The IPM Way to Manage Bedding Plant Disease

Part I: General Information and Contagious Diseases

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(***Editor's Note:*** This is a three-part article provided to help growers better understand how to manage bedding plant diseases. Part I will discuss some general information and contagious diseases; Part II will discuss foliar diseases caused by viruses and bacteria; and Part III will review noncontagious diseases. Adherence to the basic principles outlined here plus using good growing techniques will allow growers to produce quality plants. Part II and III will appear in the next issue of the Connecticut Greenhouse Newsletter.)

Unlike growers of outdoor crops, greenhouse growers are able to control many aspects of the environment, including growing media, temperature, light, humidity and pest access, to favor the crop in production. Upsetting one or more elements of this balancing act can cause symptoms of plant disease directly (leading to noncontagious, stress-related diseases) or lend the advantage to pathogens (encouraging contagious diseases). Producers of greenhouse crops, including bedding plants, can utilize environmental and cultural controls to minimize plant disease problems and dependence on fungicides. The IPM approach involves learning what the expected disease problems are on each crop, then devising simple monitoring and control strategies for those problems.

The most common contagious bedding plant diseases are caused by plant pathogenic fungi, bacteria and viruses. Some pathogens are quite specific to certain plants while others can affect a wide range of hosts. Under favorable environmental conditions for disease development, contagious diseases can

become serious problems. Reductions in plant quality or outright crop losses may result.

Environmental or cultural conditions adverse to healthy plant growth can also cause plant disease symptoms, such as leaf spotting from a misapplied spray or root damage from high soluble salts.

Table 1 lists the key (problem-prone) bedding plants and their key (most common) pests. Each greenhouse may have its own unique problems, some of which may not be listed.

The foundation of effective monitoring (or scouting) is training one's powers of observation to recognize disease symptoms and environmental conditions which favor outbreaks, and learning to associate particular crops with particular problems. Experience increases a scout's ability to correctly identify the causes of plant disease symptoms.

Controlling bedding plant diseases in greenhouses requires some knowledge of the conditions allowing the problem to develop in the first place. A disease outbreak depends on the presence of four interacting elements: a pathogen, susceptible plant(s), environmental conditions conducive to disease and time for the problem to develop. Some disease-causing organisms, such as *Botrytis cinerea*, are almost inevitably present in every greenhouse, but infections may occur only when plant surfaces are wet for extended periods of time. In other cases, the pathogens are introduced to the greenhouse with seeds, cuttings or plants, and the grower may become aware of them only when environmental or cultural conditions shift to favor the pathogens. Disease outbreaks are often traceable to cultural problems (e.g. wet foliage in the case of *Botrytis*) which persist long enough for an outbreak to occur.

An IPM approach to controlling bedding plant diseases involves targeting these four elements essential for disease development in a natural strategy for disease prevention—using a source of clean plant material, monitoring regularly to recognize problems early and providing optimum cultural conditions for the crops. Fungicides and bactericides, where they are effective, are useful tools, but much can be accomplished through good cultural management practice.

Table 1. Bedding Plants and Some of Their Common Problems in the Greenhouse		
Plant	**Cultivar(s)**	**Pest(s)**
Ageratum	All	Whiteflies, WF thrips, aphids, spider mites
Alyssum	All	Whiteflies, WF thrips, aphids
Begonia	All	*Rhizoctonia* (damping off), WF thrips?
Begonia	Tuberous	INSV, WF thrips, *Xanthomonas* (bacterial blight)
Celosia	All	WF thrips, aphids
Dahlia	Seed-grown	Aphids, WF thrips, *Botrytis*
Dahlia	Tuber-grown	TSWV, aphids, WF thrips
Dianthus	All	WF thrips, *Botrytis*
Gazania	All	WF thrips
Geraniums	Cutting-grown zonals	*Botrytis, Xanthomonas* (bacterial blight), *Phythium* (root rot), fungus gnats
Geraniums	Cutting-grown Aurora, Snow Mass	Same as other cutting-grown zonals plus whiteflies, Fe/Mn toxicity esp. on Aurora
Geraniums	Ivy types (cutting-grown)	WF thrips (esp. Sybil Holmes), *Xanthomonas* (bacterial blight) oedema
Geraniums	"Martha Washington" types (cutting-grown)	Whiteflies, *Pythium* root rot
Geraniums	Seed-grown zonals	*Botrytis*, *Pythium* (root rot), *Xanthomonas* (bacterial blight) if near infested cuttings
Herbs	All	Whiteflies, aphids, WF thrips, mites
Impatiens	All wallerana (sultani) and hybrid varieties	WF thrips, green peach and melon aphids, TS spider mites, TSWV/INSV, *Rhizoctonia* (crown rot, damping off), *Botrytis*

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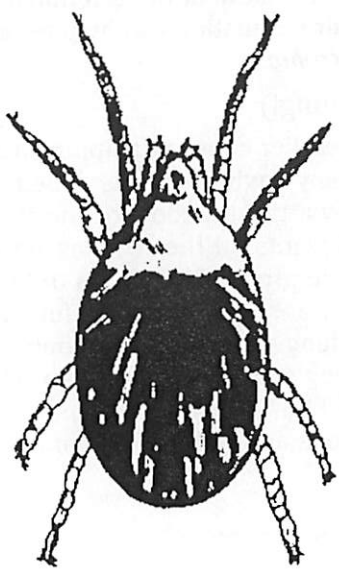
Marigolds	All	WF thrips, aphids, *Botrytis*, mites, Alternaria leaf spot
New Guinea Impatiens	All	WF thrips, INSV/TSWV, *Rhizoctonia* (crown rot), *Pythium* (crown rot), *Thielaviopsis*, *Botrytis*, *Myrothecium* leaf spot
Pansy	All	Yellowing and stunting, aphids
Petunia	All	WF thrips, *Rhizoctonia* (damping off)
Pepper	All	WF thrips, TSWV/INSV
Portulaca	All	WF thrips, INSV
Snapdragon	All	WF thrips, *Pythium* (root rot), downy mildew
Tomato	All	WF thrips, TSWV/INSV, Botrytis, leaf spots (bacterial and fungal)
Verbena	Flowering annuals (seed-grown)	WF thrips, aphids
Vinca	All	WF thrips, Pythium (damping off, crown
Zinnia	All	Whiteflies, WF thrips, melon and green peach aphids, Xanthomonas (bacterial leaf spot), Alternaria (fungus leaf spot)



Contagious Diseases

Damping-Off

Damping-off is a familiar problem to most growers. Largely a seedling problem, damping-off may be caused by 30 or more species of fungi, although the most common agents on many plants are *Rhizoctonia solani* and *Pythium* spp. Many species are susceptible to *Rhizoctonia*, but problems are perhaps most frequently encountered on vinca and impatiens. Geranium and snapdragon are notably prone to *Pythium* attack. *Alternaria*

spp. are occasionally responsible for damping-off of marigold or dusty miller. More often seen as a leaf and stem disease, *Botrytis* occasionally causes damping-off as well. There are two types of damping-off: seedlings may be killed either before emergence (usually by *Pythium*) or after emergence (usually by *Rhizoctonia*, on the stem at the soil line).

Sanitation and seed treatments are the primary means for avoiding problems prior to seedling emergence, as fungicide drench treatments at seeding may reduce germination. Spot treatments on known problem species are preferable to blanket treatments across all varieties. If preventative, across-the-board treatments are desired, several fungicide drenches are available which will provide broad-spectrum control, covering both *Pythium* and *Rhizoctonia*.

Monitoring Tips: Monitor weekly for damping-off on young plants (to about eight-leaf stage) by scanning over flats while walking along benches or aisles. Single plants may be affected or, sometimes, large circular areas or entire flats are attacked as the pathogen spreads from a central point. Look in flats for seedlings which fail to emerge, possibly indicating *Pythium* activity.

Seedlings that fall over after being attacked at the soil line suggest *Rhizoctonia* as the cause; sometimes this is accomplished by the fine, web-like strands of the fungus visible around the soil line. Greyish powdery sporulation where the stem is cankered (injured) is typical of *Botrytis*.

Note areas (crop location, bench or cultivars) affected and severity (e.g. light, moderate or severe). If the cause of the problem is not immediately apparent, a diagnosis may help in determining a course of action (e.g. seed treatment or selection and timing of fungicides). Improving air circulation can help reduce problems with *Botrytis* and *Rhizoctonia*.

Root Rots (caused by various fungi)

Many of the same fungi which earlier caused damping-off can attack more mature plants, generally having a slower, albeit sometimes equally lethal, effect by attacking roots or the stem base. Roguing (removing affected plants) at the seedling stage will minimize root and stem disease problems in packs or in the landscape. Fungicide drenches at transplanting are useful for combating these problems. Each fungicide will control only certain diseases; identifying the pathogen is important when selecting the appropriate fungicide. Workers handling diseased seedlings must be disease conscious and wash their hands before touching healthy plants.

Monitoring Tips: Monitor for root rots by scanning plants and flats weekly, looking for plants that are weak, off-color, wilting, stunted or falling over. While inspecting the crop, randomly select plants and gently dislodge them from the flat or pots, looking carefully at the roots for symptoms of disease (black or brown rotten areas, root cortex brown and sloughing off, etc.). Monitor fungus gnats and shore flies, especially in propagation houses, using yellow sticky cards placed vertically or horizontally above the crop canopy. Watch for media that seems to stay soggy or wet for long periods.

Several species of *Pythium* (black leg, *Pythium* root rot) have been shown to cause root rot problems in bedding plants, including geranium, impatiens, snapdragon and marigold. *Pythium* attacks root tips, major roots and stem bases causing a black or dark brown canker or rot. Infection is favored by poor drainage or other cultural stresses to the root system, particularly high soluble salts.

Monitoring Tips: Test soluble salts levels periodically. Conductivity levels should be below 150-200 mmhos for most seedlings. High fertility rates have ben associated with *Pythium* attack in some crops.

Since fungus gnats and shore flies are known to transport *Pythium* spores around the greenhouse, keeping their numbers low may be important for managing *Pythium.* Well-drained and sterilized potting media, clean growing practices (e.g. watering nozzles kept off the ground) and removing diseased plants are other suggestions for keeping *Pythium* under control.

Diseases caused by *Phytophthora* species (root rot, crown rot) are generally uncommon among bedding plants, although vinca *(Catharanthus roseus)* is sometimes affected by *P. parasitica.* Symptoms are similar to those for *Pythium* root rot. Wet soil and humid conditions facilitate disease development. As with *Pythium* and several other root rots, fungus gnats and shore flies are suspected of carrying spores around the greenhouse. Similar to *Pythium,* good cultural practices are generally sufficient to avoid *Phytophthora* problems (clean and well-drained potting media, hanging up watering hoses, avoiding splashing soil into pots, etc.)

Thielaviopsis basicola (black root rot) is an occasional pest of many plants, but is often associated with fuchsia, pansy, viola and vinca. Poorly-drained growing media and high pH are contributing factors; fungus gnats and shore flies may also play a role in spreading fungus spores. Fungicide drench can be used to protect plants against *Thielavopsis* infection.

Fusarium spp. can cause both root rot and wilt diseases. Root rot problems are the most common *Fusarium* disease on bedding plants. Conditions favoring *Fusarium* include plant stress (particularly poor drainage), low calcium levels, high ammonium nitrogen levels and high temperature. Avoiding these conditions will minimize the chance of *Fusarium* root rot losses.

Rhizoctonia, the most common cause of damping-off, may also cause stem rot at the soil line and sometimes a root rot. During very humid conditions, such as in a dense impatiens canopy, *Rhizoctonia* can grow upwards from the soil surface and attack plant stems and leaves causing a web blight.

Monitoring Tip: Often the cobweb-like strands of the fungus *Rhizoctonia solani* will be visible within the plant canopy.

Foliar Diseases Caused by Fungi

Only a few foliar diseases are common problems to bedding plant producers. Symptoms, monitoring and management tactics are specific to each one. Foliar diseases are caused by a variety of living and nonliving agents.

Botrytis blight, caused by *Botrytis cinerea* (grey mold), is perhaps the most recognizable foliar disease affecting bedding plants. As a weak pathogen, it attacks tissues of many kinds of bedding plants which are wet for long (four+ hours) periods. Although dead tissue is most susceptible, even healthy foliage, flowers, stems or seedlings can be affected. Sometimes the characteristic powdery grey mold spores will be visible near the affected area.

Botrytis is best controlled with cultural practices, especially by not wetting plant parts for long periods (e.g. overnight). It is also important to avoid the rain of dead plant tissue such as fallen petals and old leaves from hanging baskets above, which gives *Botrytis* a foothold on plants below. Greenhouses sometimes need to be heated and ventilated at dusk to avoid overnight condensation. Good air circulation, plant spacing and temperature control are important for managing *Botrytis;* avoid growing the most problem-prone cultivars; utilize fungicides when necessary.

Monitor for *Botrytis* by watching for cultural conditions that favor the disease; scan the crop and inspect stems where canopies are dense for dieback, stem cankers and obvious grey sporulation.

Geranium rust, caused by *Puccinia pelargonii-zonalis*, is much less frequently encountered than *Botrytis.* Fortunately, many of the same good environmental management principles apply;

avoidance of extended foliar wetness is critical for geranium rust management. Prompt detection and removal of inoculum (infected plants or individual infected leaves), followed by systemic fungicide applications will bring this highly-contagious disease under control.

Downy mildew diseases have been observed on greenhouse crops of snapdragon and pansy in recent years. On snapdragon, infected seedlings are quite stunted. The growing tips may be chlorotic.

On pansy, infected plants show yellowing or purpling of leaves that makes them appear to have a nutrient deficiency. Under humid conditions, both plants show beige to violet sporulation on the undersides of leaves. Plants become systemically infected with the fungus. Infected plants should be destroyed.

Powdry mildews are familiar to most growers as common diseases of certain garden perennials. Powedry mildew fungi (*Oidium* spp.) tend to be fairly specific in the crops they attack, meaning, for example, that the powdery mildew on begonia will not attack roses and vice versa. Powdery mildew is spread on plant material or by spores that blow from nearby plants. Fluctuating temperatures seem to favor disease development. High humidity (not wet foliage) also encourages disease development, while good air circulation aids in control. Fungicides are also available in case of an outbreak.

Monitoring Tips: The typical white powdery coating on foliage is diagnostic; a close look with a hand lens can help distinguish the fungus from spray residue. On some plants, the fungus growth is not very obvious until the disease is well-developed, and symptoms may develop on the underside of the leaf first. Cascade petunias may appear to have nutrient deficiency when the problem is actually powdery mildew. On highly-susceptible plants, such as begonia and gerbera, examine any leaf spots with a hand lens to see if powdery mildew mycelium (fungal strands) is present, especially near an outer wall where temperatures and humidity tend to vary most.

Monitoring for powdery mildew is critical. A prompt response to a powdery mildew outbreaks is important, in order to avoid a serious epidemic within the affected crop.

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