no, go to 35.
23. If leaves or portions of leaves are discolored but not dead, go to 24.
    If leaves or portions of leaves are dead (**necrotic**), go to 34.
24. Are the upper surfaces of leaves randomly speckled with yellow to green spots?
    If yes, go to 25.
    If no, go to 26.
25. If undersides of the leaves are covered with yellow or orange spots, see ***Rust*** in the ***Pests and Diseases*** section.
    If undersides of leaves are covered with brown and black tar spots, see ***Lace Bug*** in the ***Pests and Diseases*** section.

26. Are there **mines—**discolored tunnels—within the leaf?
    If yes, go to 27.
    If no, go to 28.
27. If mines are small and brown, accompanied by leaf rolling, go see ***Azalea Leaf Miner*** in the ***Pests and Diseases*** section.
    If mines are large and white, accompanied by leaf tip dieback, see ***Rhododendron Leaf Miner*** in the ***Pests and Diseases*** section.
28. Do leaves have discolored spots or splotches without any signs of insect pests?
    If yes, go to 29.
    If no, go to 32.
29. If spots are purplish, see ***Physiological Leaf Spot*** in the ***Environmental Stresses*** section.
    If spots are red, orange, yellow, brown or black, go to 30.
30. If spots have small pinhead-like structures, see ***Fungal Leaf Spot*** in the ***Pests and Diseases*** section.
    If there are no structures inside the leaf spot, go to 31.
31. If spots have fingerprint-like patterns, see ***Viral Diseases*** in the ***Pests and Diseases*** section.
    If there is no obvious spot pattern, see ***Phytophthora Blight*** or ***Powdery Mildew*** in the ***Pests and Diseases*** section.
32. Are leaves chlorotic (yellow), without any signs of insect pests or fungal fruiting bodies?
    If yes, go to 33.
    If no, go to 34.
33. If leaves (especially older leaves) are uniformly chlorotic, see ***Nitrogen Deficiency*** in the ***Environmental Stresses*** section.
    If leaves (especially younger leaves) are yellow except for their veins (interveinal chlorosis), see ***Iron/Manganese Deficiency*** in the ***Environmental Stresses*** section.
34. If injury occurs primarily on the upper leaf surface, see ***Heat Injury: Leaves*** (**sunscald**) in the ***Environmental Stresses*** section.
    If injury is only along leaf edges and tips, see ***Drought*** in the ***Environmental Stresses*** section.

If none of these symptoms describe the problem on the leaves, see ***Pesticide Injury*** in the ***Environmental Stresses*** section.

Decline, Dieback or Failure to Thrive

35. Do flower buds form?
    If yes, go to 36.
    If no, see ***Drought*** in the ***Environmental Stresses*** section.
36. Are flower or leaf buds brown and fail to open?
    If yes, go to 37.
    If no, go to 38.
37. Are brown buds covered with tiny black bristles?
    If yes, see ***Bud Blight*** in the ***Pests and Diseases*** section.
    If no, see ***Cold Injury: Floral Buds*** in the ***Pests and Diseases*** section.
38. Are the newest mature leaves significantly smaller than older leaves?
    If yes, go to 39.
    If no, go to 42.

39. Is there evidence of waterlogged soil or a perched water table?
If yes, go to 40.
If no, see ***Drought*** in the ***Environmental Stresses*** section.

40. Are there mushrooms forming at the base of the plant in fall or white rot under the bark?
If yes, see ***Armillaria Root Rot*** in the ***Pests and Diseases*** section.
If no, go to 41.

41. Is there evidence of brown staining on the lower stems or root crown?
If yes, see ***Phytophthora Root Disease*** in the ***Pests and Diseases*** section.
If no, see ***Flooding*** (**hypoxia**) in the ***Environmental Stresses*** section.

42. Are entire branches missing, with tooth marks at the break points?
If yes, see ***Mountain Beavers*** in the ***Pests and Diseases*** section.
If no, go to 43.

43. Are entire branches dying back though other branches remain healthy?
If yes, go to 44.
If no, go to 45.

44. Are there brown or black cankers girdling the stem?
If yes, see ***Root Rots or Stem Diseases*** in the ***Pests and Diseases*** section.
If no, see ***Phytophthora Blight*** in the ***Pests and Diseases*** section.

45. The entire plant fails to thrive or dies.
If there is evidence of chewed bark at the soil line, see ***Root Weevils: Larvae*** in the ***Pests and Diseases*** section.
If the plant seems loose in the ground but is still alive, see ***Planting and Management Errors*** in the ***Environmental Stresses*** section.
If leaves all turn brown and die, see ***Drought*** in the ***Environmental Stresses*** section.

Alphabetical List of Azalea and Rhododendron Pests and Diseases

Algae

Symptoms: Leaf surfaces appear dry or dull and are covered with a green powder (Figure 4) that can be gently rubbed off.

Cause: Algae grow best on foliage in shaded, damp conditions with poor air circulation.

Treatment: Careful pruning of branches can increase air circulation but this problem is mostly aesthetic and can be ignored.

Figure 4. Algae on rhododendron leaves.

Aphids

Symptoms: Leaves, particularly new growth, appear twisted, puckered, or curled (Figure 5a).

Cause: Several species of aphids can cause damage. Aphids or their cast skins can be found on the leaves, usually on the undersides, or on new growth (Figure 5b). A sticky, shiny substance called **honeydew** is deposited by the aphids onto the plant. Honeydew deposits offer a medium for black sooty mold, which may also be present. Late frost damage (see ***Cold Injury: Vegetative Buds and New Leaves***) on newly emerged leaves is somewhat similar, except that the insects, cast aphid skins, or honeydew will not be present.

Treatment: See Washington State University's Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 5a. Twisted, puckered new growth on rhododendron caused by aphid feeding.

Figure 5b. Aphids feeding on newly emerging leaves. Note the white cast skins of the aphid in the photograph.

Azalea Bark Scale

Symptoms: Small white cottony masses are present on the bark (Figure 6). Sooty mold is often present. Pink eggs and young **crawlers** (newly hatched **nymphs**) can be seen if scales have been broken open.

Cause: Azalea bark scale, *Eriococcus azaleae*.

Treatment: The greatest success for control is when crawlers are present. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and non-chemical management options.

Figure 6. Azalea bark scale. Sooty mold is also present on bark.

Azalea Leaf Gall

Symptoms: On azaleas, light green, fleshy, bladder-shaped galls appear on new leaves in late spring and early summer (Figure 7a). The galls change from red to brown, become hard, and are covered with a powdery white bloom (the **spores** of the fungus, Figure 7b). On rhododendrons, leaves may be entirely or partially chlorotic (often bleached to a creamy off-white or pinkish color) and may be somewhat thickened. Partially affected leaves have a distinct line between the healthy green and the chlorotic tissue. A white fungal growth develops on the underside of the leaves. A rosette of affected leaves may occur at the ends of branches, or a witch's broom of twigs may develop. Blossoms and seed pods can also be affected.

Figure 7a. Young azalea leaf gall on azalea.

Cause: The fungus *Exobasidium vaccinii* is responsible for azalea leaf gall. The fungus overwinters in bark and bud scales, causing disease when the buds open in the spring. Infection occurs under conditions of high humidity during bud break. Older leaves are not affected.

Figure 7b. Mature azalea leaf gall on azalea.

Treatment: Remove and destroy leaves with galls or witch's brooms before they turn white. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Azalea Leaf Miner

Symptoms: Brown, blister-like mines on leaves. Leaves may be tightly rolled and skeletonized, followed by premature leaf drop (Figure 8a).

Cause: Azalea leaf miner, *Caloptilia azaleella* (Figure 8b), is a small yellowish caterpillar that mines inside leaf tissues and later folds the leaves. It rarely defoliates the plant.

Treatment: If only a few leaves are involved, squeezing the insect within its mine may decrease damage to an acceptable level. Since the larvae pupate in leaf debris, rake and destroy the leaves in the fall. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 8a. Azalea leaf miner damage.

Figure 8b. Azalea leaf miner adult.

Botrytis Blight

Symptoms: Brown, water-soaked lesion on leaves, flowers, and shoots (Figure 9). Gray, powdery spore masses form on the surface. This disease occurs on dead or dying tissues, such as fallen leaves and flowers, and also on injured shoots. Growers note that "purple" cultivars are more susceptible than others.

Cause: The fungus *Botrytis cinerea* occurs on many plants species and is very common. Long periods of moisture favor disease development.

Treatment: Remove fading flowers and dead leaves. Reduce humidity by increasing air circulation, temperature, and plant spacing, if possible. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and non-chemical management options.

Figure 9. Foliar blight caused by Botrytis *spp.*

Bud Blight

Symptoms: Flower buds turn brown and fail to open in the spring (Figure 10a). Later, tiny black bristles cover their surface (Figure 10b). These bristles bear conidia of the fungus which are spread to healthy buds by insects and splashing rain. Diseased buds may remain attached to the plant for 2 to 5 years.

Cause: The fungus *Pycnostysanus azalea* causes bud blight, and is associated with infestations of the rhododendron leafhopper. Fungal spores are introduced into the plant via wounds made by the insects while feeding or laying eggs. Cultivars range in susceptibility to this disease with the cultivar 'Pink Pearl' showing very high susceptibility.

Treatment: Remove and destroy affected buds. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

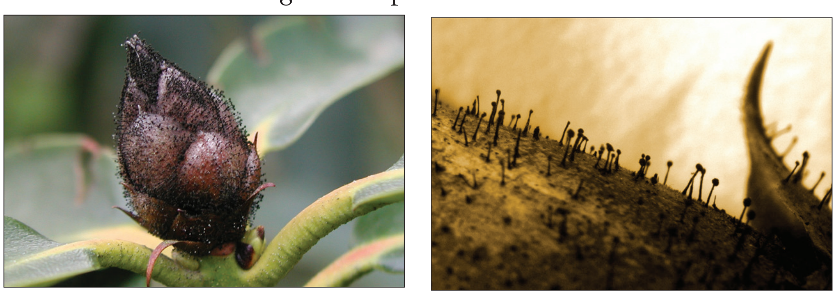

Figure 10a and 10b. Bud blight. Note the tiny black bristles or spores on the bud surface.

Caterpillars, Cutworms and Loopers

Symptoms: Large, irregular, chewed areas on leaves (Figure 11a). Damage is heaviest in early winter through spring.

Cause: Several species of caterpillars, cutworms, and loopers (Figures 11b and 11c). Loopers can chew holes in the leaves or feed from the edges; cutworms usually take large C-shaped areas from the leaf edge. Many of these pests are nocturnal feeders and can be seen at night with the aid of a flashlight.

Treatment: When damage becomes too unsightly, or the plant is threatened, select a registered pesticide, or pick off the caterpillars and destroy them. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 11a. Damage to rhododendron typical of climbing cutworms.

*Figure 11b. Rusty tussock moth caterpillars (*Orgyia antiqua*) on rhododendron. Caterpillars can be seen feeding during the day, and often strip the leaves down completely. Caterpillars, cocoons, egg masses, or wingless gray females are signs of this insect. Caterpillars are approximately 1 inch long; note the distinctive tufts of hair.*

Figure 11c. A looper and its damage (similar to cutworm damage). Loopers may be up to 1½ inches long depending on the species.

Fungal Leaf Spot

Symptoms: Spots are irregular in size and color. Some have red-brown borders with silvery gray centers. Very small black dots (fruiting structures of fungi) are sometimes visible in the center of the spot or in concentric rings. These fungi commonly enter through wounds or damage caused by sunscald or freezing. Favored by wet weather, fungal spores spread in splashing water. Symptoms are often seen at the tips and edges of leaves where water collects.

Cause: Several fungi cause leaf spot on rhododendrons. The fungi *Pestalotiopsis*, *Phyllosticta*, and *Septoria* are the most common. *Pestalotiopsis sydowiana* (known as gray blight). Leaf spots are at first white in the middle with a dark brown margin; later becoming a blotch. Later stages small fungal fruiting bodies form on the surface and the interior takes on a gray color. Leaf infection often occurs after damage from freezing or sun-scald. *Phomopsis* spp. Dark brown lesions on foliage (Figure 12a). This fungus can also kill shoots and cause branch dieback. *Phyllosticta* spp. Spots are dark brown, zonate, and frequently cover half the leaf area (Figure 12b). Fungal fruiting bodies (pycnidia) give the upper surface a bumpy texture. At least six species have been reported to cause this disease. The fungus enters through wounded tissues. *Septoria* spp. Dark, reddish brown, angular spots appear on leaves, which fall prematurely. Leaves turn yellow on some cultivars (Figure 12c).

Treatment: Remove and destroy affected leaves. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 12a. Leaf blight caused by Phomopsis *spp.*

Figure 12b. Leaf spot caused by Phyllostycta *spp.*

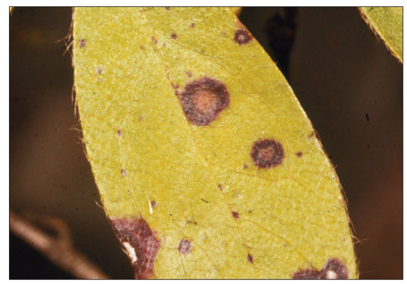

Figure 12c. Leaf spot caused by Septoria *spp.*

Lace Bug

Symptoms: Leaves show a yellowish speckling on the top surface (Figure 13a). Brown and black tar spots are present on the underside of leaves (Figure 13b).

Cause: Rhododendron lace bug, *Stephanitis rhododendri*, and azalea lace bug, *Stephanitis pyrioides*, (Figure 13c). When speckling appears, control is advised.

Treatment: Lace bugs do not survive well in shaded areas, where they are eaten by natural predators, such as spiders. Plant rhododendrons in shaded landscapes with mixed vegetation that provide refuge for invertebrate predators (Trumbule et al. 1995). Select rhododendrons with thick, waxy cuticles on their leaves, as these are more resistant to lace bug damage (Chappell and Robacker 2006). Prune back and discard heavily damaged branches. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 13a. Yellow speckling on upper leaf surface caused by rhododendron lace bug.

Figure 13b. Lace bug damage on underside of rhododendron leaf. Note the fecal drops or "tar" spots.

Figure 13c. Adult lace bug. Note the lace-like wings.

Leaf Roller

Symptoms: Leaves rolled, webbed, and chewed (although significant chewing may not yet be apparent at the time of observation, Figure 14).

Cause: Several species of leafroller caterpillars.

Treatment: Look carefully for the caterpillars, or at least their damage, before any treatment. Harmless spiders sometimes web leaves together, but they do not chew leaves. If leaf rollers are confirmed, the rolled leaf can be pinched to kill the caterpillar. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 14. Leafroller damage. Leafroller larvae are about ½ inch long.

Lecanium Scale

Symptoms: Plant appears thin and unthrifty; sooty mold is often present. Tortoise-like, soft bumps are present on the bark. The bumps may be brown or marbled white and brown, and can be picked off (Figure 15).

Cause: *Lecanium* scale, oystershell scale, and possibly other scales may also attack this plant group.

Treatment: See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 15. Lecanium scale.

Lichens

Symptoms: Papery, leathery, or fleshy patches of orange, yellow, green, brown, or black are found on the bark (Figure 16).

Cause: Lichens are actually two groups of organisms—a fungus and an alga—growing together on the bark of many woody species.

Treatment: Lichens cause no damage to the plant and removing them can injure the protective bark.

Figure 16. Lichens.

Mountain Beavers

Figure 17. A mountain beaver.

Symptoms: Entire branches are removed and can often be found surrounding the entrance to a burrow. Branch ends will show evidence of gnawing.

Cause: Mountain beavers are an ancient species unrelated to true beavers, and found only in the Pacific Northwest. These rodent-like creatures are burrowers and occasionally eat away part or all of the subterranean portion of the plant. They are also inordinately fond of rhododendrons (Figure 17), and will cut off branches and drag them back to their burrows or leave them where they fall.

Treatment: Rhododendrons and azaleas can be fenced to prevent access by mountain beavers, or the mountain beavers can be live-trapped and relocated by a pest control company. Other methods of control are illegal or show inconsistent results (Chalker-Scott and Pehling 2009).

Phytophthora Blight

Symptoms: Infected areas of leaves are often irregularly shaped, and are located where water collects (leaf edges and tips, Figure 18a). It may also appear along midribs from infected petioles and shoots. Leaf lesions often have a water-soaked appearance, but do not produce fruiting bodies as are found with fungal infections. Foliage can remain attached if the shoot dies rapidly, or the branch can defoliate. Branches can also have necrotic patches (Figure 18b).

Cause: Several species of *Phytophthora*, a water mold, cause leaf blight and dieback on rhododendron. Among these are the quarantine species *P. ramorum* and *P. kernoviae*. Symptoms of *Phytophthora* blight are similar for all species, and culturing or a DNA test is necessary to identify species. *Phytophthora* species active in cool temperatures include *P. ramorum*, *P. kernoviae*, and *P. syringae*; those active in warm weather include *P. plurivora*, *P. cactorum*, *P. parasitica*, and *P. heveae*.

Treatment: Cultural control measures for *Phytophthora* blight include removal of dead leaves and branches, and destruction of diseased material. Do not allow leaves to touch the soil, as infested soil is a source of inoculum for this disease. The pathogen can overwinter in dead plant material and contaminate puddles, which will cause infection when splashed onto foliage. Mulch over bare soil and dead plant material to prevent re-infection. This will also provide a barrier between infested soil and plant surfaces. See ***Appendix A*** for a list of rhododendrons that are susceptible or resistant to *Phytophthora* foliar blight, including *P. ramorum*.

Figure 18a. Phytophthora *blight on rhododendron leaves.*

Figure 18b. Phytophthora *blight on rhododendron branches.*

Powdery Mildew

Symptoms: Leaves may be off-color and covered with fungal growth, which is often powdery (Figure 19a). Black pepper-sized structures of the fungus (cleistothecia) are visible later in the season. These are more often found on deciduous azaleas than on evergreen rhododendrons. Most azaleas and the rhododendron cultivars 'Purple Splendor' and 'Vulcan's Flame' show the typical powdery mildew symptoms. Some rhododendrons have unusual symptoms, and lack the white powdery appearance that is typical of powdery mildew diseases. The most common symptoms are diffuse yellow spots on the upper leaf surface (Figure 19b), and various discolored areas on the lower surface (Figure 19c). Other varieties may show purple-brown spots, purple ring spots, or purple discoloration along the leaf veins. Infected leaves may drop prematurely. Severe defoliation can occur on cultivars such as 'Virginia Richards' and the species *R. campylocarpum* and *R. cinnabarinum*.

Cause: Powdery mildew is caused by several fungi, most commonly the fungus Microsphaera azalae.

Treatment: To reduce the incidence of this disease, reduce humidity by using less overhead irrigation and space or prune plants for better air circulation. Plants in the shade may show more symptoms. Some cultivars that have shown disease resistance are 'Fragrant Star', 'Garden Party', 'Millennium', 'Parade', 'Popsicle', and 'June Flame'. This disease has not been observed on the Pacific Northwest native species *R. albi-florum* and *R. macrophyllum*. Rake up and destroy fallen leaves. Plant resistant varieties. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Fig. 19a. Powdery mildew on rhododendron.

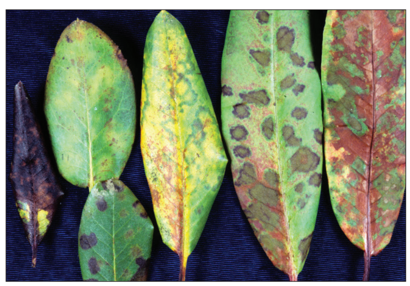

Fig. 19b. Powdery mildew symptoms on upper leaf surfaces as seen on some rhododendron varieties.

Fig. 19c. Lower leaf surface of rhododendrons showing the diversity of powdery mildew symptoms.

Rhododendron Leaf Miner

Symptoms: A serpentine or fairly straight mine starting at the leaf edge and eventually going vertically to, into, or across the midrib (Figure 20), causing all leaf tissue from that point to the leaf tip to die.

Cause: Rhododendron leaf miner (*Lyonetia latistrigella* and *L. ledi*). These insects seldom cause enough damage to warrant control.

Treatment: Remove and destroy infested leaves. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 20. Mine and damage by rhododendron leaf miner (middle leaf).

Root Rots

Figure 21. Leaf rolling from root rot.

Overview: Symptoms of root disease on *Rhododendron* resemble those of cold response (see ***Cold Response: Leaves***), but are seen in periods of warm weather when the plant is water-stressed. Leaves roll downward (Figure 21), turn yellow, and eventually the plant dies. Dead leaves remain attached to the plant. Small, fibrous roots rot first. Rot progresses to large roots, and finally, the entire root system and lower stems develop a brown discoloration or decay.

Phytophthora *Root Disease*

Symptoms: Symptoms of *Phytophthora* root disease are brown staining under the bark at the root crown or lower stem (Figure 22).

Figure 22. Brown staining from Phytophthora *root disease.*

Cause: The water mold, *Phytophthora cinnamomi*, is a common cause of root rot, but other species of *Phytophthora* can also be responsible. These species include *P. cactorum*, *P. cambivora*, *P. plurivora*, *P. cryptogea*, and *P. parasitica*. Some also cause *Phytophthora* blight of above-ground portions of the plant (see ***Stem Diseases***).

Phytophthora root disease occurs in poorly drained soil. Roots suffocate in water and are then invaded by rot organisms. Most species and cultivars of *Rhododendron* are susceptible to *Phytophthora* root disease, but a few are resistant. These are listed in Appendix A and are recommended for planting in areas where *Phytophthora* may be present in the soil. Be aware that soil moisture extremes can predispose normally resistant rhododendrons to this disease (Blaker and MacDonald 1981).

Treatment: Remove and destroy the infected plant. Do not replant into the same hole. When propagating plants, do not re-use dirty pots without sanitizing them, as pathogens will contaminate the new plant from residual potting mix in the pot. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Armillaria *Root Rot*

Figure 23a. Warm weather wilting of Rhododendron.

Symptoms: Rhododendrons with *Armillaria* root rot will show characteristic symptoms of root disease, such as wilting of the entire plant during warm weather (Figure 23a). *Armillaria* root rot causes decay of the roots and lower stems, sometimes covering roots in white mycelium (Figure 23b). Characteristic white mycelial fans can sometimes be seen under the bark of infected rhododendrons. Some species of *Armillaria* form black "shoestrings," as well as mushrooms at the base of the plant in the fall.

Cause: Several species of the fungus *Armillaria* cause this root disease by infecting and decaying woody roots. Any roots left in the soil after the plant is removed will be a source of inoculum to infect other plants placed in the same location.

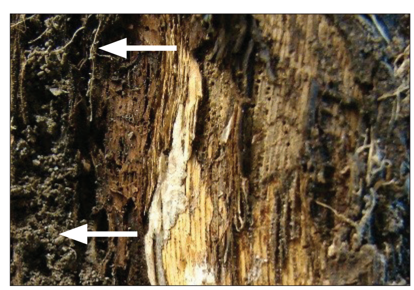

Figure 23b. Armillaria root rot. Arrows show white mycelial threads under bark.

Treatment: To avoid *Armillaria* root rot, provide good soil drainage, purchase healthy plants from reputable outlets, and plant them correctly with the root crown slightly above grade. Do not plant rhododendrons in areas where previous plants have died from the disease. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Root Weevils: Adults

Symptoms: The edges of leaves and flowers are notched or ragged (Figures 24a through 24c). Buds may be eaten down from the tip, resulting in whorls of leaves with missing tips. Twigs may die at the tips where adults have girdled the stem by feeding on the bark.

Cause: Adult root weevils (Figures 24d through 24g). Sixteen species of root weevils (*Otiorhynchus* spp. and others) have been documented as feeding on rhododendrons and azaleas in landscapes and nurseries throughout Washington. Adults are small (1/8 to 1/4 inch), hard-shelled beetles with a snout and jointed antennae; most species feed at night.

The damage to leaves is not usually a serious threat to plant health. However, since rhododendrons hold their leaves for several years, even light feeding over time can accumulate and result in an unsightly plant.

Treatment: To confirm that weevils are present, check leaves at night with a flashlight, or hold a shallow cardboard box under plants then shake the foliage. Adults will drop and cling to the cardboard. Repeat nocturnal collection for several nights or until there is no new damage. This process may reduce the weevil numbers to acceptable levels. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Many rhododendron and azalea varieties or species demonstrate considerable weevil resistance (see ***Appendices B*** and ***C***). Selecting resistant varieties will minimize maintenance and damage.

Figures 24d through 24g. The four most common root weevils found in landscapes and nurseries: the woods weevil (d), the clay colored weevil (e), the lilac root weevil (f) and the black vine weevil (g).

Figure 24a. Adults of most root weevil species feed on the leaf edges, causing irregular notching.

Figure 24b. U-shaped notches are typical of the lilac root weevil; currently, this weevil is found only in eastern Washington.

Figure 24c. Damage typical of the nut leaf weevil. These weevils work in clusters creating a complex maze-like pattern.

Root Weevils: Larvae

Symptoms: Plants fail to thrive with no apparent symptoms on foliage, except full or partial loss of color in the leaves. Soils are not overly wet. Over time, plant declines and dies (also see ***Planting and Management Errors***).

Cause: Root weevil larvae feeding on the roots or girdling the base of the plant. The legless, cream colored, C-shaped larvae live in the soil and feed on the small roots through the winter. In the spring, they attack larger roots and may even girdle the plant (by chewing away bark) just below or above the soil or mulch line. A girdled plant may still get some water and nutrients to the leaves, so the death process is prolonged. Look for a poor root system (Figure 25a), girdled crown (Figure 25b), or white larvae in the soil (Figure 25c).

Treatment: See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 25a. Root weevil larvae initially feed on small root hairs along the bottom and sides of pots, then move inwards to feed on woody roots.

Figure 25b. Crown girdling by root weevil larvae. Note irregular damage.

Figure 25c. Root weevil larva. C-shaped, legless grub with brownish head and strong mandibles.

Rust

Symptoms: Light green to yellow, small, diffuse spots randomly distributed on the leaf (Figure 26). Associated with spots on the underside of the leaf, are **pustules** producing yellow to orange powdery spore masses. These symptoms are usually seen in late summer to fall on the previous year's foliage. The airborne spores produced in the pustules can cause new infections and spread the disease rapidly among plants. Severe infections may cause defoliation. Later in the season, dark brown spores are produced in these pustules. Secondary fungi may colonize these infected areas, causing leaf spots. Gardeners can confuse this disease with the naturally occurring, rust-colored indumentum (see ***Normal Morphology and Development of Rhododendrons***).

Figure 26. Rust on rhododendron.

Cause: Several rust fungi infect *Rhododendron*. They require the presence of an alternate host, usually a conifer species (including Sitka spruce), to complete their life cycle. The fungus *Chrysomyxa ledi* is the most common cause of rust in the Pacific Northwest.

Treatment: Avoid planting Sitka spruce and other alternate hosts in close vicinity to rhododendrons. Space plants for good air circulation and low humidity to prevent spore germination on the leaf surface. Some azaleas are rust-resistant. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Sawflies

Symptoms: Leaves are badly chewed, sometimes stripped down to midrib (Figure 27). Only certain azaleas (*Rhododendron mollis* and *Rhododendron occidentale*) appear to be affected.

Cause: Sawfly larvae are true not flies, but belong to the order **Hymenoptera** and are ½ to ¾ inch long. As seen in Figure 27, these green caterpillar-like larvae blend in with the leaves.

Treatment: If only are few plants are infected, the sawfly can be easily picked off and destroyed. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

Figure 27. Sawfly larva and damage. Note caterpillar-like insect in center of picture.

Sooty mold

Symptoms: A black sooty growth (Figure 28), which is present on the leaf surfaces and bark, and is easily wiped off. It is associated with aphid or other sucking insect activity, either on the plant or on trees or shrubs overhead. In severe cases the covering of sooty mold interferes with photosynthesis, reducing plant vigor.

Cause: Sooty mold is a fungus that develops on the honeydew excreted by sucking insects.

Treatment: Sooty mold can be partially washed off with water. Control sooty mold by controlling the insect infestation. See aphids, azalea bark scale, and lecanium scale.

Figure 28. Sooty mold on rhododendron leaves at center and bottom of photo.

Stem Diseases

Overview: In contrast to root rots, where the entire plant is affected, diseases causing stem dieback usually only affect some of the twigs and branches, while others will appear normal (Figure 29a). Two organisms, *Phytophthora* and *Botryosphaeria*, are common causes of the problem. Reddish brown to black sunken cankers develop and girdle the stem. Leaves and stems above the canker wilt and die (Figure 29b). Diseased stems should be pruned out well below the cankered area. The pruned branches should be destroyed and the pruning shears disinfected. Shoot dieback occurs when the green shoots and buds are killed. The dieback can extend into the woody parts of the plant.

Tissue killed by *Botryosphaeria* spp. appears grayish where the cuticle has separated from the branch or shoot, and often has black, pinhead-like fruiting bodies present (Figure 29c). The spores of this fungus are spread in wet conditions, so avoid pruning out diseased tissue during these times. See Hortsense (http://pep.wsu.edu/hortsense/) for chemical and nonchemical management options.

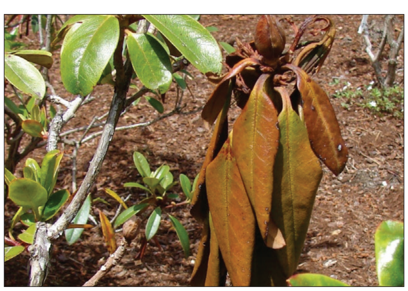

Figure 29a. Wilting and death of branch due to branch canker.

Figure 29b. Botryosphaeria dieback.

Figure 29c. Botryosphaeria dieback with characteristic gray bark color and pinhead black fruiting bodies.

Viral Diseases

Symptoms: Bright yellow to red-brown rings, spots, and blotches on rhododendron leaves (Figure 30). The fingerprint-like pattern is distinct, but margins of the patterns are vague. Necrotic ringspot **virus** becomes noticeable in 2-year old leaves, although symptoms are not apparent in new growth. The concentric rings become more numerous during the growing season and will eventually lead to the leaves turning red or yellow, and falling. The virus may also reduce overall plant vigor.

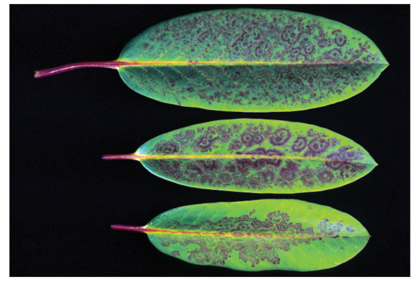

Figure 30. Virus symptoms on rhododendron.

Cause: Viral injury is not common. If damage is severe, remove and replant with other varieties.

Treatment: Viral diseases cannot be cured. Once a plant is infected, it remains infected. Pruning tools can transfer viruses from one plant to another. Watch for symptoms when purchasing new plants.

Witches' Broom

Symptoms: Multiple woody shoots arising from the base of a vegetative bud, forming a broom-like structure (Figure 31).

Figure 31. Witches broom

Cause: The blister blight fungus *Exobasidium vaccinii* will cause witches broom on some species of *Rhododendron*, in particular the Pacific Northwest native *R. macrophyllum*.

Treatment: The disease can be controlled by removing the branch several inches below the base of the broom.

Alphabetical List of Azalea and Rhododendron Environmental Stresses

Alkaline Soil

Symptoms: Leaves are yellow while veins remain green (**interveinal** chlorosis). **Chlorosis** is most prevalent on new leaves (Figure 32). Also see ***Iron and/or Manganese Deficiency and Phosphate Fertilizer Overuse***.

Figure 32. Interveinal chlorosis in leaves due to high pH levels in the soil.

Cause: Many rhododendrons perform poorly when planted in alkaline soils (soils with a pH of greater than 6.0). Iron, manganese and other metallic nutrients are less mobile under alkaline conditions, and the lack of iron and manganese uptake results in interveinal chlorosis. Soils may be naturally alkaline, or may have an artificially high pH due to the presence of lime (from lawn fertilizers or newly poured concrete).

Treatment: While some rhododendrons perform best on very acid soils (pH 4.0 to 5.5, C´ustic´et al. 2005), others, especially azaleas, tolerate both neutral (Gröger et al. 2003) and alkaline soils (Alexander et al. 2003; Scariot et al. 2013). The key seems to be to ensure the soil has sufficient levels of soluble iron and manganese. In these situations, rhododendrons can tolerate pH levels as high as 8.4 (McAleese et al. 2003). Soil treatment with ammonium sulfate will reduce the surface pH temporarily, as will a woody mulch.

Cold injury: Floral Buds

Symptoms: Flower buds turn brown and fail to open (Figure 33a), or only partially open. If they open, only some of the **florets** develop, while the undeveloped florets turn brown (Figure 33b). Fungal bristles and spores are not present (but may appear later as the buds decompose).

Figure 33a. Complete cold injury to flower bud. The entire bud has died.

Cause: Marginally hardy species and cultivars are susceptible to damage if exposed to freezing temperatures from late fall to early spring. If freezing temperatures occur when buds are in the process of opening (usually between May and June), all rhododendrons will experience cold injury (Sauliene et al. 2010).

Figure 33b. Partial cold injury to flower bud. Note differential bud development with healthy florets next to shriveled florets.

Treatment: Replant with hardier cultivars or species if floral bud injury occurs regularly, or move the affected plants to a more protected microclimate (for example, south-facing, closer to the house, or protected from winter winds). Be sure to keep rhododendrons well-watered throughout fall and winter, as those found in dry soils have reduced freezing tolerance (Aniśko and Lindstrom 1996). Often, gardeners will be rewarded with increased flower bud set the year after a severe winter kill (Gilkey 1996b).

Cold Injury: Vegetative Buds and New Leaves

Symptoms: Newly emerging leaves may have a wrinkled, distorted appearance (Figure 34a) or necrotic splotches and distortions (Figure 34b). Injury occurs only in the spring when vegetative buds have opened and leaves are developing.

Cause: Late spring frosts can injure or kill actively expanding leaves, which lack cold hardiness. Varieties which start to grow early, such as 'Christmas Cheer', are more susceptible to late frost damage.

Treatment: If injury occurs annually, consider moving affected plants to a more protected location.

Figure 34a. Cold injury to new leaves. Cold temperatures occurred as early leaf buds were opening. Leaf buds that opened later are undamaged.

Figure 34b. Necrotic patches develop where freezing temperature have killed young leaf tissues.

Cold Response: Leaves

Symptoms: Leaves droop and roll into cigar-like cylinders in the winter (Figure 35).

Cause: Some rhododendrons will roll their leaves into cigar-like structures during hard freezes. This phenomenon, called thermonasty, is a normal reaction of the plant which minimizes damage by preventing leaf water loss and/or solar damage (Nilsen 1991; Wang et al. 2008). Leaf appearance will return to normal with warmer weather. Species that are tolerant of winter conditions have the most intense leaf curling, while species with minimal cold tolerance have little or no leaf rolling (Nilsen 1991; Wang et al. 2008). If leaves are exposed to bright sunlight while they are curled, they may develop scorching along the exposed part of the leaf (usually along the midrib; see ***Heat Injury: Leaves***).

Figure 35. Thermonasty is normal leaf rolling as a result of low temperature stress.

Treatment: There is no treatment and it should not be viewed as a problem. It is a natural response by rhododendron species which protects them from damage (Wang et al. 2008).

Drought

Figure 36. Wilting of rhododendron foliage indicates that soil water may be too low.

Symptoms: Overall wilting, especially of young tissues (Figure 36). The margins and tips of leaves may be necrotic. With chronic drought, overall growth rate will decrease and mature leaf size will be smaller than normal. Leaves will also senesce earlier than normal. Floral bud set is often affected by chronic drought, meaning that fewer or no flowers appear the following spring. Also see ***Flooding, Planting and Management Errors, Root Rots,*** and ***Salt***.

Cause: Insufficient irrigation, especially in the summer, damages broadleaved species such as rhododendrons. There are secondary causes of leaf drought, referenced above, which should be considered when irrigation is sufficient.

Treatment: Increase irrigation to affected rhododendrons and azaleas. Foliage should recover quickly if the problem is simply lack of soil water. Otherwise, investigate other causes of leaf wilt.

Flooding (Hypoxia)

Figure 37. Dead and dying rhododendrons in poorly drained soil.

Symptoms: Overall leaf wilting, chlorosis, marginal leaf **necrosis**, and leaf drop (Figure 37). These symptoms are similar to those found in drought-stressed plants, but the soil around the roots is wet rather than dry.

Cause: Poor drainage, which can be due to soil compaction or improper soil amendment, means that soil pore spaces are filled with water rather than air. The lack of oxygen kills roots, meaning less water can be taken up to the leaves. This indirect water stress causes symptoms similar to those caused by drought.

Treatment: If soil is bare, mulch it well with a coarse organic mulch such as wood chips. Mulching will reduce soil compaction and improve drainage. Recently planted rhododendrons can be dug up and reinstalled into a well-drained site.

Heat Injury: Leaves (Sunscald)

Figure 38. Sunscald on rhododendron leaves.

Symptoms: Necrotic patches appear on the upper surface of leaves, not along margins or tips (Figure 38).

Cause: Leaves that are suddenly exposed to full sun do not have the same cuticle protection as those leaves already growing in full sun. Recently pruned rhododendrons can develop sunscald symptoms on shaded leaves, which after pruning, are fully exposed to the sun. Full sunlight during very cold winter days can also cause sunscald on overwintering leaves.

Treatment: Choose species and cultivars with demonstrated heat tolerance (Zhang et al. 2011); most likely these would be tagged as tolerant of full sun. Be conservative with pruning, especially during the hottest time of the year.

Iron and/or Manganese Deficiency

Symptoms: There is a definite pattern of yellowing between veins of leaves. This is called interveinal chlorosis and can either be finely detailed (Figure 39a) or have a coarser appearance (Figure 39b). Also see Alkaline Soil and Phosphate Fertilizer Overuse.

Cause: Chlorosis is due to a lack of chlorophyll. Both iron and manganese are required for the synthesis of chlorophyll, so when these nutrients are lacking in leaves, less chlorophyll is produced.

Treatment: While gardeners may assume that iron or manganese deficiency in leaves means that the soil is deficient as well, this is rarely true. A soil test will definitively answer this question. More likely, the chlorosis is caused by high soil pH or phosphate toxicity as discussed elsewhere in this manual.

Figure 39a. Iron deficiency.

Figure 39b. Manganese deficiency.

Nitrogen Deficiency

Symptoms: Uniform yellowing of leaves, usually beginning with older leaves but eventually affecting younger leaves as well (Figure 40).

Cause: Lack of available nitrogen reduces chlorophyll formation so that leaves gradually lose their green color. A soil test will reveal whether nitrogen is deficient or not. Alternatively, a foliar spray of nitrogen-rich fertilizer can be used as a diagnostic tool: if the leaves turn green after application, a nitrogen deficiency is indicated.

Treatment: Use a nitrogen-rich fertilizer around the root zone of affected plants only if a soil test or diagnostic foliar spray reveals a nitrogen deficiency. If no nutrient deficiency is found or if addition of fertilizers do not solve the problem, look for other factors that cause chlorosis.

Figure 40. Nitrogen deficient leaves are uniformly yellow.

Pesticide Injury

Symptoms: There are a variety of leaf discolorations and deformations that do not fit well into previously listed symptoms.

Cause: Runoff or drift from de-mossing chemicals, horticultural oils, and other improperly applied pesticides can damage leaves in unusual ways. Leaves exposed directly to herbicides and other pesticides or chemicals may show chlorotic or necrotic spotting (Figure 41). Plants exposed to translocatable pesticides may have leaves that are twisted or otherwise physically deformed.

Treatment: Identify and stop the source of contamination.

Figure 41. Chlorotic spotting from chemical drift.

Phosphate Fertilizer Overuse

Symptoms: Interveinal chlorosis (Figure 42) as described earlier.

Cause: Iron and/or manganese deficiency in leaves caused indirectly by excessive levels of soil phosphorus. Phosphorus interferes with the ability of roots to take up iron and manganese, so leaves receive less of these nutrients. Also see ***Alkaline Soil*** or ***Iron and/or Manganese Deficiency***.

Figure 42. Interveinal chlorosis due to high levels of soil phosphorus.

Treatment: Do not use fertilizers containing phosphorus unless a soil test indicates a deficiency. The popular perception that flowering is enhanced by phosphorus is incorrect. In fact, the best flower production in rhododendrons was found in those plants that received the lowest levels of phosphorus (Shanks et al. 1955).

Physiological Leaf Spot

Symptoms: Variously colored (generally dark purple), discrete or diffuse spots, discoloration and blotches occur on leaves as a result of environmental and cultural stress (Figure 43). Sometimes this phenomenon is called oedema. Oedema is often accompanied by small corky areas on the underside of leaves.

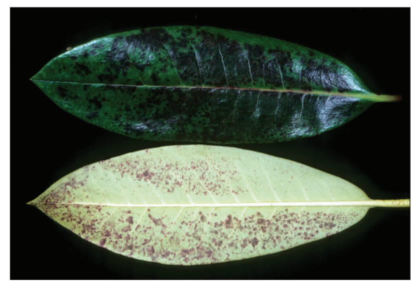

Figure 43. Physiological leaf spot. Note diffuse blotches on leaves.

Cause: The actual causes of physiological leaf spot are not known. It has been linked to high humidity and excessively fertilized soil. If the problem is severe or persistent, consider replacing the rhododendron with a species or cultivar known to perform well in your region.

Treatment: None known, though high levels of phosphate fertilizer have been associated with this phenomenon (Chalker-Scott and Olmsted 2009). Have a soil test done to identify any nutrient deficiencies or toxicities.

Planting and Management Errors

Errors in planting rhododendrons and managing soil can reduce root function, leading to symptoms similar to those related to root failure.

Symptoms: Smaller than normal leaves indicate that insufficient water was available during leaf expansion (Figure 44a). Compare the current leaf size to that of previous years. Wobbliness in the planting hole indicates a lack of root establishment outside the original root ball.

Cause: Improper soil amendment can restrict water and air movement to the roots, resulting in decreased root growth and reduced water uptake. Planting the root ball too deep will kill roots and possibly cause rotting along the buried portion of the trunk. If you cannot see the root flare of the plant (Figure 44b), it is planted too deeply (Figure 44c).

Treatment: Rhododendrons and azaleas can be dug up and replanted correctly. Take care to remove all foreign materials surrounding the root ball and plant at grade. Water and mulch well with a coarse organic mulch.

Figure 44a. New leaves that are smaller than old leaves indicate a lack of sufficient water, often due to a failing root system.

Figure 44b. The root flare is where multiple trunks arise and should be visible.

Figure 44c. Lack of a visible root flare means this rhododendron was planted too deeply.

Salt

Symptoms: Wilting and marginal necrosis are typical responses to salt stress. Because these symptoms are not specific for salt exposure, it's important to look for other clues. White crusting on leaves, pots and soil are indicators of saline conditions (Figure 45).

Cause: Azaleas and rhododendrons are very sensitive to salt damage (Lunt et al. 1957; Parnell 1989). High levels of salt in soils or irrigation water means less water can be extracted by the roots. Leaves wilt and develop tip and marginal necrosis.

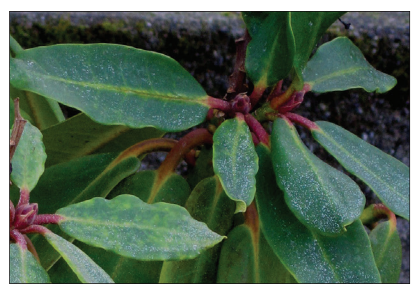

Figure 45. White dots on leaves are salt deposits from overuse of fertilizers.

High levels of salt in soil can be caused by the excessive use of soluble fertilizers, saline irrigation water, or deicing salts on roadways and sidewalks. Recycled water (sometimes called gray water) may contain salts that can damage rhododendrons (Parnell 1989).

Treatment: Irrigation with fresh water will leach salts through containers and soils. When installing new azaleas and rhododendrons near coastal areas, be sure to locate them away from prevailing winds.

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Glossary

Algae. A single celled photosynthetic organisms.

Chlorosis. A yellow coloration due to lack of chlorophyll.

Crawlers. The mobile nymphal stage of certain insects, such as scales, mealybugs, and the like. Later nymphal stages become somewhat or completely immobile.

Cultivar. Literally a “cultivated variety.” Cultivars are propagated from naturally occurring varieties found in the wild or bred for special characteristics.

Cuticle. The outer waxy covering of leaves and other green tissues.

Ericoid. Related to the Ericaceae; the family to which *Rhododendron* and *Azalea* belong.

Floret. An individual flower within an inflorescence. In rhododendrons, the inflorescence is called a truss.

Fungi. Organisms which feed on living or dead plants and animals. Pathogens feed on living tissues and are considered harmful to plants; decomposers break down dead organic matter and are usually harmless or beneficial to plants.

Fungicides. Chemicals that prevent or retard fungal development.

Girdling. A circling constriction of a stem or root, which reduces the flow of water and nutrients. Girdling can be caused by staking materials or circling roots. It can also occur when the cambium is killed by pathogens.

Honeydew. The name given to the sticky excretory material of aphids and many other sucking pests.

Hymenoptera. The taxonomic order of insects including bees, ants, wasps, and sawflies.

Hypoxia. A condition where oxygen is deficient. If this occurs in the soil, roots and other soil organisms can die.

Indumentum. The soft, woolly mat of epidermal hairs found on the underside of leaves in some rhododendron species. Indumentums can range from white to orange to brown.

Interveinal. The area of a leaf found between the veins.

Larva/Larvae. An immature stage of insects that possess an eggàlarva-làpupalàadult progression.

Mine. The condition seen after an insect (usually the immature stage) feeds between the epidermal (surface) tissue of leaves or just under the bark.

Morphology. The outward appearance of an organism.

Mycorrhizae. Mutually beneficial relationships between certain fungal species and plant roots. Mycorrhizae enhance the ability of plants to take up water and nutrients. Many mycorrhizal fungi on rhododendron and azalea are ericoid, a name derived from Ericaceae.

Necrosis. The progression of tissue death. In leaves, the tips and margins turn brown or black; the tissues are dry and crumble easily.

Nymph. An immature stage of insects possessing an egg → nymph (young adult) → adult progression.

Pesticide. A substance or mixture or substances that kills, repels, or mitigates a pest. Pesticides include fungicides, herbicides, and insecticides which kill fungi, plants, and insects respectively.

pH. A measurement relating to the acidity (low pH) or alkalinity (high pH) of soil or water.

Pustules. A blister-like disruption on a plant surface containing fungal spores.

Root crown. The junction of the major stem or trunk and the roots.

Senescence. Programmed cell or tissue death. The process of senescence allows plants to recover and store nutrients before the leaves die and fall.

Spores. Reproductive bodies produced by fungi and some plants.

Symptoms. Abnormal appearances of a plant associated with insects, mites, diseases, or adverse environmental conditions.

Virus. Submicroscopic infective particles which can only multiply in living cells, often detrimental to these invaded cells.

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Figure 43. Ralph Byther, WSU
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Appendix A

Disease resistance and susceptibility of selected rhododendrons and azaleas. Phytophthora foliar blight includes disease caused by *Phytophthora* spp., including *P. ramorum*.
R = Resistant, S = Susceptible

Rhododendrons

Species or cultivar	*Phytophthora* root disease	*Phytophthora* foliar blight	Powdery mildew	*Botryosphaeria* canker
'Boursault'		S		R
'Caroline'	R			
'Catawbiense Album'		S		S
'Chionoides'		S		S
'Crete'		R		
'Cunningham's White'		S		R
'English Roseum'		S		R
'Fantastica'		R		
'Ginny Gee'		R		
'Golden Torch'		R		
'LeBar's Red'				R
'Martha Isaacson'	R			
'Nova Zembla'		S		S
'Percy Wiseman'		R		
'Professor Hugo de Vries'	R			
'Purple Splendour'		S	S	
'Roseum Elegans'		S		R
'Teddy Bear'		R		
'Virginia Richards'		R	S	
'Vulcan's Flame'		S	S	
'Yaku Princess'		R		
R. albi-florum			R	
R. arboreum		R		
R. augustinii		S		
R. campylocarpum			S	
R. cinnabarinum		S	S	
R. dauricum		S		
R. davidsonianum 'Serenade'	R			
R. delavayi	R			
R. glomeralatum	R			
R. griffithianum		R		
R. hyperethrum	R			
R. intricatum	R			
R. keiskei		R		
R. lapponicum	R			
R. macrophyllum		S	R	
R. ponticum		S		
R. pseudochrysanthum	R			
R. racemosum		R		
R. websterianum	R			
R. yakushimanum		R		

Azaleas

Species or cultivar	*Phytophthora* root disease	Powdery mildew	Rust
'Alaska'	R		
'Blazae'			R
'Buzzare'		R	R
'Chimes'	R		
'Corrine Murrah'	R		
'Eikan'	R		
'Fakir'	R		
'Formosa'	R		
'Fragrant Star'		R	
'Fred Cochran'	R		
'Garden Party'		R	
'Glacier'	R		
'Hampton Beauty'	R		
'Higasa'	R		
'June Flame'		R	
'Merlin'	R		
'Millennium'		R	
'Morning Glow'	R		
'New White'	R		
'Parade'		R	
'Pink Gumpo'	R		
'Pink Supreme'	R		
'Polar Seas'	R		
'Popsicle'		R	
'Rachel Cunningham'	R		
'Rapture'			R
'Red Letter'			R
'Red Velvet'			R
'Redwing'	R		
'Rose Greely'	R		
'Shin-ki-gen'	R		
'Sweetheart Supreme'	R		
R. occidentale	R		
R. poukanense	R		
R. quinquefolium	R		
R. sanctum	R		
R. simsii	R		

Information was compiled from the following sources: Benson et al. (1991); Clement and Malinoski (2006); Hoitink et al. (1975); Pscheidt et al. (2014).

Data on *Phytophthora* foliar blight resistance and susceptibility were collected by Dr. Marianne Elliott.

Appendix B

Species rhododendrons showing resistance to feeding by adult root weevils.

Species	Series	Possible Blossom Colors	Rating*
R. adenophorum	Teliense	rose	77
R. arizelum	Falconeri	white, yellow, rose, crimson	73
R. burmanicum	Maddenii	yellow to greenish white	100
R. campylogynum	Campylogynum	pink, purple, crimson	77
R. cardiobasis	Fortunei	white, rose	73
R. carolinianum	Carolinianum	pink, rose, white	80
R. ciliatum	Maddenii	white, rose	70
R. concatenans	Cinnaborinum	apricot, yellow	70
R. cuneatum	Lapponicum	rose	90
R. dauricum	Dauricum	lavender-rose	97
R. davidsonianum	Triflorum	white, pink, rose	70
R. decorum	Fortunei	white, pink, chartreuse	73
R. desquamatum	Heliolepis	rose, violet	93
R. diaprepes	Fortunei	white, pale rose	73
R. discolor	Fortunei	white, pink	70
R. eursiphon	Thomsonii	ivory, rose	73
R. fastigiatum	Lapponicum	lilac, purple	90
R. ferrugineum	Ferrugineum	rose, white	93
R. glaucophyllum	Glaucophyllum	white, rose	73
R. heliolepis	Heliolepis	white, rose	100
R. hemsleyanum	Fortunei	white	93
R. hippophaeoides	Lapponicum	lilac, rose	73
R. impeditum	Lapponicum	purplish blue	100
R. imperator	Uniflorum	pink, rose	70
R. intricatum	Lapponicum	mauve	97
R. irroratum	Irroratum	white, ivory, rose	83
R. lepidastylum	Trichocladum	pale yellow	73
R. minus	Carolinianum	rose, white	93
R. oreodoxa	Fortunei	rose, white	80
R. oreotrephes	Triflorum	mauve, purple, rosy red	77
R. pemokoense	Uniflorum	lilac-pink	73
R. praestans	Grande	magenta-rose, pink	73
R. pubescens	Scabrifolium	white, rose	73
R. racemosum	Virgatum	white, rose	80
R. rubiginosum	Heliolepis	pink, rose	83
R. russatum	Lapponicum	blue-purple	80
R. scintillans	Lapponicum	purplish blue	100
R. ungernii	Ponticum	white, pale pink	83
R. vernicosum	Fortunei	white, rose	77
R. xanthocodon	Cinnaborinum	ivory, yellow	77
R. yakusimanum	Ponticum	white, rose	90
R. yunnanense	Triflorum	white, lavender, pink	70

*The higher the number, the less feeding is expected. A 100 rating indicates complete resistance.

Appendix C

Hybrid rhododendrons showing resistance to feeding by adult root weevils.

Hybrid	Possible Blossom Colors	Rating*
'Candi'	bright rose	72
'Cilpinense'	white	88
'Cowslip'	cream, pink	80
'Crest'	yellow	79
'Dora Amateis'	white, lightly spotted green	79
'Exbury Naomi'	lilac tinged yellow	81
'Faggetter's Favourite'	cream with pink	70
'Graf Zeppelin'	bright pink	71
'Jock'	pink	92
'Lady Clementine Mitford'	pink	72
'Letty Edwards'	yellow	76
'Loderi Pink Diamond'	delicate pink	71
'Lucky Strike'	deep salmon-pink	83
'Moonstone'	yellow	73
'Naomi'	pink	76
'Oceanlake'	deep violet-blue	80
'Odee Wright'	yellow	76
'P.J. Mezzitt' (P.J.M.)	pink	100
'Pilgrim'	rich pink	76
'Point Defiance'	pink	76
'Pride of Leonards Lee' (Luscombei)	rose-pink	80
'Rainbow'	carmine-pink	76
'Rose Elf'	white, flushed violet-pink	89
'Sapphire'	blue	90
'Snow Lady'	pure white	71
'Vanessa'	soft pink	80
'Virginia Richards'	Chinese yellow with crimson blotch	81

*The higher the number, the less feeding is expected. A 100 rating indicates complete resistance.

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