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In This Issue

Gray Mold of Bedding Plants

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Gray mold (causal agent = *Botrytis cinerea*) is one of the most common diseases affecting bedding plants. Host commonly include (but are not limited to): begonia, carnation, chrysanthemum, cyclamen, geranium, impatiens, marigold, million bells, petunia, vinca and zinnia. Fortunately, gray mold is one of the easiest diseases to manage. By changing cultural conditions that are unfavorable to fungal growth, the disease can be successfully controlled.

Symptoms and Signs

The proper diagnosis is necessary prior to undertaking any control strategy. Because gray mold affects numerous host plants, care must be taken in examining affected plants. Symptoms of gray mold depend upon the type of host and the type of environmental conditions. Commonly observed symptoms include: bud blast, leaf spots, flower blight, stem canker, and/or crown rot, with plant death resulting (Fig. 1). Infected tissue is soft and brown, and may appear water-soaked. A key sign of Botrytis infection is the proliferation of gray mold covering the diseased plant (Fig. 2).

Figure 1. Symptoms of botrytis include leaf spot, blight, cankering and death.

Figure 2. Gray-brown fungal growth is a key diagnostic sign and consists of hyphae and hundreds of thousands of spores (conidia).

Figure 3. Flowers are often the first part of the plant infected and can lead to more severe infections of the entire plant.

Infection often begins at the site of the flower or bud (Fig. 3). Flower blight of bedding plants is one of the first symptoms of this disease. The fungus establishes itself in the petals Infections are most common in the lower canopy of the plant, and in areas of the plant where humidity is high and air movement is poor. Upon infection, the fungus spreads from the flower into the pedicel/peduncle. Eventually, the fungus invades the stem, leading to plant death. Symptoms of flower or bud blast begin as irregular gray/brown spots on the petals, whereas buds turn brown and/or have a water-soaked appearance. Infected buds may not open, or they may fall off.

Leaf spot often appears in young, tender seedlings or when infected flowers petals contact the plant leaves. Leaf spots often appear water-soaked, are tan in color and have irregular

margins. If warm temperatures and high humidity persist, the fungus can spread into the main stem and form cankers. When this occurs, plants can quickly die.

One of the key diagnostic features is the presence of the gray-brown mold growing over the affected area. The fungus will readily produce spores in 85% humidity and warm (75 degree F) temperatures, which spreads the disease. Although the sign of Botrytis is a key diagnostic feature, you must remember that Botrytis may also appear as a secondary decay fungus. Care must be taken in observing that symptom development is consistent with Botrytis infection. If you observe unusual symptoms (e.g., wilt, angular leaf spot, deformity) of plant disease that are inconsistent with gray mold, and Botrytis is recovered, it should be assumed that Botrytis was acting as a decay agent and did not cause plant death.

Management

Despite its voracious nature, gray mold is easily controlled by cultural techniques. Upon identification of gray mold, infected plant material should be removed and disposed of. This reduces the inoculum source and minimizes the possibility of infection. Equally essential for control of this disease is manipulating the environmental conditions that contribute to the growth and sporulation of gray mold. The fungus that causes gray mold infects a wide variety of hosts found in the yard and garden (including weeds) and survives on dead plant material from the previous season. In spring, large numbers of microscopic spores (conidia) are released and spread by wind, splashing water, and human activity.

In the nursery, greenhouse, and landscape, Botrytis often appears during cool, overcast days. Temperatures of 70° to 80°F and ample moisture favor the disease, although infections may occur at

lower temperatures when plants are wet for prolonged periods. Frequent irrigation or rain promotes disease development. Lush plant growth and cultivars that have dense foliage that shade blossoms and/or fruit are most susceptible to attack.

Adequate plant spacing, maintaining the relative humidity below 85% and providing good air circulation provide excellent control for this disease. This allows rapid drying, which reduces the probability of infection. This disease can be avoided by proper plant spacing, lowered humidity and good air circulation, bypassing the need for chemical controls.

Even with the best of cultural controls, fungicides may be needed. Fungicides must be applied to foliage to effectively manage this disease. Use of Decree (Fenhexamid), and Medallion (Fludioxanil) consistently provide excellent control. Assuming resistance is not an issue, Chipco 26019 WDG, 26GT (iprodione-containing products) is very effective. These products need to be rotated with Daconil (chlorothalonil)or Dithane 75F (mancozeb)(FRAC M), or Palladium (FRAC 9+12), or a 7-11 fungicide (Broadform, Pageant, Orkestra).

Table 1. Fungicides labeled for botrytis control.

TRADE NAME	ACTIVE INGREDIENT	FRAC Code	Sites*	REI	Comments
Astun	isofetamid	7	G, N	12	
Broadform	trifloxystrobin+fluopyram	7+11	G, N, L, I, S	12	
Mural	azoxystrobin+benzovindiflupyr	7 + 11	G, N, L, S	12	
Orkestra, (fluxapyroxad + pyraclostrobin)	fluxapyroxad + pyraclostrobin	7 + 11	G, N, L, I, S	12	
Pageant Intrinsic (pyraclostrobin+boscalid)	pyraclostrobin+boscalid	7+11	G, N, L, I, S	12	
Cleary's 3336; OHP6672	thiophanate-Methyl	1	G,N,L,I	12	
Chipco 26019 WDG, 26GT	iprodione	2	G, N, L	12	Not for residential landscape use
Daconil Zn, PathGuard	chlorothalonil	M5	G, N, L	48	Can be phytotoxic to Knock Out®, Double Delight roses.
Dithane 75DF	mancozeb	M	G, N	24	Greenhouse: Limit to 20 applications per year.
Medallion, Emblem	fludioxanil	12	G, N, L, I, S	12	May cause stunting or chlorosis on some geranium varieties
Decree	Fenhexamid	17	G, N	1	
Affirm, Veranda O WDG	polyoxin D zinc salt	19	G,S	4	
Palladium WDG	cyprodinil + fludioxonil	9+12	G, N, S	12	
Spectro 90	Thiophanate-Methyl+chlorothalonil	M+1	G, N, L, I, S	12	Do not use with Dipel 4L, Foil, Triton AG-98, Latron B1956, Triton B1956, Latron AG98

* G=Greenhouse, N=Nursery, L=Landscape, I=Interiorscape, S=Shadehouse,

How to Identify Tree Defects and What to Do about It?

(Lindsey Purcell, lapurcel@purdue.edu)

Trees provide many benefits for our homes and properties. If a tree is found to have a defect such as dead branches or broken limbs from a storm; it can become a risk issue. It is important to understand that tree owners have a duty to inspect and maintain their trees. All property owners should take reasonable steps to protect themselves by involving a qualified consultant or certified arborist when needed.

All

Figure 1. Trees should be inspected for defects which pose a threat or risk to targets.

trees have some sort of risk involved with it. They are living organisms that are endangered by environmental impacts and pests. However, it is important to create a balance between the risk a tree may pose and the benefits provided by the tree. We don't want to remove trees unnecessarily, but rather reduce the liability by Identifying, analyzing and evaluating the problem.

Inspect regularly: Trees should be assessed through inspections by a qualified arborist, preferably an International Society of Arboriculture Certified Arborist. It is especially important to inspect trees after major weather events. At a minimum, trees should be carefully checked out every 3-5 years.

Document and maintain records: Every inspection should be recorded and kept on file for future reference. Past evaluations can show how a tree has changed in its health and structure over the years. Also, these written evaluations could minimize liability if a failure occurs and a claim is filed against the tree owner.

Tree Inspections

For a tree to be considered a risk it must be defective and a target that is threatened.

Figure 2. Targets are people, property or activities that could be disrupted by a tree failure.

A **target** is people, property or activities that could be injured, damaged or disrupted by a tree failure. Review everything in the target zone. This should include the area inside a circle around the tree, which is at least as wide as the total tree height.

Read the body language of the tree. Inspect each section of the tree including the crown, branches and root zone to check for signs of failure. These include:

- Dead, diseased, dying or broken branches.
- Thinning or poor canopy health.
- An unstable branching pattern overextended or weakly attached branches, or cracks in the stems.
- Cracks or decayed areas in the main trunk.
- Exposed or decayed roots, heaving of the soil, fungus growth or cracks in the soil around the root plate.

Among the characteristics to consider when conducting tree risk evaluations are:

- Decay, cankers, cracks and other positive indicators of weakness in the roots, stems and branches.
- Canopy size, shape and weight distribution. This is especially true in situations where a tree is exposed to windy conditions, is leaning or has a poor stem-to-canopy ratio.
- Crown architecture. Poor branching and similar characteristics can create high-risk situations in strong winds and other weather conditions.
- Plant health and vigor. This determines how a tree can overcome wounding or pest infestations.

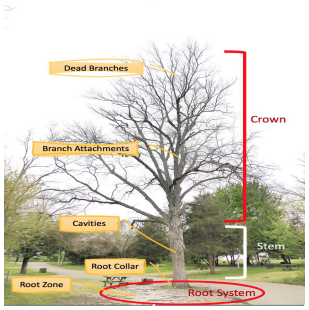

Figure 3. Regular tree inspections should occur reviewing all parts of the tree.

What do you do when a defect is found?

The goal is to reduce the likelihood of failure. Most of the time pruning can improve risk situations. Perhaps cabling and bracing may be an option. Also, plant health care improves the trees condition which can reduce risk... the last option should be removal and that should be an informed decision.

Recurrent inspections to determine tree health and condition are important for sustainable, long-lived tree plantings. The most important factor for any tree owner is know when to contact an ISA Certified Arborist who understands tree risk assessment. They can help with the decision making for the tree if there are concerns about its safety and health.

For more information refer to the publication Tree Risk Management and Trees and Storms at the Purdue Education Store.

Find a certified arborist in your area by going to www.treesaregood.org

Needlecast Diseases: Not Just a Spruce Problem

(John Bonkowski, jbonkows@purdue.edu)

Many are familiar with Rhizosphaera needlecast of spruce. If you aren't, please see these two articles by Janna Beckerman and Megan Haas for more information about the disease and it's management on spruce. The common name for the disease, needlecast, describes the ultimate fate of the needles: they are cast off. Loss of leaves or needles hurts some trees more than others (Figure 1, 2, 3).

Figure 1: Douglas-Fir branches with bare spots where needles have fallen off the stem Image Credit: Frantisek Soukup, Bugwood.org

Figure 2: Closer image of Figure 1, showing some of the needle necrosis and bare areas on the stem. Image Credit: Frantisek Soukup, Bugwood.org

Figure 3: Rhabdocline symptoms on Douglas-Fir needles Image Credit: Penn State Department of Plant Pathology & Environmental Microbiology Archives , Penn State University, Bugwood.org

Deciduous trees can tolerate some leaf drop each year with little harm, but conifers put a lot of energy and resources into making their needles, which remain on the tree for 2-5 years in most species. Some pine trees hold onto one or two years of needle growth while other pines and many other conifers retain their needles for much longer and rely on them to produce food, which is why if they fall off prematurely it can lead to decline and/or death of individual branches and reduced plant vigor. Branches that lose needles will remain bare because conifers do not sprout new growth from old wood the way deciduous trees and shrubs can.

Within the last few weeks the Purdue Plant and Pest Diagnostic Laboratory has been receiving samples of pine and fir trees with needles turning brown from the tip back and severely affected needles falling off the tree. Many different fungi cause needle cast diseases; and some, like Rhizosphaera on spruce and Swiss needle cast of Douglas fir cause extensive damage, but most are weak pathogens that infect plants that are stressed, or are planted in the wrong site.

Most needlecast diseases can be found in the inner canopy near the bottom of the tree where there is more shading, less air movement, increased humidity and longer periods of leaf wetness. As the disease progresses, it spreads outward and upwards, gaining speed as the tree becomes more stressed. Needles will gradually turn brown, either along its length or from the tip back, before falling off of the stem. Chronic disease will lead to bare inner branches and dead, lower limbs of severely affected trees.

Some of the needlecast fungi we found in the lab recently include *Lophodermium* (Figure 4, 5), *Ploioderma* (Figure 6), and *Dothistroma* (Figure 7, 8) on pines and *Rhizosphaera pini* on multiple firs (Figure 9, 10), which all produce small black fungal structures on the needles that can look fairly similar and can be difficult to differentiate them without the use of a microscope. These structures may not always be apparent, especially during dry spells, so you may need to place needles in a humid environment (like a plastic bag with a moist paper towel) for a day or two before looking for structures on older or cast-off needles.

Figure 4: Dropped pine needles with black fungal fruiting bodies of Lophodermium. Image Credit: PPDL

Figure 5: Close up view of fungal structure produced by Lophodermium. Image Credit: PPDL

Figure 6: Fungal structures produced by Ploioderma on Pine needles. Image Credit: PPDL

Figure 7: Symptoms of brown spot disease caused by Lecanosticta on Pine needles. Image Credit: PPDL

Figure 8: Pine needle tip dieback caused by Lecanosticta. Image

Credit: PPDL

Figure 9: Fir needle tip dieback caused by an infection by Rhizosphaera pini. Image Credit: PPDL

Figure 10: Close up image of fruiting bodies produced by Rhizosphaera from the stomates on the underside of the Fir needles. Fir needles also have a strip of stomates along the middle of the upper surface of the needles where Rhizosphaera can also be seen growing. Image Credit: PPDL

Management

Cultural management options can significantly reduce the severity of needle cast diseases. These diseases tend to cause more damage to trees that are crowded and shading each other, so it is important to maintain adequate spacing for good airflow and light penetration. Removing weeds and mowing grass to reduce the height of other vegetation near the base of the tree will also help increase air movement and reduce leaf wetness duration. Prune out and destroy or burn dead limbs.

When selecting a tree for a particular location, make sure it is adapted to thrive in the conditions of that site. Soil conditions generally need to be moist, but well-drained soils that are moderately acidic for most conifers, although some conifers, such as Norway spruce, may tolerate a wider range of conditions. Avoid planting trees that are highly susceptible to needlecast diseases, such as Colorado blue spruce.

Fungicide programs can help manage needlecasts, but some fungi can be present in an infected needle for months to over a year before symptoms become visible, which makes determining spray timing difficult. First, an accurate diagnosis is needed to determine the best timing for application and recommended fungicides for management, but also to determine how long of a spray schedule you will need to clear up the disease (single year or multi-year program). When trees are losing many lower limbs due to attrition and reduced vigor, it may be a good idea to replant with a healthy, resistant variety.

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