PLANT DISEASES and DISORDERS

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Manual for Certified Nursery and Landscape Professionals
Original Author: Cynthia L. Ash
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Helen Atthowe, Nick Engler, Alice Janke, Mary Keck

Insects, animals, infectious organisms (biotic), and non-infectious (abiotic) factors can all cause injury to plants. Healthy plants are usually less susceptible to insects, diseases, and abiotic problems than are plants weakened from stress.

Preventive steps, such as monitoring for insects and infectious diseases, and applying cultural, biological, and chemical controls as needed, is referred to as Integrated Pest Management (IPM). Implementation of an IPM program in the nursery or landscape requires a good working knowledge of the plants, the environment, and all agents that could cause plant injury. See Chapter 6 for more on IPM.

Correct identification of the causal agent is the first and most important step in solving a plant problem. Use all available resources, including books, extension publications and services, and university clinics. After determining the cause, evaluate the severity and extent of the problem before deciding what action to take. There may be more than one way to correct the problem. Chemicals can be used as part of an IPM system, but may not always be the most desirable or effective solution. Often insect and disease problems follow as a result of an abiotic problem. The term abiotic simply means caused by a non-living factor such as mechanical injury or cold temperatures.

Abiotic Plant Problems

Many abiotic factors cause plant problems. More often than not plant disorders are caused by abiotic factors. Diagnosing abiotic problems can be simple or difficult. A complete plant and site history is required in some cases. Sometimes the only way to identify a problem as abiotic is to rule out all possible infectious diseases and insect problems. The more information you obtain, coupled with a thorough on-site investigation, the better your diagnosis will be.

Proper culture and maintenance of plants in nurseries and landscapes will prevent most abiotic plant damage. An abiotic event, such as drought, may stress a plant and make it susceptible to secondary insect and disease organisms.

Common Abiotic Problems

Transplant shock

Nursery professionals often prune roots of trees to be used as bare root transplants or containerized trees. These trees must reestablish an adequate root system in the new location before the plant can resume normal growth. During this period, stress symptoms are normal. Symptoms include: overall stunting of leaves and shoot growth, wilt, scorch and winterkilled twigs or buds. As a rule of thumb, the transplant shock period lasts one year for each inch of stem caliper.

To minimize transplant shock, use correct planting techniques, provide adequate water and don't fertilize for the first year or two. Transplanting established trees with wide spreading root systems will cause significant transplant shock due to the substantial loss of roots.

Deep planting

Tree death can occur when trees are planted too deeply. If the root collar of the newly planted tree is several inches below the landscape grade, the tree has been planted too deeply. Planting trees too deep can potentially result in a number of problems, the most common being the development of girdling roots. Deeply planted trees often decline slowly over a period of 5 to 10 years and may eventually die.

Girdling roots

Girdling roots grow in a circular pattern around the trunk resulting in root death and loss of anchorage in a tree. Not all girdling roots are problematic. Only those that occur at the root collar or above are considered most damaging. Certain trees are prone to problematic girdling roots, such as maple, poplar and linden.

Pot-bound plants often develop girdling roots if the roots are not pruned at planting time. Girdling roots can also develop from poor planting techniques, such as twirling the bare-root system into a small planting hole or planting too deep. Symptoms include leaning, early leaf drop, twig dieback, thin canopy and no stem taper at the ground level.

Root Disturbance

One of the most common yet least recognized causes of tree problems is root disturbance often associated with construction activity. Even shallow cultivation in the root zone of trees can damage roots growing near the surface. Compaction from heavy equipment or storing building materials under the drip line of a tree can cause root death. Rope off the areas under trees to prevent compaction.

Piling only a few inches of soil under the drip line of established tees to change the grade or build up a berm can suffocate the roots resulting in tree death. If the grade must be changed near an established tree construct a terrace as far out from the trunk as possible to maintain the original grade around the tree.

Drought

Individual plants vary widely in their resistance to drought. However, in years of low rainfall many species can be substantially weakened or killed by drought. Deciduous trees appear to die form the top down, have small pale leaves and narrow growth rings. Conifers generally die from the bottom up when subjected to drought. Secondary problems from insect and disease are likely to follow when a tree is drought stressed.

Leaf scorch

When weather conditions turn suddenly hot and dry, leaf scorch may occur. Affected plants generally have yellow or brown leaf edges. The affected leaves may remain on the plant or they may drop early. Watering during hot, dry weather may prevent or alleviate this problem.

Excessive watering

Many plants die or are severely stressed by excessive watering. Automatic sprinkler systems can be problematic if they are not adjusted for weather fluctuations. Pore spaces in soil should ideally be filled half with water and half with oxygen. Water logged soils have no room for oxygen and plant roots suffocate and die. Plants typically have yellow leaves and can appear limp or wilted. Plants growing on clay soils are much more susceptible to damage from over watering. Excessive watering prevents plants from properly hardening off for winter.

Fall freeze damage

Plants still growing actively in the fall may be damaged by unseasonable cold periods. This damage occurs before the plant has moved into dormancy, indicated by fall color change and normal leaf drop. Frozen leaves often hang on the tree until spring. Damage may range from a little twig damage to death the entire plant. Planting trees and shrubs adapted to the climate is very important. Also allowing trees to grow at a slower rate by not pushing them with fertilizer and excessive watering can minimize fall freeze damage.

Winter freeze damage

By mid-January, most northern trees have experienced enough cold weather to meet dormancy requirements. After this, plants can begin to grow again when conditions are favorable. Winter thaw periods may occur where daytime temperatures exceed 60 degrees for several days at a time. Trees may begin to grow as though it were spring, only to experience winter damage when temperatures drop again. In such cases, only the main trunk and scaffold branches may be viable in the spring. Planting species adapted to the local climate can lessen chances of winter freeze damage. Marginally hardy plants should be planted in protected locations on the leeward side of buildings or a shelterbelt.

Winter desiccation

Winter desiccation is a condition that is most common with evergreens. Winter sun and wind cause water loss from needles, while roots are in frozen soil and unable to replace this water. The usual symptom is browning or purpling of needles on the windward or southwest side of the plant. Such symptoms may be more severe on newly transplanted plants that have not yet established a good root system. Late fall and winter watering can minimize winter desiccation. Anti-desiccant sprays can be effective if applied in late fall and again in late winter. Burlap screens are used to break the wind and shade specimen plants.

Sunscald

Bark on the southwest side of tree trunks may be killed by sunscald, which occurs when bark warms in the afternoon sun on clear, cold days, then rapidly refreezes when temperatures drop at sunset. Damage from sunscald can result in fungal infections such as cankers and predispose the tree to frost cracks. Damage is most common on dark colored, smooth-barked trees such as mountain ash, apple and maple. Paper, cardboard or plastic tree wraps can help prevent sunscald on young trees by keeping the bark cool. White latex paint is also effective as it reflects the sunlight. Wrap the trunk up to the first branches in November and remove in April. A similar disorder known as sunburn can also occur on the trunks of young trees in solar intense situations such as in a rock-mulched bed on the south side of a building, or when mid-summer pruning causes sudden exposure of shade-adapted stems to direct sunlight.

Frost Cracks

Frost cracks are vertical separations in the trunk wood of trees, and are a major point of entry for disease and wood-rot organisms. Frost cracks contract during warm temperatures and are often closed-over by wound wood in summer, only to re-expand the following winter. Research has found the cause of most frost cracks to be underlying wounds or branch stubs, which predispose the wood to cracking from internal stresses during freezing temperatures. Thus the best prevention of frost cracks is to minimize wounding of the trunk (e.g. mowers, string-trimmers, sunscald, etc.) and the proper pruning of branches.

Mechanical damage

The weight of heavy snow or ice can break or crack tree branches and crush shrubs. If temperatures are above freezing snow can be gently shaken off branches. Shaking frozen branches may snap them off. Winter damaged trees should not be pruned hard. Prune off only torn or badly damaged limbs. Give the tree a year to recover and then prune sparingly as needed. Hard-pruned trees often don't make it, while those not pruned will.

Possibly the most common cause of mechanical damage to plants is from string-trimmers. Trimmer damage can be prevented using weed-free mulch rings, trunk guards and through proper training of operators.

Additional abiotic factors that cause damage to plants are listed in Table 7-1. Many are discussed in other chapters in this manual.

Table 7-1. Common abiotic factors causing plant problems.

Lawn mower injury	Construction damage
Frost/freezing injury	Hail damage
Drought or excessive soil moisture	Air pollution
Wind damage	High/low temperatures
Improper site	Root girding/constriction
Improper maintenance	Improper soil type
Improper pruning	Improper fertilization
Cultivating too close	Improper pesticide application
String trimmer injury	Improper soil pH
Soil compaction	

Biotic Plant Problems

Fungi and bacteria cause most infectious plant diseases. However, viruses, nematodes, and phytoplasma also cause diseases. Some disease organisms are very virulent and can attack and invade healthy plants. Other pathogens invade only stressed plants, and still others invade only dead plants. In order for a biotic plant disease to occur the host plant must be susceptible, the pathogen must be present and the conditions must be favorable for infection. Specific pathogens vary in their ability to infect different plant species. Proper diagnosis of causal agents can be very difficult.

To start a diagnosis, first gather history on the plant and the site. Information such as age of the plant, watering schedule, recent fertilizer or pesticide applications can all be helpful. Next, check the plant for symptoms of dieback, cankers, decreased growth for the past several years, sap oozing, insect activity, and fungal reproductive structures. These symptoms may be readily apparent or they can be so small that a hand lens is needed to see them. Compare the samples with other plants in the same area. Knives, pruners, saws, increment borers, soil probes, and razor blades are standard tools in diagnosing plant problems.

After examining the sample, consult several references. Check to see which diseases, insects and abiotic problems are common on the affected species and review their symptoms. Be cautious and review all possibilities.

Positive identification of many diseases requires culturing of microorganisms or other diagnostic tests. Fresh samples can be submitted to a state or university lab for this purpose. Before submitting samples to a lab, contact the lab to determine how and what to sample, as well as how to package the specimens. Rapid diagnostic kits for use on site have been developed for certain organisms and may be cost effective in some situations.

Review

A. What is an abiotic disorder? Give several examples. _____

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B. What is a biotic disease? Give several examples. _____

_____

C. Why are biotic diseases infectious, while abiotic disorders are not? _____

D. How can an abiotic stress lead to a disease problem? _____

E. Name the five types of pathogens responsible for plant diseases. 1. _____

2. _____ 3. _____ 4. _____ 5. _____

F. Which pathogens cause most plant diseases? _____

G. What is sunscald and how can it be prevented? _____

H. What effect does watering have on winter hardiness? _____

Disease Groups

When discussing infectious diseases it's easiest to group them according to their symptoms. This is also an excellent way to categorize disease symptoms in the field. A few diseases, however, such as rust and powdery mildew, just don't fall into well-defined categories.

Leaf Spots

Most leaf spots are caused by fungi or occasionally by bacteria and viruses. Leaf spots are localized infections, occurring mainly on leafy tissue. Free moisture is necessary for most fungi to develop. The best control is to avoid conditions that encourage extended periods of leaf wetness, such as watering at night.

Infected areas may have irregular blotches of dead tissue or somewhat circular spots. Spots caused by fungi tend to be circular, while those caused by bacteria are often angular. Circular fungal spots may vary in size but often have a light colored center with a darker margin. There are exceptions. A few fungi produce completely black fibrous or tar like spots. Fungi commonly produce tiny dark or brightly colored fruiting structures in the center of mature lesions during wet periods. A hand lens is needed to check for these fungi. Note carefully if leaf spots occur only between leaf veins or if veins are involved.

Occasional outbreaks of leaf spot diseases are usually not seriously damaging to healthy trees and shrubs, and chemical controls are usually not recommended. Recurring or severe outbreaks can, however, seriously weaken woody plants.

Rusts

Rusts are caused by fungi that may have several spore stages and complete their life cycles on more than one host. The most commonly observed spores (urediospores) appear in orange to rust-colored pustules that break through the surface of leaf and stem tissues. Spores are released when the pustules break open. A rusty color on the leaf tissue doesn't necessarily indicate a rust infection. Examples of rust diseases are ash rust, rose rust and potentilla rust.

If alternate hosts are involved, one host will produce the orange urediospores, the other host will produce aeciospores. Aeciospores are orange in color but are encased in a white structure that is most visible on the undersurface of infected leaves, on needles, or on the main stem of trees. Pine needle rust, white pine blister rust, and cedar-apple rust are common examples of fungi with alternate hosts.

Where alternate hosts are involved, removal of the alternate host in the vicinity of the desired plant will stop the disease cycle. Avoid wilting the foliage to limit the germination of rust spores. Fungicides are available for several crops and are generally applied to prevent, not cure, rust diseases.

Cankers

Cankers are localized dead areas on woody plant tissues. Fungi and a few bacteria cause most cankers. Non-infectious agents can also cause cankers. Hail, sunscald, heat, and lawn mower damage can all cause abiotic cankers.

Cankers appear as either lighter or darker than normal, sunken areas on trunks, or branches. Their margins may have callous formation and a breaking or tearing of the bark as it dries out. Bark on the face of the canker may produce reproductive structures characteristic of the causal organism. Eventually, the bark cracks and is sloughed off.

There are different types of cankers: some of the fungi involved attack healthy trees; others attack only those under considerable stress. Prevention is the key to control. Keep plants healthy, avoid mechanical damage, and promptly remove all cankered areas to prevent spread into the main trunk of the tree. Disinfect pruning shears between each cut and prune at least 6-8 inches below any sign of infection. Conduct annual dormant pruning only in late winter/early spring and avoid leaving branch stubs or making flush cuts when pruning (See Chapter 17 on Pruning).

Root Rots

Root rots are difficult to diagnose without digging up at least a portion of the root system. The deterioration of the root system due to disease organisms will show up with symptoms similar to abiotic causes of root damage, such as top dieback, increased seed production, small leaves, and chlorotic or dying foliage. The infected roots may appear to have a wet, slimy rot, or a dry rot. Laboratory examination and culture work are often necessary to identify a specific pathogen. Fungicides are registered for use on nursery crops for several root pathogens. In the landscape, the normal course is to increase the vigor of the plant so that it may wall off the infection. Otherwise removal and replacement with a resistant species is recommended.

Wood Decay

Wood decay can be caused by many different fungi and often goes unnoticed until strong winds break down a limb or homeowners become concerned about carpenter ants "invading" their tree (carpenter ants will nest in decaying wood, never healthy wood). Wood decay fungi enter through wounds (even those covered with wound dressings) and begin to decay portions of the wood. Healthy trees will respond by walling off (compartmentalizing) the decay and containing it within a small pocket in the tree. Decay can spread outside these pockets or barriers in weakened stressed trees, or in trees that are repeatedly wounded. Extensive decay will result in a weakened tree subject to wind damage. Evidence of wood decay in an otherwise healthy appearing tree takes the form of fleshy or hard fungal reproductive structures (conks), which are actually a form of mushroom.

Prevent or minimize decay problems by maintaining healthy plants and avoiding mechanical damage. Proper pruning will also minimize decay. No chemical controls are recommended. Filling cavities with concrete or other material will cause more problems and is not recommended.

Wilt Diseases

Fungi that enter the vascular (water conducting) system of a plant cause the common wilt diseases of trees and shrubs. Once in the vascular system, they begin to multiply and may physically block water flow in the plant. The host plant may form gums and saps in an attempt to stop the infection and these can further restrict water flow. In some cases, the fungi form toxins. These reactions within the plant result in a discoloration of the vascular tissues that can often be seen by peeling back the bark and examining the vascular (xylem) tissues. The presence of streaking will usually rule out abiotic problems such as lack of water or high temperatures.

Wilt pathogens can enter plants through roots and openings in stems and branches. It is important to know the basic life cycle of the disease that is suspected since the streaking will first occur at the point where the fungi enters the plant. If insects carry the disease, find out where the insect feeds. In the case of Dutch elm disease the insects feed in the upper canopy of the tree. Therefore, the initial wilting and vascular streaking will be in the top of the tree.

If the suspected disease organism is commonly found in the soil, the disease will enter through the root system. Initial foliar symptoms will be similar to those that occur when the fungi enters the tree above ground - wilting followed

by yellowing of branches in the upper canopy. However, since the disease enters through the root, the vascular streaking will occur first in the roots and spread towards the trunk of the tree. Verticillium wilt is an example of a wilt disease that enters through the root system and persists in the soil.

Some wilts quickly kill their hosts; others persist in the host for years causing branch dieback. Chemicals are sometimes used to protect the tree for a given period of time. An example is the injection of chemicals to protect elm trees from Dutch elm disease. However, for most vascular infections, the tree or shrub must be replaced. When the wilt organism is present and persistent in the soil, a tree species resistant to the disease must be planted.

Yellows

Organisms called phytoplasma cause diseases known as 'yellows'. Phytoplasmas, which can infect a wide range of plant species, are spread by insects, usually leaf hoppers, and enter the phloem (conducting cells) during insect feeding. The presence of phytoplasma are usually detected using molecular laboratory techniques.

Aster yellows can be found on many hosts including flowers, vegetables and weeds. Yellows diseases are systemic and usually result in the death of the plant. There are no chemical cures. Use plant varieties that are resistant to yellows when they are available.

Virus Diseases

Viruses cause symptoms that change plant growth or coloration, which may or may not be readily noticeable. Common symptoms include stunting, mottling, mosaic patterns, reduced flowering, change in leaf size or shape, and chlorosis. In roses, winter hardiness may be reduced. In some cases viruses may result in the death of the plant.

Infection by viruses is systemic. Viruses are spread by grafting, handling, insects and fungi, and occasionally by seed. Plant virus diseases can't be cured and infected plants must be destroyed.

Miscellaneous Diseases

Other diseases can occur on a variety of plants, but don't fit into the above groups. They include blights, scabs, powdery mildew, storage rots, smuts, and galls. Powdery mildew is probably the most common. Several mildew fungi grow over the surface of the plant tissues. The fungal growth appears white to gray in color and may have tiny black dot-like reproductive structures in it. Powdery mildew fungi seldom cause serious damage but they do stress the plant and may limit photosynthesis. Plants susceptible to powdery mildew should be placed and pruned properly to allow maximum air circulation and sunlight penetration. Fungicides are available for some plants but their effectiveness is temporary. Repeated spraying with a baking soda mixture can be effective, as well as pruning off infected leaves. Clean up leaves in the fall to reduce infection the following year.

Table 7-2 lists several cultural practices useful in preventing and controlling plant diseases. These suggestions can be followed in most disease situations. They should also be followed to prevent the initial occurrence of plant disease.

Table 7-2. Cultural practices for controlling plant diseases.

Site Selection

Avoid planting in dense, shady locations.

Plant in well-drained soils.

Ensure good air circulation around plants and avoid excessively humid conditions.

Avoid planting new plants in infected soil.

Plant Selection

Use only plant materials that are well adapted to your climate and location.

Choose disease- and pest-resistant plants.

Use only disease-free plants, seeds, bulbs, tubers, and corms.

Planting

When diseases have been a problem, plant new clean plants in a different area.

Rotate annual plants to different locations each year.

Avoid crowding plants.

Use sterilized potting soil.

Avoid injury to tubers, corms, and bulbs when digging and handling.

Routine Care

Mulch to minimize soil moisture loss.

Water early in the day to ensure that foliage dries quickly.

Avoid wetting foliage when watering.

Remove old leaves in the fall and destroy them.

Control weeds, which can serve as alternate hosts to plant pathogens.

Control insects that can carry plant diseases.

Treating Diseases

Chemical control is not necessary or practical for some disease problems.

Some diseases have no chemicals currently labeled for their control.

Only use pesticides that are registered for a particular crop and situation.

Always follow label directions.

Whenever practical, remove and destroy infected plants.

If only part of a plant is affected, prune off and destroy infected parts.

Don't put diseased plant materials in the compost pile.

When diseases (particularly rusts) are a problem, remove alternate hosts, where practical.

Don't always use the same fungicide; alternate with another appropriate fungicide.

Summary

Plant disorders and diseases, whether abiotic or biotic, can be destructive. Be familiar with the way healthy plants look in the nursery and landscape. Proper placement and maintenance are of the utmost importance. Anticipate common problems and implement preventive solutions. An IPM approach is the best way to deal with most situations.

The use of fungicides can be a valuable tool. They are best used for temporary control and should only be used when other methods are not available. Pesticides are not a substitute for good management. To quote an old adage, "an ounce of prevention is worth a pound of cure."

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Chapter Review

A. What does plant health have to do with pest and disease resistance? _____

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B. Name and briefly describe at least four disease groups, based upon symptoms.

1. _____

2. _____

3. _____

4. _____

C. Which pathogen is normally responsible for wilt diseases? What causes the wilting?

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D. What does most fungi need to develop? _____

E. Explain how alternate hosts are involved in rust diseases. _____

_____

F. Which is the best way to prevent leaf spot diseases? _____

G. Which pathogens are responsible for leaf spots? _____

H. What are cankers? Briefly describe what one looks like. _____

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I. What precaution can you take when pruning to prevent spreading disease-causing organisms? Describe how you would do this.

_____

J. Describe the symptoms of powdery mildew. What can you do to prevent this disease?

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