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POWDERY MILDEW

Powdery mildew is considered one of the most common, easily recognized, and widely distributed diseases of herbaceous and woody plants in Connecticut. This disease is primarily of cosmetic concern, since it usually results in disfigured and unsightly plants rather than plant death. However, in some cases, such as powdery mildew of tomato, infections can significantly reduce fruit production and can also result in plant death. Powdery mildew tends to be more problematic in mid to late summer when day-night temperatures favor high relative humidity (RH), although this disease can develop at any time during the growing season.

SYMPTOMS:

Powdery mildews are easily recognized by the white, powdery growth of the fungus on infected portions of the plant host. The powdery appearance results from the superficial growth of the fungus as thread-like strands (hyphae) over the plant surface and the production of chains of spores (conidia). Colonies vary in appearance from fluffy and white to sparse and gray (Figures 1-4). Powdery mildew fungi usually attack young developing shoots, foliage, stems, and flowers, but can also colonize mature tissues. Symptoms often first appear on the upper leaf surface, but can also develop on lower leaf surfaces. Early symptoms vary and can appear as irregular, chlorotic, or purple areas, or as necrotic lesions, all of which are followed by the typical white, powdery appearance. Some infected leaves may shrivel, brown, and drop prematurely. Other symptoms include atypical scab-like lesions, witches'-brooms, twisting and distortion of newly emerging shoots, premature leaf coloration and drop, slowed or stunted growth, and leaf rolling. In rare but extreme situations, heavy infections cause plant death.

Figure 1. Powdery mildew of torenia.

Although diagnosis of powdery mildew is not difficult, symptoms often escape early detection if plants are not periodically monitored, since symptoms can first develop

on lower or middle leaves. The time delay from when infections begin and when disease is detected helps explain reports of sudden "explosions" of disease. This can occur when the percentage of infected leaves increases from 10% to 70% in one week.

Figure 2. Powdery mildew of liatris. Note bright white colonies.

Figure 3. Powdery mildew of gerbera daisy.

Figure 4. Powdery mildew of lilac. Note sparse colonies on the leaf.

CAUSAL ORGANISMS AND DISEASE DEVELOPMENT:

Although the symptoms of disease are similar, the fungi responsible for powdery mildew fall into a number of different genera. The most common genera include *Erysiphe*, *Golovinomyces*, *Phyllactinia*, and *Podosphaera*. These fungi are all obligate parasites that require living hosts to complete their life cycles so they readily infect healthy, vigorous plants. Some powdery mildew fungi have broad host ranges, whereas others are fairly host-specific. For example, the powdery mildew fungus that infects lilac is not capable of infecting cosmos and *vice versa*. However, the powdery mildew fungus that infects oak can also infect rhododendron and dogwood.

Powdery mildew fungi have fairly simple life cycles on most plants. Spores (conidia) are produced in chains on stalks (conidiophores) (Figure 5). Conidia are "powdery" and are readily disseminated by air currents.

Figure 5. Chains of powdery mildew conidia on conidiophores growing the surface of a leaf (arrows).

After the conidia land on the plant surface, they germinate, penetrate the tissues, and send food-absorbing projections (haustoria) into the epidermal cells. Thread-like strands of the fungus (hyphae) then grow over the surface of the infected plant part and eventually produce more conidiophores and conidia. The time from when conidia land to the production of new conidia can be as short as 72 hours, but is more commonly 5-7 days. Powdery mildew conidia are unique since, unlike most fungal spores, they do not require free moisture (e.g., guttation, dew, rain, overhead irrigation) on plant surfaces in order to penetrate and infect.

Some powdery mildew fungi produce small, black, pepper-like resting structures called chasmothecia (formerly called cleistothecia) (Figures 6 and 7). These structures serve as overwintering structures and also allow the fungus to survive in the absence of a suitable host. Chasmothecia are found in plant debris and in crevices or cracks in woody tissues (i.e., grapevines) and are often the primary sources of inoculum the following spring. Other powdery mildew fungi overwinter as hyphae or fungal strands in buds or other parts of living plants.

Figure 6. Chasmothecia of different ages of maturity, from immature yellow to mature dark brown or black.

Figure 7. Powdery mildew of grape. Chasmothecia (dark spots) are visible on some fruit.

Development of powdery mildew is influenced by many environmental factors including temperature, RH, light, and air circulation. Because these optimum conditions usually occur in mid to late summer, powdery mildew outbreaks are most common at that time. As a consequence of this timing and the cosmetic nature of the disease, powdery mildews generally don't have long-term health implications for herbaceous or woody plants.

STRATEGIES FOR DISEASE MANAGEMENT:

Managing powdery mildew can be achieved using an integrated approach. This disease can be effectively managed by following good sanitary and cultural practices and is often not serious enough to warrant chemical control.

1. Culture-

- Plant vigor should be maintained by following sound cultural practices such as proper watering, fertilizing, mulching, and pruning.
- Maintain adequate plant spacing to increase air circulation around plants.

2. Sanitation-

- All plant debris should be raked and removed in the fall.
- During the growing season, symptomatic leaves should be removed as soon as they are detected and immediately placed in a plastic bag to avoid spread of the powdery spores to other plants.

3. Scouting-

- Scout for disease on a regular schedule to identify outbreaks before they become widespread.

4. Resistance-

- Genetic resistance is very effective for powdery mildew control, but is not available for all plants. Examples of powdery mildew resistant plants are phlox 'David,' New England aster 'Purple Dome,' beebalm 'Marshall's Delight,' and crabapple 'Indian Summer.'

5. Chemical-

- Since a number of compounds are registered for homeowner use in Connecticut, it is important to read the pesticide label. Spraying usually begins as soon as symptoms are detected and continues until conditions are no longer favorable for disease development. The label will contain information on host plant, dosage rates, application intervals, days-to-harvest interval (for edible crops), and safety precautions. Some of the compounds registered for use include:
  - "Biorational" compounds: neem oil, insecticidal soap, horticultural oil, and potassium bicarbonate.
  - Biological agents: *Bacillus subtilis.*
  - "Traditional" fungicides: copper, fenarimol, myclobutanil, propiconazole, triadimefon, thiophanate-methyl, and sulfur.
  - Organic options include approved formulations of potassium bicarbonate, neem oil, and horticultural oil, copper, and sulfur.

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