Dr. Sharon M. Douglas
Department of Plant Pathology and Ecology
The Connecticut Agricultural Experiment Station
123 Huntington Street, P. O. Box 1106
New Haven, CT 06504

Phone: (203) 974-8601
Fax: (203) 974-8502
Email: Sharon.Douglas@ct.gov
Website: www.ct.gov/caes

Founded in 1875
Putting science to work for society

COMMON PROBLEMS OF RHODODENDRON AND AZALEA

There are several diseases that commonly occur on rhododendrons and azaleas in landscapes and nurseries every year in Connecticut. These include fungal leaf spots, leaf and flower gall, root rot, oedema, leaf flooding, winter injury, and chlorosis. However, the occurrence and severity of these diseases are influenced by many factors, such as the level and severity of infection and overwintering inoculum from the previous year, the weather at the time of leaf emergence, cultural practices, and the species or cultivar planted.

FUNGAL LEAF SPOTS

Causal Agents: Several genera of fungi (e.g., *Cercospora*, *Colletotrichum*, *Septoria*, and occasionally, *Pestalotiopsis*).

Symptoms: Many cultivars of rhododendron and azalea can be infected by one or more leaf-spotting fungi. Symptoms usually develop on current season foliage in mid to late summer. However, in some cases, infections may not be visible until the following winter or spring after infection. Leaf spots appear as dead areas of tissue scattered over the surface of the leaf. They usually have distinct margins that are often darker than the brown, black, tan, or reddish centers. Spots are usually visible on both upper and lower leaf surfaces (Figures 1 and 2). However, the spots can vary in size from pinhead to those that are more diffuse or even coalesce over the entire leaf. Small, black fruiting bodies may be visible on the upper or lower surfaces of the spots (Figure 3).

Figure 1. Fungal leaf spot of rhododendron.

Figure 2. Characteristic leaf spots with distinct margins.

Tan masses of fungal spores can sometimes be seen oozing from the black fruiting bodies after periods of wet weather. These tendrils consist of masses of individual fungal spores that are readily wind- or rain-driven to newly emerging leaves in spring (Figure 4).

Figure 3. Small, black fruiting structures of the fungus are visible in the leaf spots.

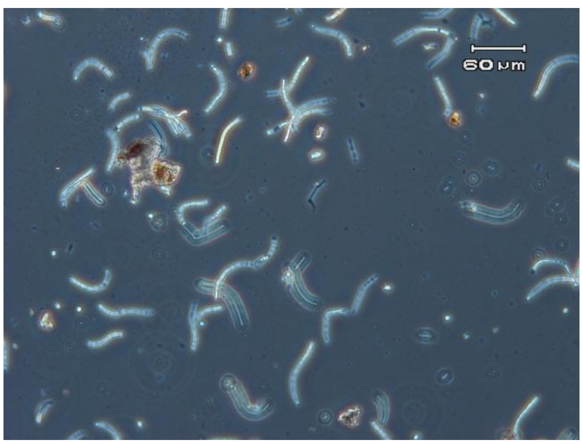

Figure 4. Photomicrograph of spores of the leaf spot fungus *Cercospora*.

Management: Fungal leaf spots can be managed using a variety of strategies. Leaf spots are rarely serious enough to warrant chemical control and are often effectively managed by following good sanitary and cultural practices. In autumn, it is important to rake and remove fallen leaves from the vicinity of the shrub since many of the leaf-spotting fungi overwinter on fallen leaves and plant debris. This practice reduces the number of spores available to infect emerging leaves in spring.

It is also important to follow sound cultural methods that promote plant vigor. These include proper watering, fertilizing, and mulching, appropriately timed pruning, and managing insects, particularly the black vine weevil.

In some cases, leaf spots can become serious and result in injury (i.e., branch and twig dieback) or even plant death. This is especially problematic on new transplants or on weakened or stressed plants. In such cases, chemical control is often necessary, especially in cool, wet springs. Several fungicides are registered for use in Connecticut, including thiophanate-methyl, chlorothalonil, and mancozeb. Organic options include sulfur and copper compounds. Several biological products can also be used as protectants. These include *Trichoderma harzianum* Rifai strain KRL-AG2, *Streptomyces griseoviridis* strain K61, and *Bacillus subtilis* strain QST 713 may be effective as protectants. The pesticide labels contain information for use, including specific plant hosts and diseases, dosage rates, and safety precautions. Since most leaf-spotting fungi infect in spring as new leaves are emerging, the first fungicide spray is usually applied at bud break. Additional applications may also be necessary in unusually wet springs. When symptoms are visible on the new leaves, it is usually too late for effective chemical control.

LEAF AND FLOWER GALL

Causal Agents: Several species of the fungal genus *Exobasidium*.

Symptoms: Diagnostic symptoms develop on young leaves of azaleas and occasionally on rhododendrons in the early spring. Some of the native rhododendron species (azaleas) are more susceptible than hybrid rhododendrons. Leaves and buds are infected as they emerge in April and May. Affected leaves, stems, and flowers become distorted, thickened, and bladder-like. They are succulent and fleshy (Figures 5 and 6).

Figure 5. Young, pale green, fleshy gall on azalea.

Figure 6. Older azalea leaf gall covered with the white spores of the fungus.

Galls are initially pale green in color, but develop a white "bloom," which consists of spores of the causal fungus. The galls eventually turn red and brown and shrivel into hard masses (Figure 7). The severity of the disease usually depends on the weather and history of disease. Favorable weather includes prolonged bud break due to cool temperatures and adequate rainfall or dew to provide free water on the plant tissues. The fungus overwinters in bud scales and infects tender tissues as they are emerging.

Figure 7. An aging gall that is turning brown and shriveling.

Management: Leaf and flower galls are generally not serious, although they can be disconcerting, because of their eye-catching appearance. They generally do not contribute to long-term plant health issues. However, when this disease re-occurs for several consecutive years, especially on new transplants, it can reduce plant vigor.

When only a few plants are involved, this disease can be managed by hand picking and discarding the galls. It is important to pick the galls before the white layer of spores appears. Plants growing in sites with poor air circulation or poorly drained soil are more susceptible, so anything that can be done to remediate these conditions can be helpful in managing the disease.

Fungicide applications are generally not warranted or efficacious in home landscapes.

Differences in susceptibility and resistance to leaf and flower gall has been reported for azalea and rhododendron. Azalea: some highly susceptible cultivars include the Indica group; resistant cultivars include

Formosa, Sensation, and Aphrodite. Rhododendron: some highly susceptible species are *R. maximum*, *R. catawbiense*, and their hybrids.

PHYTOPHTHORA ROOT ROT

Causal Agents: Several species of the genus *Phytophthora*, an oomycete or fungus-like organism (e.g., *P. cactorum, P. cinnamomi).*

Symptoms: Phytophthora root rot is a serious disease of landscape as well as field- and container-grown nursery plants. Above-ground symptoms of Phytophthora root rot are generally non-specific and non-diagnostic. Initial symptoms consist of slow growth, slightly off-colored foliage, and drooping or wilting of the foliage, especially in mid-day. As the disease progresses, more dramatic above-ground symptoms develop, which include twig and branch dieback and inward curling and drooping of olive-green leaves (Figure 8).

More diagnostic symptoms are visible in the root and crown area and roots. Infection begins as the pathogen enters root hairs and non-woody roots. Infected roots appear waterlogged and blackened; the outer cortex often pulls away from the stele. The pathogen then grows into larger-diameter roots and into the root crown. Plants can be girdled as the pathogen moves up the stem. The cambium is killed and turns a diagnostic cinnamon-brown. Without a functional root system, leaves become chlorotic, roll downward toward the midrib, and gradually wilt. Highly susceptible, young, container-grown rhododendrons may die within 14 days. Older, landscape plants may gradually develop symptoms before eventually dying, or may show minimal above-ground symptoms until additional stresses cause the weakened plants to die. Phytophthora root rot can be confused with mechanical damage, soil compaction, nematode damage, and other root diseases.

Figure 8. Diagnostic olive-green, inward curling leaves associated with Phytophthora root rot.

Phytophthora root rot is often associated with drainage problems and wet sites. This soilborne pathogen (previously called a "water mold") produces motile spores that readily move in water. As a consequence, declining plants often follow drainage patterns, especially in chronically low, wet areas or on hills. Infections occur after periods of standing water or follow drainage patterns. Depending on the species, two types of resistant resting structures (chlamydospores and oospores) can form in infected roots. These allow the pathogen to survive in the soil for quite some time during unfavorable conditions. In warm and saturated soils (even for a few hours), chlamydospores and oospores germinate to form sporangia. Sporangia form and release swimming zoospores. Zoospores "swim" in free water and are attracted to nearby roots, especially root tips or injured roots. Zoospores invade the root hairs and roots. The longer the soil is saturated, the more severe the infection. The greater the number of periods of saturated soil, the more severe the infection. The optimum temperature for disease range from 59-77 °F for most infections, although cooler temperatures can also be conducive to infection. Roots are most susceptible during the spring and fall, which corresponds to the same time that soil temperatures are most favorable for zoospore production and activity. When plants are dormant, rootstock susceptibility and pathogen activity are both low.

Management: Phytophthora root rots are most effectively managed in the landscape by prevention. This includes purchasing healthy, pathogen-free plant material, by careful attention to the characteristics of the site selected for planting, and the planting practices. Sites should be well-drained. Additional site modifications that can be effective include planting on raised beds or installing drain tiles to direct water away from the root zone.

Once the disease is detected, infected plants should be removed from the planting. Since high nitrogen favors disease, it is helpful to avoid using fertilizers high in nitrogen or to apply a low rate of slow-release fertilizer.

Differences in susceptibility and resistance to Phytophthora root rot has been reported for azalea and rhododendron. Rhododendron hybrids with good resistance to *P. cinnamomi* include Caroline, Martha Isaacson, Pink Trumpet, Professor Hugo de Vries, and Red Head; with moderate resistance: Bosley, Brickdust, Aureum, and English Roseum. Rhododendron species with good or moderate resistance include *R. delavayi, R. glomerulatum, R. hyperythrum, R. lapponicum, R. ciliatum, R. hemitrichotum, R. shwelliense, R. simiarum, R. spiciferum*, and *R. yunnanense.* Azalea cultivars with resistance include Alaska, Chimes, Corrine Murrah, Formosa Fred Cochran, Rachel Cunningham, and Redwing.

Fungicide applications are not curative and are usually not effective once plants are infected. However, they can be helpful to protect uninfected plants and prevent spread of the pathogen to adjacent healthy plants. These should be used in conjunction with cultural methods previously mentioned in order to be most effective. Among the fungicides registered in Connecticut are mefenoxam, metalaxyl, fosetyl-Al, etridiazole, etridiazole + thiophanate-methyl, and phosphorous acids. The pesticide labels will contain information for use with specific plant hosts, dosage rates, and safety precautions.

OEDEMA

Causal Factors: This physiological disorder is associated with a water imbalance that develops in leaves. This occurs when the air is moist and cool and the soil is moist and relatively warm. The roots take up more water than the plant can use or transpire through the stomates.

Symptoms: Initial symptoms appear as pale, chlorotic spots on the upper leaf surfaces. Diagnostic symptoms develop on the abaxial surfaces and appear as water-soaked blisters that eventually become brown and corky (Figures 9 and 10). At quick glance, they can be confused with scale or other insect pests. When severe, leaves can yellow and drop prematurely. Oedema is most prevalent in the late winter especially during extended periods of cool, cloudy weather.

Management: Oedema can be managed by attention to plant spacing to improve the flow of air over the leaves and reduce relative humidity. Symptomatic plants often recover from oedema when more favorable growing conditions return in spring and early summer.

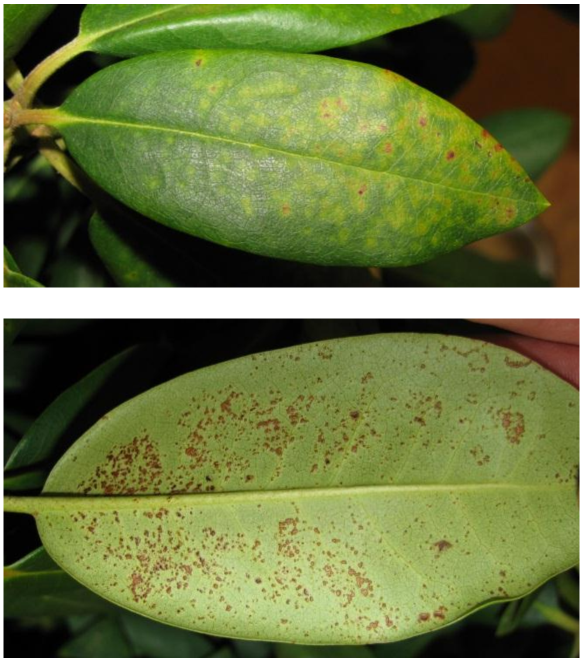

Figure 9. Oedema of rhododendron: upper leaf surface with pale chlorotic areas (top photo); brown, corky blisters (bottom) associated with oedema.

Figure 10. Close-up view of corky oedema lesions.

LEAF FLOODING

Causal Factors: This is a physiological disorder associated with movement of excess water into the leaves by root pressure at the same time that transpiration is inhibited by high relative humidity. This can develop on plants in winter storage when conditions are designed to provide high relative humidity using polyethylene "blankets" as a vapor barrier in order to prevent leaf damage from desiccation, especially while rootballs are frozen. This condition rarely develops in field-grown or landscape plants.

Symptoms: Leaves initially develop dark, water-soaked blotches as a result of water infiltrating the intercellular spaces, especially along the mid-vein. Under normal conditions, these air-filled intercellular spaces comprise 10-20% of the leaf. The extent of flooding depends upon the duration of favorable conditions and cultivar. On some plants, flooding can disappear after conditions improve. On others, the blotchy areas become necrotic (Figure 11). Nova Zembla is highly susceptible whereas Roseum Elegans rarely develops leaf flooding symptoms.

Figure 11. Rhododendron leaves with symptoms of leaf flooding.

Management: Symptoms of leaf flooding and conditions that favor its development should be monitored, especially after an extended period of rainy weather during storage. Venting storage facilities for a day or two when the weather clears should cause the flooding to disappear.

WINTER INJURY

Causal Factors: This abiotic disorder can be attributed to diverse factors that include sudden temperature fluctuations, excessive or late season fertilization, lack of snow cover, drying winds, and late spring frosts. The most common type of winter injury on rhododendron is excessive drying. This results from factors that create a water deficit in the plant. This type of injury occurs when water evaporates from leaves on windy or warm, sunny days during the winter or early spring. Drying occurs because this water is not replaced, since the roots cannot take up enough water from cold or frozen soil.

Symptoms: Winter injury or winter drying of rhododendron and azalea commonly occurs on plants growing in both wind-swept and sheltered locations. This is a general term applied to a group of environmentally-caused problems that have little in common other than they occur during the winter. Winter injury is important in and of itself, but it also predisposes the plants to secondary invaders or opportunistic pests. Quite often, the effects do not show up immediately after the damage has occurred. Symptoms can develop on one or two individual branches or on the entire shrub (Figure 12). They can appear as tip or marginal browning of leaves, dieback of tips and branches, desiccation of growing tips or twigs, and longitudinal rolling of leaves along the mid-vein (Figures 13 and 14). Water evaporates from the leaves on windy or warm, sunny days and cannot be replaced since the water in the soil is still frozen or unavailable to the plant roots.

Figure 12. Winter injury symptoms on one portion of an established plant.

Figure 13. Diagnostic symptoms of winter injury including rolling of the leaves along the mid-vein.

Figure 14. Close-up of winter injury symptoms.

Plants that have been recently transplanted and lack well-developed or established root systems are most susceptible to winter injury, as are established shrubs of all sizes and ages whose root systems are predisposed and damaged by excess water or drought.

Management: Winter injury does not generally contribute to long-term issues with plant health. However, it can be disconcerting, because of the eye-catching damage that can occur. It can also be stressful when it occurs on new transplants or when damage occurs for several consecutive years. While there is no cure for this physiological disorder, there are steps to help minimize its effects. These include selecting an appropriate site for planting and maintaining plant vigor by following sound cultural practices. Deep watering the plants before the ground freezes in the fall and mulching around the base of the plant can provide and maintain sufficient moisture in the root zone. Fertilizing at the proper time and rate can be helpful, especially avoiding late summer and early fall fertilization, which encourages growth that does not harden off properly for winter conditions. Good sanitation is also helpful, by pruning out dead, dying, or damaged branches in spring to minimize potential problems with secondary invaders and opportunistic pests. For new transplants and plants in exposed locations, providing physical protection from water loss and drying winds can be helpful. Burlap wraps and sprays of anti-transpirants or anti-desiccants can be effective.

CHLOROSIS

Causal Factors: This physiological disorder occurs when rhododendrons and azaleas grow in soils with pH levels above 6.0-6.5. This results in iron chlorosis and micronutrient deficiencies.

Symptoms: Rhododendrons and azaleas growing in naturally alkaline soils, near new cement walls or foundations, or in heavy or poorly drained soils often develop chlorotic or yellowed leaves. Under the former two conditions of high soil pH, plants are unable to absorb iron. This results in a deficiency that leads to yellowing or interveinal chlorosis--where the leaf veins remain green and the area between the veins turns yellow. These symptoms usually develop on the youngest foliage first. Iron is not necessarily deficient in the soil—it may be there, but just in an unavailable form for absorption through the root system as a result of the soil pH.

Management: This physiological disorder can usually be corrected by treating the soil with an iron chelating compound or by lowering the soil pH (to pH 5.5 or below) using soil amendments such as sulfur, iron sulfate, or ammonium sulfate. These amendments must be thoroughly incorporated into the root area in order to be effective. Therefore, it is very helpful to have the soil tested prior to planting; this will also provide information on rates for the amendments. Leaf chlorosis can be temporarily remediated by spraying the foliage with iron compounds such as iron sulfate, iron chelate, and soluble organic iron complexes.

Under conditions of heavy or water-logged soils, leaves yellow because plants are unable to absorb nutrients because the feeder roots have been damaged by excessive soil moisture and lack of oxygen. This condition is often irreversible, especially if damage is extensive. However, if the problem is recognized early, efforts to improve soil texture and drainage can promote root health and improve root function.

March 2011 (revised)