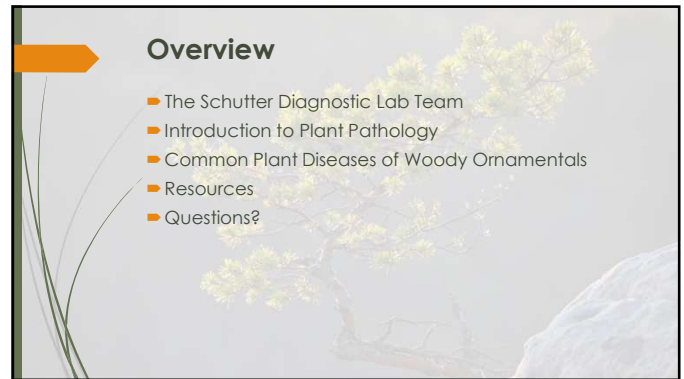
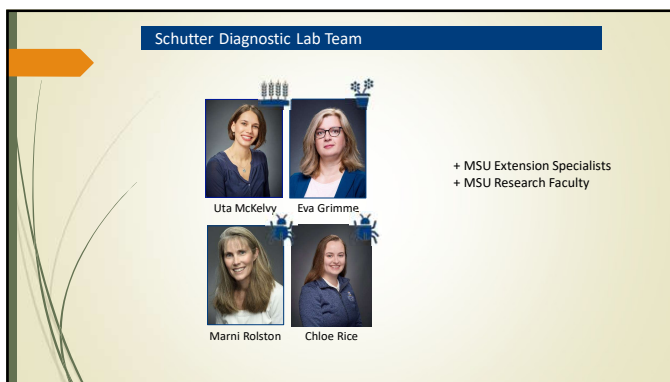




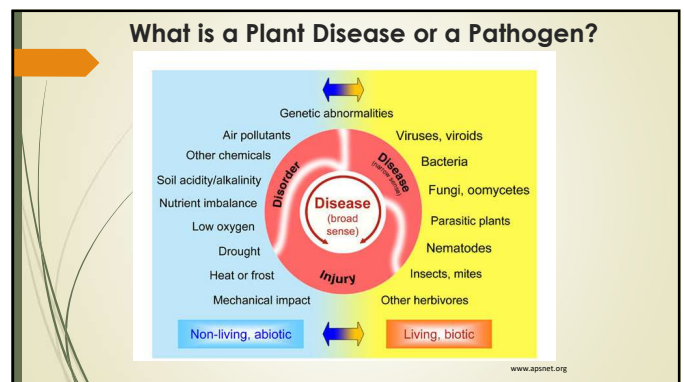
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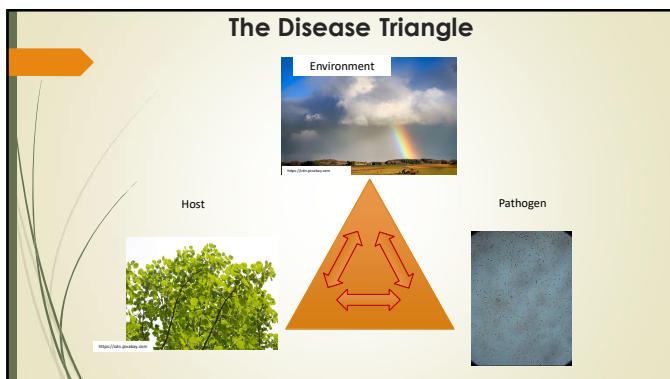
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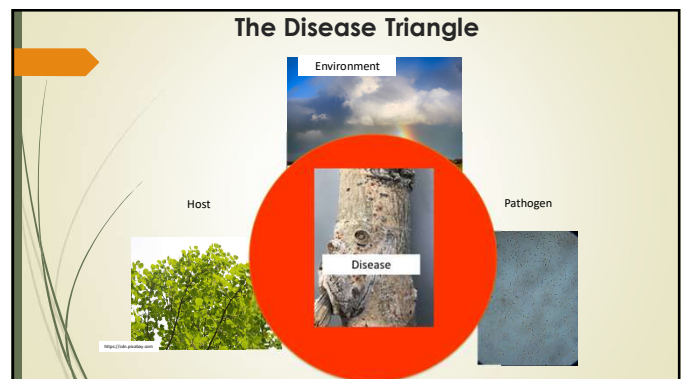
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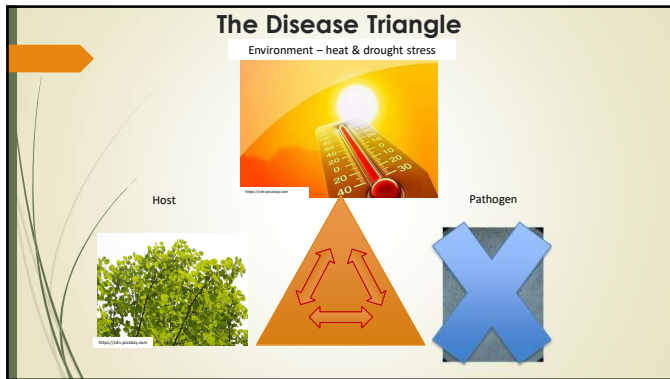
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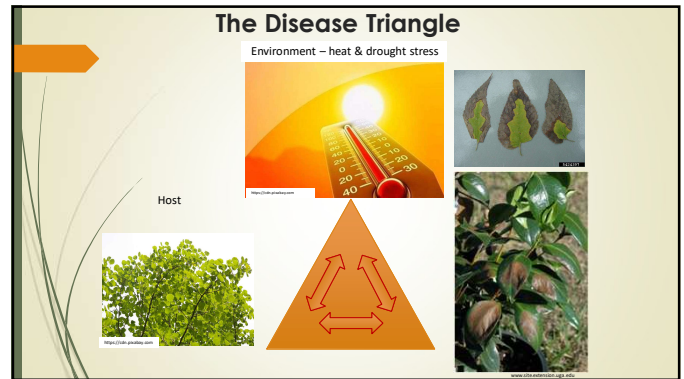
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8

Symptoms

- Wilting, Stunting
- Discoloration
- Dieback
- Necrotic spots
- Rotting

Signs

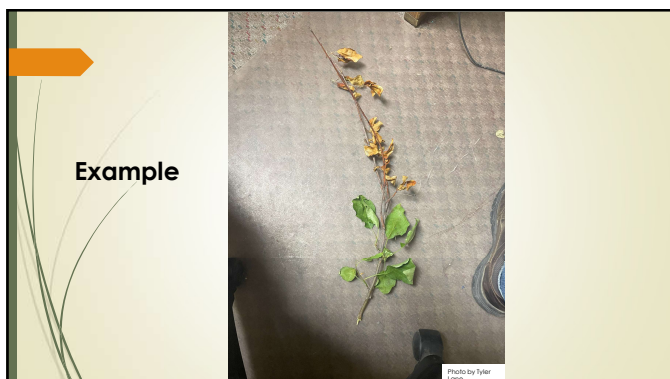
- Evidence of a pathogen
 - Fungal mycelium
 - Fungal fruiting bodies
 - Bacterial oozing

9

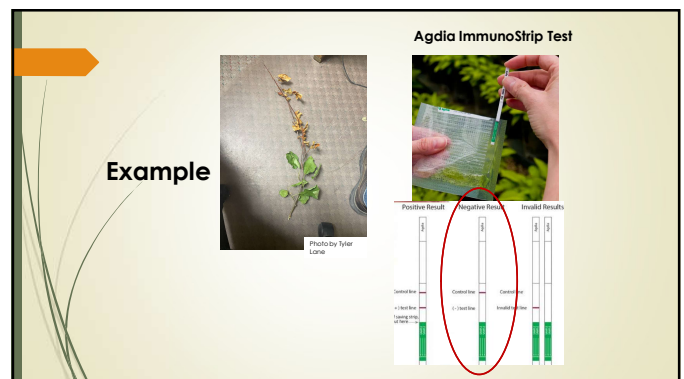
Ask lots of questions

- Know the host plant
- Check for signs & symptoms
- What diseases/insect pests are known on the plant host?
- When did symptoms appear?
- Cultural practices
- Growing environment
- Environmental factors: extreme temperatures, rainfall, hail, lightning, prolonged drought, air pollution, chemical drifts, strong winds
- Site factors: soil pH, soil type, drainage problems
- Pesticide use

10



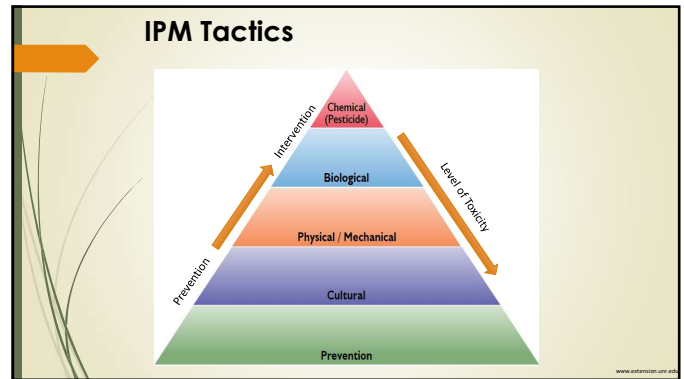
11



12



13



14



15



16



17



18



Snow Mold

Typhula sp. or *Microdochium nivale*

- There are two types of snow mold: gray snow mold (*Typhula* sp.) and pink snow mold (*Microdochium nivale*)
- Rings appear in early spring as the snow melts in matted grass
- Unlike gray snow mold, pink snow mold can occasionally form without snow cover in wet, cool & matted grass

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Snow Mold Management

- Snow mold damage is seldom serious – affected areas will take just a little longer to green up
- Rake the matted areas: this will help with aeration and increase temperature
- Avoid excessive nitrogen applications in the fall
- Mow grass at recommended heights until it is no longer actively growing in late fall

20

Black Knot Disease

Pathogen: *Dibotryon morbosum* (fungus)

Hosts: *Prunus* spp. (plum, cherry, chokecherry)

- Elongated, rough swellings or knots
- Most common on small twigs and branches
- In the spring, ascospores are produced and infect succulent green twigs of the current season's growth
- Normal growth is interrupted; fungus causes the plant to produce tumor-like growths

Control:

- Prune out & destroy infected branches



M. Grabowski, UMN Extension

ascus

ascospore

www.gettyimages.com

www.plantpath.comail.edu

21

Black Knot Disease



ascus

ascospore

http://pup.km@rock.edu

http://pup.km@rock.edu

www.plantpath.comail.edu

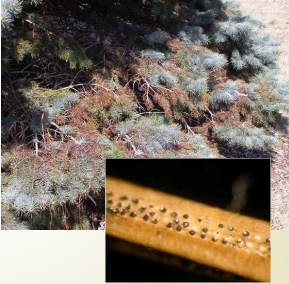
22

Rhizosphaera Needle Cast

R. kalkhoffii (fungus)

Hosts: Spruce, Pine;

- Tree looks thin and bare;
- Year-old needles turn purplish brown by late winter or early spring;
- Bottom needles drop in late summer while current year needles remain;
- Spread upward and around tree;
- Pycnidia in rows in stomata in late winter/early spring;



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Rhizosphaera Needle Cast



www.pinecast.com

www.pinecast.com

www.pinecast.com

http://pup.km@rock.edu

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SNEED – Sudden Needle Drop

Setomelanomma holmii (fungus)

- Host: Spruce
- Yellowing to browning of older needles;
- Fruiting bodies are not found on or in the needles, only on the woody tissue at the base of the needles;
- Affected branches may be scattered through the canopy;
- By fall, all of the affected needles drop off except the newest needles on the tips of the branches;



www.universityofillinoisplantclinic.com

25

April

May

June

26

Root Rots

Scientific Names: *Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp.

- Plants can become infected at any growing stage
- Damping-off
- Infection can spread via soil particles or water
- Difficult to control
- Stunted growth
- Wilting
- Reduced root system - roots appear brown to black



<https://extension.umn.edu>

1001402011

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Pythium root rot



www.ncsu.edu

Fusarium root rot



<http://www.southfloridians.com>



Rhizoctonia root rot

www.ncsu.edu

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Root Rots

Management

- Plant disease-free plants & resistant varieties whenever possible
- Maintain good soil drainage & avoid excessive water
- Plant seeds when soil temperatures are 60-65 °F
- Sanitation: Remove and destroy infected plant material
- Consider a preventative soil drench before planting



<https://aguplantclinic.com>



<https://extension.umn.edu>

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Galls

- Caused by **fungi, bacteria, viruses, insects, mites, nematodes**

Symptoms:

- Abnormal, localized outgrowth or swelling of plant tissue (balls, knobs, lumps, warts).
- Galls may occur on leaves, twigs, roots, or flowers.
- Galls may have a range of colors (red, green, yellow, black).
- Most galls are caused by irritation or feeding.
- Bacteria may cause tumors on the stems and crowns.



Peach leaf curl – caused by a fungus

<https://aguplantclinic.com>



Crown gall – caused by a bacteria

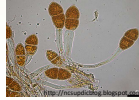
<https://extension.umn.edu>

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Cedar-Apple Rust & related Rust Diseases

- Rusts require 2 different hosts (Juniper & plant in Rosaceae-family) to complete their life cycle;

- Cedar-apple rust
- Hawthorn rust
- Quince rust



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Cedar-Apple Rust & related Rust Diseases

Symptoms on plants in Cupressaceae family (Eastern red cedar & other junipers):

- Hardy woody galls or swollen stems from summer through early spring of following year;
- Gummy-looking, orange teliospores develop in spring on Junipers;



32

Cedar-Apple Rust & related Rust Diseases

Symptoms on plants in Rosaceae family (apple, crabapple, hawthorn, serviceberry):

- Leaf spots on upper surface are first yellow, then turn bright orange, often with a bright red border;
- Small, raised black dots form in the center of leaf spots on upper leaf surface when spots mature;

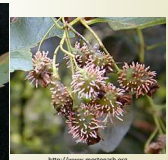


33

Cedar-Apple Rust & related Rust Diseases

Symptoms on plants in Rosaceae family (apple, crabapple, hawthorn, serviceberry): continued

- Finger-like structures/tubes (aecia) emerge on lower surface of leaves, occasionally on fruits.



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Cedar-Apple Rust & related Rust Diseases

Management

- Plant disease-resistant apple & crabapple varieties;
- Don't plant juniper plants within a few hundred yards of susceptible Rosaceae plants;
- Prune and remove woody galls in spring;
- Consider protectant sprays¹ (myclobutanil, copper, sulfur) on Rosaceae plants (at emergence of flower buds & continued until weather becomes consistently warm and dry;

¹Caution: Mention of a pesticide or use of a pesticide label is for educational purposes only. Always follow the pesticide label directions attached to the pesticide container you are using. Remember, the label is the law.

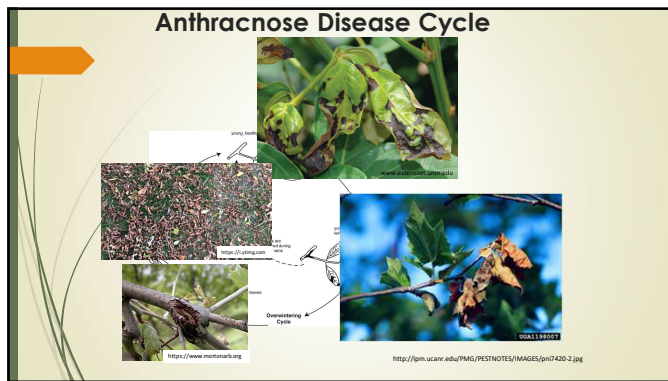
35

Anthracnose (fungal)

- Caused by several species of fungi (Discula, Colletotrichum);
- Infecting developing leaves & young shoots;
- Small tan, brown spots appear which enlarge to blotches;
- Young leaves become curled & distorted;
- Severely infected young leaves drop late spring;
- Young twigs & branches can be killed;



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Anthracnose Management

- Good plant spacing for optimal air circulation;
- No effective control after symptoms appear;
- Rake & dispose of fallen leaves and twigs;
- Prune out infected branches (dormant season);
- Plant resistant varieties;
- Some preventative fungicides available – reliability questionable

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Bacterial Blight of Lilac

Pseudomonas syringae pv. *syringae* (bacterium)

- Affects all types of lilacs;
- Infection occurs in spring during wet weather;
- Brown spots appear on leaves and stems;
- Spots can then enlarge and cause contorting of leaves;
- Blackening and wilting of shoots can occur if the disease spreads into shoot tissue; if stems are girdled, distal shoots and blossoms are killed;

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Bacterial Blights - Management

- Prune during the dormant season;
- The infection will extend beyond the visible canker;
- Make the pruning cut 10 to 12 inches below visible infection;
- Disinfect tools between cuts to avoid spreading the pathogen;
- Remove affected plant materials;

40

Root rots - *Pythium* spp. (fungus-like organism/water mold)

- Hosts: all turfgrasses;
- Time: often in spring, early summer
- Severe when turf is over-irrigated & soil drainage is poor;
- Bleached patches develop;
- Roots appear necrotic; foliage can appear chlorotic or necrotic, water-soaked.

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Root Rots

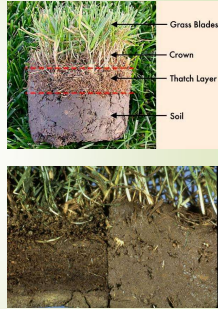
Management

- Irrigation management is key!
- Avoid overwatering;
- Remedy soil compaction (core aeration);
- Increase mowing height to reduce plant stress.
- Manage the thatch layer;
- Fungicides can be applied at disease onset (a. i. fosetyl-al; mefenoxam; source: UC IPM)

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Thatch

- **Thatch:** Layer of dead and living organic materials (including shoots, stems, and roots) that develops between the soil and the green turfgrass vegetation
- If thatch becomes too thick ($> \frac{1}{2}$ inch), it can be detrimental to the lawn by limiting the movement of air, water, and nutrients into the soil and the turf roots



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Aeration

- Aeration can help with things such as thatch accumulation, soil compaction, allowing more oxygen and moisture into the root zone, and encouraging deeper rooting in turf
- In problem turf, or areas that receive heavy wear/tear aeration should occur every year (and sometimes more frequently depending on issues such as soil compaction)
- In healthy home lawns, aeration can occur every couple of years and/or as needed
- Spring and fall are the best times to aerate your lawns



44

July

August

September

45

White Mold

Scientific Name: *Sclerotinia sclerotiorum* (fungus)

- Fungus survives as sclerotia in the soil
- Disease is favored by cool & moist conditions
- Infection starts as water-soaked areas on flowers and stem joints
- Stems are killed quickly; dead, dry stems look bleached
- Water-soaked stem lesions can also appear at the soil line
- Affected areas are covered by white, cottony mycelium



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White Mold

Management

- Choose plants with an upright & open form
- Good plant spacing to optimize air circulation
- Use drip irrigation or soaker hose
- Remove infected plants as soon as symptoms appear
- Crop rotation – avoid: canola, soybean, sunflower, alfalfa, pumpkin, potato, etc.
- Deep plowing to bury sclerotia
- Foliar fungicide applications need to be applied before infection
- Biological control products (a.i. *Coniothyrium minitans*) are available to affect sclerotia



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Cankers

- Caused by **fungi** and **bacteria**

Symptoms:

- Round to irregular sunken, swollen, flattened, cracked, discolored, or dead areas on the stems (canes), twigs, limbs, or trunk.
- Cankers may enlarge and girdle a twig or branch, killing the foliage beyond it.
- They are most common on plants weakened by cold or drought stresses, insect injury, nutritional imbalances.



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Fire Blight (bacterial disease)

Pathogen: *Erwinia amylovora*

Hosts: Apple, pear, mountain ash, raspberry, hawthorn, cotoneaster - >130 species in rose family



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Fire Blight



50

Cankers

Caused by **fungi** and **bacteria**

Management:

- Prune out affected limbs 8-12 inches below cankers & infected areas
- Reduce stress on trees
- Avoid wounding plants
- Balanced watering & nutrient management
- Plant resistant varieties
- Fungicides – not shown to be effective!



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Cytospora Canker (fungal disease)

- **Hosts:** ash, cottonwood, elm, maple, spruce, willow, apple, birch
- Affects stressed trees
- Fungus girdles the limbs, killing the plant above the canker
- Look for pimple-like structures on branches and trunk
- Can produce discolored cankers



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Cytospora Canker - Spruce

- Look for swellings, cankers
- Blue or white resin might be visible on branches, trunk
- Branches die back in a spiral pattern upward



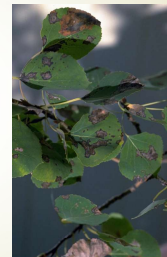
53

Marssonina Leaf Blight

Marssonina spp. (fungus)

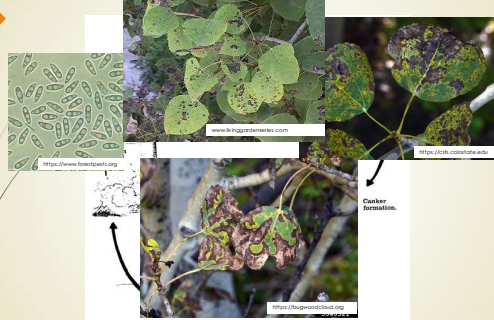
Hosts: Aspen, cottonwood, willows;

- Infection in early spring;
- Dark brown flecks with yellow margins gradually enlarge (appear late July);
- Can cover aspen leaves and defoliate by mid summer;
- Favored by wet weather in spring and summer;
- Overwinters in leaf debris;
- Control: Rake up and remove infected leaves;



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Marssonina Leaf Blight



55

Oak Leaf Blister

Taphrina caerulescens (fungus)

- Very common on oaks in Montana; red oak group is particularly susceptible;
- Favored by cool, wet springs;
- Typically does not cause severe damage;
- Blisters or depressions on leaf surface appear in early summer;
- A fungicide (a.i. chlorothalonil) can be applied in spring when buds begin to swell (protectant);



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Oak Leaf Blister



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Powdery Mildews

Causal agent: *Erysiphe* sp., *Podosphaera* sp.,

Uncinula sp. and other fungi

Hosts: Most floral and foliage plants (examples: hydrangea, zinnia, monarda)

➤ Pathogens are host-specific



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Powdery Mildews

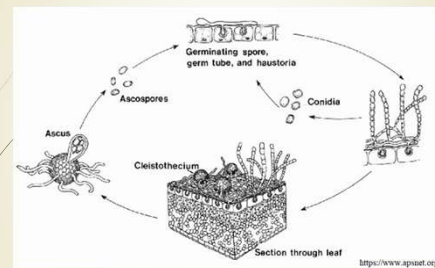
Symptoms:

- Easily recognized
- Appear as white, powdery areas on mostly upper leaf surfaces
- Older leaves may be more symptomatic than young ones
- Infections easily spread via air currents and splashing water
- Severe infection will cause plant dieback

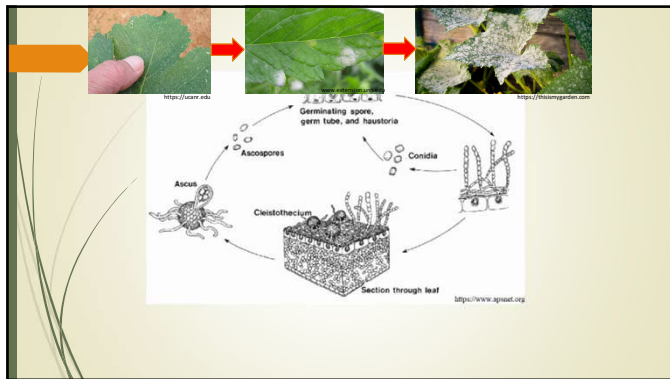


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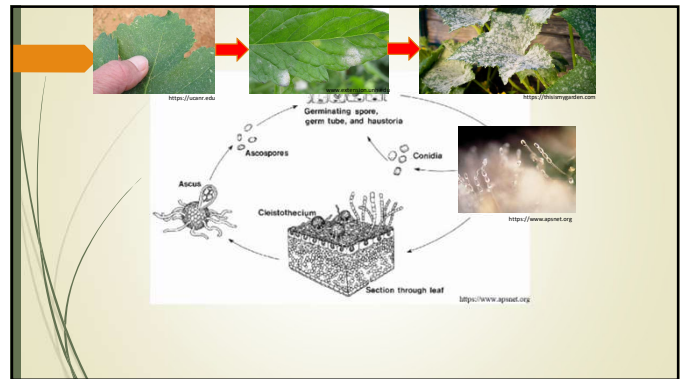
Powdery Mildews



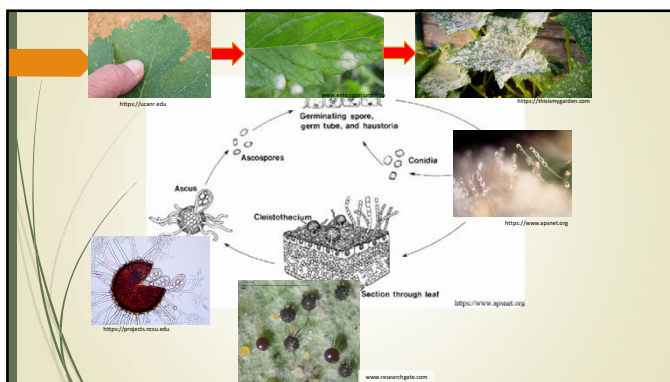
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Powdery Mildew Management

- Sanitation
 - Remove and destroy infected plant materials;
- Reduce relative humidity
- Avoid overcrowding
- Plant resistant varieties
- Change cultivation methods (e.g., drip irrigation)
- Fungicides (a.i. azoxystrobin; myclobutanil)
- Organic options: potassium bicarbonate, sulfur, neem oil, horticulture oil

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Apple Scab

- **Pathogen:** *Venturia inaequalis* (fungus)
- **Hosts:** apple and crabapple trees
- **Symptoms:** Round, olive-green leaf spots with fringed borders appear on leaves in late spring; affected leaves yellow and may drop mid-summer.
- Spots on fruits can also appear. Leaf spots turn brown to black with age.
- **Management:** plant resistant cultivars. Remove fallen, infected leaves to prevent the primary infection in spring. Fungicides (a.i. chlorothalonil, copper, or lime-sulfur) can be applied in seven- to ten-day intervals until petal fall.

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Brown Patch

Rhizoctonia solani (fungus)

- It is a major **summer foliar disease**;
- Hosts (cool-season grasses): Perennial ryegrass, tall fescue, bentgrass, Kentucky bluegrass (less likely);
- Time: mainly **June to September**;
- Light brown circular patches develop (inches to several feet diameter);
- White mycelium can be seen on dew-covered leaf blades in early morning;
- Saprophytic pathogen surviving in thatch;

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Brown Patch

Rhizoctonia solani (fungus)

- Leaves first appear water-soaked with irregular, light brown lesions with dark brown borders;
- A dark, smoky ring often surrounds outer margins (in low-cut bentgrass);
- Disease can rapidly kill large areas of turf grass;



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Brown Patch

Management

- Avoid excess nitrogen during summer months;
- Irrigate early in the morning;
- Reduce thatch layer
- Core aeration
- Prune trees and shrubs to optimize air circulation and sun exposure
- Fungicide applications (e.g., azoxystrobin & chlorothalonil) are sometimes needed;
- Curative applications immediately after onset of symptoms;
- Preventative early in the season;



www.gardensupply.com

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Potato – Scab



©T.A. Zitter



Treat planting row/hole with small amount of oats or barley

Streptomyces scabies (bacteria)

- Soil inhabitant
- Maintain 70% soil moisture
- Crop rotation (2-3 years)
- Resistant/Tolerant Varieties*:
 - Nooksack
 - Norgold
 - Onaway
 - Russet Burbank
 - Superior
 - Targhee
 - Red Norland

*<https://yardandgarden.extension.umd.edu/how-to-manage-potato-diseases-diseases-and-pests/>

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Sooty Mold

- Tree limbs and leaves are covered by black, sooty growth
- Caused by saprophytic fungi – **not a disease!**
- On plants infested with sapsucking insects (aphids, leaf hoppers, scales);
- Insects secrete honeydew which is a food base for sooty mold;
- Control the insects;
- Mold will gradually disappear or can be physically washed off;



University of Maryland

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Blossom End Rot

Physiological Disorder

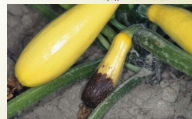
- Affects tomato, pepper, zucchini squash, eggplant
- Water-soaked spots appear on the first fruits formed
- Tissue on the blossom end of fruit breaks down & rots
- Caused by calcium deficit in the fruit due to inconsistent soil moisture

Recommendation:

- Irrigate evenly; apply mulch



<https://www.extension.umd.edu/>



<https://www.cornell.edu/>

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Physiological Leaf Roll

Physiological Disorder

- Leaves are firm & leathery
- Leaves roll upward
- No yellowing or stunting
- Plant may look wilted
- Symptoms favored by hot, dry weather (wind)

Recommendations:

- Focus on supporting plant vigor by providing adequate water and nutrients



Dr. Keith Willis



T. Smith, UMass

72



73

Necrotic Ring Spot

Ophiosphaerella korrae (fungus)

- Host: mainly Kentucky bluegrass;
- Time: **spring/fall** (cool, wet weather)
- Disease affects **roots, crowns** and leaves
- Circular patches (inches to 2-3 feet diameter);
- Infected leaves turn reddish brown to light straw color;
- Lower stems and roots might be covered with black runner hyphae;
- Affected root tissues might turn black;
- Often the turf will survive and recolonize the infected centers (frog-eye effect);

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Necrotic Ring Spot

Management

- Reduce stress on turfgrass;
- Daily, light watering will support recovery;
- Remedy soil compaction (core aeration);
- Consider planting resistant varieties;
- Clean equipment between properties;
- Preventative fungicides can be applied in spring when soil temperatures are > 60°F (a. i. myclobutanil, propiconazole)

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Seasonal Needle Drop

- Older, inner needles turn completely yellow (without spots);
- Needles drop (in the fall);
- Lost needles may be two+ years old, depending on species;
- Needle drop most vividly in white pine;

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Seasonal Needle Drop

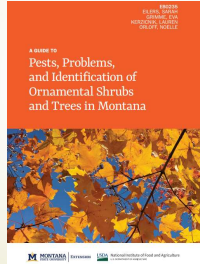
Control:

- No control required;
- Natural process;
- Follow good cultural practices;

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Resources

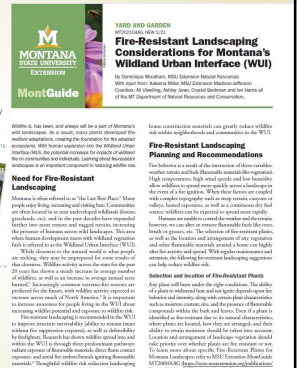
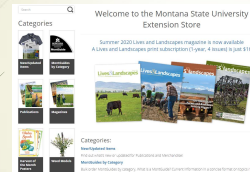
- <https://msuextension.org/pubs/a-guide-to-pests-problems-and-identification-of-ornamental-shrubs-and-trees-in-montana/intro-and-table-of-contents.html>



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Resources

- <https://store.msuextension.org/>



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How we keep in touch

AgAlerts and Urban Alerts:

<https://www.montana.edu/extension/ipm/alerts/>



Facebook: @SchutterDiagnosticLab



<https://www.montana.edu/extension/diagnostics/>

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Questions?



Schutter Diagnostic Laboratory
121 Plant BioScience Building Phone: (406-994-5157)

e-mail: diagnostics@montana.edu

Bozeman, MT 59717
Disclaimer: The recommendations provided in this presentation serve only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The authors and Montana State University assume no liability resulting from the use of these recommendations. The Montana State University Extension Service is an ADA/EO/AA/Veteran's Preference Employer and Provider of Educational Outreach.

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