Pesticide Certification Information #19

TURFGRASS

PEST CONTROL

WEST VIRGINIA UNIVERSITY
EXTENSION SERVICE
AN EQUAL OPPORTUNITY/
AFFIRMATIVE ACTION INSTITUTION

TURFGRASS PEST CONTROL

INTRODUCTION

Pest control in turf grass includes:

1. Good cultural practices.
2. Chemical pest control.

Turfgrass problems often result from causes other than pests. These other causes include:

1. Improper watering.
2. Improper fertilization practices.
3. Injury from pesticides.
4. Accumulation of excessive thatch.
5. Improper selection of turfgrass species.
6. Improper mowing height.
7. Poor root systems.
8. Soil that is either too acidic or too alkaline.
9. An accumulation of soluble salts in the soil.

Be sure to consider these factors when diagnosing and treating turfgrass problems.

TURF DISEASES

Most turf diseases are caused by parasitic forms of plant life called fungi. Fungi live in the soil and in the dead leaves, stems and decaying roots that form “thatch”. They lack the ability to manufacture their own food, but become active and attack living tissue when environmental conditions become absolutely ideal. Fungi spread from place to place by microscopic reproductive structures called spores. These spores are easily transported by wind, water, shoes, clothing, maintenance equipment, etc.

Although there are a great number of diseases, only a few are capable of extensive damage. Fortunately, these are fairly easy to recognize.

The prevalence of a particular disease is dependent upon a number of factors. Each factor must be in exact balance before fungus can become extremely active. Primary components for active disease are nutrient levels, atmospheric and soil temperatures, atmospheric moisture and soil moisture stress. Variations in any one of these components will determine the severity or absence of any active infection.

Recent years have also brought about the advent of turfgrasses with varying degrees of disease tolerance. Most of these improved varieties may exhibit complete immunity toward one disease, but be highly susceptible to another. For instance, one variety may never be harmed by leaf spot, but is highly susceptible to brown patch. In the search for tolerant grasses, the ideal variety would exhibit immunity toward all infections, regardless of environmental conditions.

During hot, humid weather, brown patch may become extremely destructive. The cool, moist weather that follows melting snow often brings an attack of snow mold. Dollar spot may occur during hot, dry weather. Specific weather situations have a tendency to encourage specific diseases. Even though anticipated, these situations often vary greatly from year to year. Once a disease becomes established, other fungi join in the destruction. At this stage, visual identification becomes impossible and laboratory analysis cannot reveal the original disease-causing organism.

It is not only helpful to recognize a disease at its initial start, but more important to anticipate the conditions that encourage disease. Grasses are susceptible to certain diseases all year round. Their prevention with proper fungicide is much more desirable than applications after the damage has started.

It is well to remember that fungicides do not heal the damaged grass plants. They arrest the disease by:

(a) Preventing further damage to the affected plant.
(b) Preventing the disease from spreading into other turf areas.

Brown Patch (Rhizoctonia solani)

During extended periods of high temperatures and humidity, severe brown patch damage can occur overnight. On large areas such as golf courses many sections of greens and fairways may be attacked simultaneously. The fungus spreads from a central point in a circular pattern and can cover a few inches or several feet. Within this pattern, leaves turn purplish-green, collapse and then turn brown. A characteristic of brown patch is the "smoke-ring" or grayish-black mycelium that often appears around the perimeter of the diseased area. This "smoke-ring" is most evident in early morning, but disappears as the sun dries the grass.

Within the infected area, dead leaves remain upright and occasional plants of green grass are left undamaged. After several days, the patches of diseased turf appear appressed or pocket-like.

Brown patch can strike suddenly and is one of the most destructive of all turf diseases. Many times other fungi join with brown patch to make the damage even more severe. In general, the disease is most severe on closely cut grass.

Dollar Spot (Sclerotinia homeocarpa)

Dollar spot appears in late spring or early summer when the weather is warm and moist. When left unchecked, it continues through summer and early fall. This disease is most damaging when there is a deficiency in nitrogen and in areas of stress where turf suffers from inadequate moisture. Thus, even prolonged dry periods can lead to severe outbreaks. First stages of dollar spot appear as bleached or yellow-green blotches about the size of a silver dollar. As the disease progresses, spots turn to a dull-colored tan. Grass blades around the edge of these spots often have straw-colored lesions shaped like an "hour glass". When the disease is active and moisture is present, a fine, "cobwebby" mycelium may cover the infected area during the early morning hours.

Dollar spot left unchecked will gradually grow into large patterns of "straw-colored" dead grass that mats together and forms depressions in the turf. All grasses in the North are subject to attack. Bentgrasses are especially susceptible and most seriously damaged.

Like other diseases, dollar spot is often followed by the intrusion of many other fungi. The infection then becomes an undefinable pattern.

Fairy Ring (Many Genera)

Fairy rings are arcs, or continuous circles, formed by bands of turfgrass that are darker green and faster growing than grasses on either side. These bands can be 4 to 12 inches wide, with the diameter of the circle varying from 3 to 50 feet or more. A characteristic of fairy ring is the presence of toadstools, or mushrooms in the infected area, especially during periods of abundant moisture.

Fairy ring is caused by fungi which grow in decaying matter below the surface of the soil. The dense mass of white mycelium formed by the fungi traps the movement of air and gases and prevents the penetration of water. Nitrogen becomes available to the infected area in excessive amounts. This causes a rapid, dark green growth in the fairy ring. Eventually, the combination of excessive nitrogen and toxins produced by the fungus cause the infected area to die.

There are many types of fairy rings. Some appear and disappear rapidly, while others return to the same spot and keep growing each year. To suppress fairy ring activity, use a spade or similar hand tool to perforate the soil to a depth of 6 or 8 inches at the outside edge of the fairy ring. Pour ProTurf Broad Spectrum fungicide into the opening. A heavy watering of the infected area will help leach the excessive nitrogen and toxin and give more rapid control. Repeated applications are generally necessary.

Fusarium Blight (Fusarium roseum)

Fusarium roseum was first observed in turf just a few years ago. Although it recurs in the same areas each year, the extent of damage is extremely variable. Fusarium is characterized by a "frog-eye" pattern or a ring of diseased grass with seemingly healthy grass in the center.

With warm, humid, spring weather, fusarium spores germinate and send out threads which form a "cobwebby" mycelium at the crown of the plant. In this early stage, orange lesions appear on the blade and grass will have a soapy feeling. When temperatures rise to the 70's, infected plants begin to rot and die. Brown patches, or rings, with some green growth within, appear in the turf. If conditions for growth are proper, the diseased areas gradually grow across each other and large portions of turf become completely destroyed.

Fusarium can continue its active growth until cool weather and then go dormant. It survives the winter in soil, or in dead plant tissue, and reappears in the exact spot the following year. Conditions encouraging "frog eye" include: excessive thatch, excessive summer fertilization and improper watering. If these conditions are corrected or avoided, disease damage may be decreased.

No chemical prevention or control exists, but a sound maintenance program is helpful. Thus far, turf in areas of the deep South have been unaffected.

Leaf Spot (Helminthosporium spp)

Leaf spot is one of the most destructive turf diseases, especially in bluegrass. This disease is active during spring, early summer and fall when moist conditions exist. Symptoms first appear as a rust-colored cast throughout the turf. The observer often confuses this condition as drouth. Close inspection of the grass will reveal small, conspicuous "leaf spots", or lesions, outlined in purple-black on the leaf's surface, stem or crown. Lesions enlarge and merge on the infected plant as activity increases. If the disease is not controlled, the lesion girdles the leaf causing it to turn yellow and then completely brown. Advanced stages of the disease continue into the crown and eventually into the root system of the host plant causing it to wilt and die--a condition known as "crown rot" or "fade out."

Leaf spot may appear in several other forms. Occasionally, grass blades turn yellow and the turf is infected with large chlorotic patches. This condition is often mistaken for a lack of nitrogen or an iron deficiency. Inner parts of the crown and roots turn brown and the infected area eventually dies.

During hot weather the disease may affect the turf without any visible symptoms. Large irregular patterns suddenly die and the typical leaf spot lesion is completely absent. Kentucky bluegrass seems to be especially vulnerable to this disease, although many other grasses may be similarly affected.

Ophiobulus Patch (Ophiobulus graminis)

Ophiobulus is a disease of cool, wet weather. It is most destructive in early spring or late fall to bentgrasses of the Pacific Northwest. The infection starts by forming a circular, depressed pattern a few inches in diameter.

This straw-colored patch spreads outward until it reaches several feet in diameter, while the center fills in with resistant varieties of grasses and weeds. Thus, the diseased area assumes the form of a large, irregular automobile tire.

As infestation continues, patches run together and form large, eccentric patterns. Damage can become so severe that plants and roots are completely destroyed and re-seeding becomes necessary.

Ophiobulus is most damaging on newly seeded areas and especially where soil sterilants have been used. After 2 or 3 years susceptibility decreases.

It is spread from one area to another by equipment, such as tractors and mowers. Although fungicides should be used for prevention, fertility may play an even more important role. Ophiobulus patch has shown a definite response to sulphur. Adequate supplies of this nutrient, in a complete fertilizer, may greatly reduce incidence and severity.

Powdery Mildew (Erysiphe graminis)

Powdery mildew is most often found in shaded, moist areas, that suffer from poor air circulation. Grasses under stress are particularly susceptible to this disease.

Powdery mildew first appears as a powdery, white growth confined to the upper surface of the grass blade. The fungus grows rapidly and soon covers the leaves of an entire plant. At this stage, the leaves assume a powdery, dusty, white appearance. If corrective measures are not taken, powdery mildew continues its suffocating activity to a point where the blades turn yellow and plants die. Severe thinning of turf continues in infected areas.

In general, powdery mildew is not considered to be a serious turf disease and is often observed as more of a nuisance. The presence of powdery mildew, however, encourages a weakness in turf that brings about other problems. The severity of this disease varies greatly from year to year. Bluegrasses seem to be most susceptible.

There is no absolute cure for powdery mildew. Preventive applications of fungicides help to inhibit initial infection. But, the best corrective program can be achieved by improving air circulation and increasing sunlight in the infected area. This can be accomplished by pruning of nearby trees and shrubs.

Pythium (Pythium spp)

Pythium attacks all turfgrasses with extreme severity. It can be one of the most swiftly destructive of all turfgrass diseases and it is not uncommon to see an established stand destroyed within 24 hours. Such areas must often be completely reseeded.

Although pythium is considered a disease of warmer climates, under proper conditions, it can occur anywhere. During prolonged periods of warm, wet weather, pythium becomes most damaging. It is most active when temperatures are between 85 and 95 degrees. Pythium is first observed as small spots up to 4 inches in diameter. A white, cottony growth of mycelium covers these diseased areas. Blades of grass turn dark and appear to be water-soaked, or greasy. As the disease progresses, patches generally run together and form elongated streaks. These streaks follow the channels of natural water runoff, or other areas of drainage. With heavy moisture, pythium can follow downhill slopes and cover long distances in a very short time. This makes it especially difficult to hold in check.

Golf greens are especially susceptible to attacks by pythium. Young plants in new seedings are also extremely vulnerable. A proper fungicide prevention program, coupled with good maintenance practices, help prevent pythium. It might be well to note that the disease is easily carried from place to place by any kind of clothes or equipment.

Red Thread (Corticium fuciforme)

Red thread attacks all commonly cultivated turfgrasses throughout the United States. The disease is most prevalent in cooler regions and seems to be most destructive on the fescues of the Pacific Northwest. It occurs when temperatures are between 65 and 75 degrees and especially when the air is saturated with moisture.

Red thread first appears as irregularly shaped patterns of off-colored turf. These patches may vary from several inches up to several feet in diameter. Patches are not clearly defined because many plants within the diseased area remain unaffected.

When the disease is active, a pink or red colored mycellium may be seen emerging from leaf sheaths and extending from leaf to leaf. These strands of pink-red fungus actually bind the injured blades together. As the disease progresses, leaves appear water-soaked, twisted and brown. Eventually the infected tissue dries out and fades to tan-colored patches of dead turf.

The severity of red thread is directly related to soil fertility. Nitrogen is especially important in off-setting the incidence of red thread. A fungicidal preventive program will help prevent red thread, but good maintenance practices are also extremely important.

Rust (Puccinia spp)

Bluegrasses, ryegrasses and certain Bermuda grasses are especially susceptible to rust. In the early stages of development, lesions are viewed as yellow-orange flecks on the surface of the blades. As the infection increases, the number of lesions increase. Eventually, the surface of the leaf breaks open and disease spores form tiny orange colored sacks, or pustules. If the infestation is severe the leaves turn yellow, progressing from the tip to the sheath.

In the overall view, turf takes on a rusty appearance. When walking through turf with rust, orange-red dust comes off on shoes and clothing. This dust is composed of the many spores that produce the disease. Spores are also carried from place to place by wind. If they land on grass blades with sufficient moisture, a new infection is started.

Rust is most common during July and August depending upon the section of the country. The best control for rust is a good preventive fungicide program, coupled with proper fertilization. In many instances, it is possible to quickly eradicate rust by using a program of fertilization, mowing and watering. This is a practice of merely growing the turf out of the disease. Turf that enters winter with rust is very susceptible to winter-kill.

Slime Mold (Pysarium cinereum - Mucilago spongiosa)

Slime mold is considered to be quite harmless, but is capable of becoming quite a problem. It generally occurs in the warm, moist weather of early spring, but may appear after heavy rain or watering during summer and early fall.

The disease is first noted as white, yellow or gray slimy masses that grow over the grass in irregular patches. As these masses dry, they form blue-gray, gray, black or white powdery structures. These structures are easily crushed between the fingers or may be swept from the blades with a broom.

Unlike many other diseases, slime mold is not parasitic. The organism feeds on thatch or decaying material in the soil. When atmospheric conditions become extremely humid, the disease moves to anything that is capable of support. Thus, surrounding grass blades are soon covered with the spore masses. Well watered turf is often troubled with slime mold.

Slime mold does little damage to grass plants, but it does tend to shade, suffocate and discolor the blades. If the suffocating effect is severe enough, a natural thinning of the grass will take place. Slime should be swept from the grass whenever observed. This not only inhibits damage but stops the disease from spreading.

Snow Mold (Fusarium nivale, pink - Typhula itoana, gray)

This disease may occur any time from late fall until early spring when temperatures range from 28 to 45 degrees. An excessive amount of moisture or melting snow must be present.

Snow mold has a tendency to start in depressed areas, or in areas where grass entered the winter with excessive growth. Damage is most severe when snow covers turf for a long period of time.

Gray snow mold and pink snow mold are the two types which cause the most damage. Gray snow mold is particularly troublesome. It is characterized by tan to grayish-white rings, or “halos”, which range in size from a few inches to several feet in diameter. These rings may grow across each other to form large, irregular disease patterns. Grass within these patterns becomes matted, closely appressed to the ground and often completely destroyed.

Pink snow mold causes similar damage. The diseased patches are generally much smaller than gray snow mold, but can cover a very large area. Pink snow mold is characterized by its bright pink mycelium.

Repairing damaged areas requires loosening of matted grass blades to improve air circulation. With proper feeding and maintenance the turf may recover; otherwise re-seeding is necessary.

DISEASE CONTROL

Disease-producing agents in turfgrasses can be minimized and in some cases controlled through the use of good management practices. Turfgrass fungicides are available for use as preventive sprays or granules. When an outbreak of a disease agent occurs, preventive fungicides should be applied immediately. After infection has occurred, the use of a preventive fungicide is directed at protecting against future infection. Timing of protective fungicide applications should be based on a knowledge of:

1. Life cycle of the fungus.
2. Weather conditions that are best for its parasitic activities.

In certain instances, preventive use of a fungicide is warranted when the location has a history of turfgrass disease. The routine use of fungicides can prevent disease outbreaks in turfgrass, but is an expensive and potentially harmful practice.

TURF WEEDS

Any plant can be considered a weed if it is growing where it is not wanted. Bentgrass, for example, would be a weed in a bluegrass lawn. To plan a good weed control program, you must:

1. Identify the desirable turfgrass.
2. Identify the existing weeds.
3. Know what other weeds are likely to become a problem.

Annual Weeds

Annual weeds complete their life cycle in less than one year. Because climatical conditions influence the timing of the life cycle, the correct time for control varies from place to place, year to year and from one species to another.

There are certain annual weeds that often appear in newly seeded turf, but will not persist in succeeding years. Weeds in this category are:

Broadleaf Weeds	Grass Weeds
Lambsquarter	Foxtail
Redroot Pigweed	Barnyardgrass
Ragweed	
Mustard	

Seeds from the above weeds are present in most Maine soils and are likely to germinate and grow when the soil is prepared for a new turf seeding. These weeds cannot stand continuous mowing at turf height and gradually disappear. When these weeds are so numerous that they prevent the young grass from getting established, herbicide treatment may be necessary.

Other Annual Weeds

There is another group of annual weeds that may show up in turf year after year. These are common chickweed, knotweed, annual bluegrass and crabgrass. Two out of these weeds are actually management problems. Knotweed is normally present only when the soil is too compact for good turf growth. Crabgrass is not a competitive weed in Maine and shows up only when turf growth is sparse.

Chickweed and annual bluegrass, on the other hand, are very aggressive weeds that will invade turf at any cutting height. Herbicide treatment is usually necessary once either of these weeds get established.

Biennial Weeds

Biennial weeds normally occur at the same time as perennial broadleaf weeds. Controls are similar. Examples are: roundleaf mallow and wild carrot.

Perennial Weeds

Perennials, both broadleaf and grasses, occur widely as turfgrass weeds. Examples are:

Broadleaf Weeds	Grass Weeds
dandelion	bentgrass
hawkweed	tall fescue
wild garlic	quackgrass
plantain	
mouse-ear chickweed	
red sorrel	

(Nutsedge is not a grass, but often considered as one in turfgrass weed control.)

CONTROL

The presence of weeds in turfgrass does not always require the use of herbicides. In areas that contain sensitive plants, it may be better to avoid the use of herbicides than to risk injury. In some locations, any kind of plant cover may be better than dead plants or bare ground. Granular formulations are effective for preemergence herbicides.

Sprays are better for postemergence control where foliar coverage is needed.

Broadleaf Weeds

Several postemergence herbicides are used to selectively control annual, biennial, and perennial broadleaf weeds in turfgrasses. They can be used along or as combinations of more than one active ingredient. Spring and fall applications of post emergence herbicides normally give satisfactory control and reduce the possibility of damage to non-target plants. Young weeds are usually more susceptible to herbicides. Spot treatments are best for scattered weed populations. Weather conditions affect control results.

Grass Weeds--Control of annual grasses is best achieved with:

1. Preemergence herbicides for general infestations.
2. Spot treatment with postemergence herbicides for localized infestations.

Few herbicides are safe for use on newly seeded turf-grass. Some pre-emergence herbicides applied in the spring adversely affect germination of turfgrasses seeded in the fall. Certain varieties of turfgrasses are more prone to injury by some herbicides. Check labels for precautions.

Perennial grass weeds are the most difficult to control. No chemicals will control these weeds without damaging cool season turfgrass. Some chemicals will selectively control them in warm season turfgrass. Soil fumigants and nonselective herbicides are sometimes used.

INSECTS

When examining turfgrass for insects, look for:

1. Thinned grass stands.
2. Dying or dead patches.
3. Discolored or withered blades.
4. Chewed or frayed blades.
5. Frass or webbing.
6. Small holes, mounds, or burrows, or
7. Presence of large numbers of birds and animal droppings.

Some of the more troublesome turfgrass insect pests are described here.

Chinchbugs (Blissus spp)

Chinchbug damage usually begins with temperatures in the high 70's or above. Symptoms first appear as patches of dead grass in areas where heat is radiated from sidewalks or driveways. This condition is often confused with drouth. The chinchbug inserts a slender beak into the grass plant, injects a toxin and extracts plant juices. If activity is not stopped at once, chinchbugs continue to spread into new turf until large areas are destroyed. Because of the toxin, grass does not recover from severe chinchbug damage.

Each female deposits 15 to 20 eggs per day for 20 to 30 days. Eggs are laid on blades, in soil debris, or other protected places. These eggs hatch in 7 to 10 days. Active, reddish, nymphs, with a band of white on their back, feed on grass plants immediately. They become darker as they grow older, and in the adult stage have black bodies with white, folded wings. Chinchbugs measure about 1/6 of an inch in length when mature. Two or more generations may occur during the growing season.

To test for chinchbugs, remove both ends from a metal can and press it into the ground, next to the damaged area. Fill the can with water. If chinchbugs are present they will float to the surface.

Hyperodes Weevil (Hyperodes spp.)

Identification--The hyperodes weevil is a relatively new insect pest that has been found mainly in the northeastern United States. Both the adult and larva stage of the weevil are responsible for turf damage. Mature adults are about 3/16 of an inch in length and are mottled brownish-black to shiny black. Some species have narrow, grayish, longitudinal bands on their wing covers while other species have three short, narrow bands of gray scales on their thorax. All adult weevils have an elongated snout with chewing mouth parts at the tip. Adult hyperodes weevils closely resemble adult bluegrass billbugs. The larvae range in length from microscopic to about 3/16 of an inch. They are cream-colored, legless grubs, with black heads. The pupa are also cream-colored and the pupa can be found in soil depths of 1/4 to 3/4 inch.

LIFE CYCLE

The adult hyperodes weevil lays two microscopic eggs on the leaf blades of Poa annua grass plants. When the eggs hatch, only one of the larvae survives. It then burrows down through the stem and feeds at the node just above the root collar. Many times the larvae also do severe damage by feeding in the crown of the plant. They will then emerge from one plant and move to another.

After several stages of development, the larvae mature and burrow into the sod to form pupal cells. The pupae emerge as adults in several weeks. They first appear in late March but are seen in the greatest numbers during the fall.

DAMAGE SYMPTOMS

The hyperodes weevil has been responsible for some serious damage on golf courses on Long Island and Westchester County in New York. Furthermore, the weevil prefers Poa annua to other turfgrasses. The damage is caused by complete or partial severing of grass stems, often in areas about the size of a dime. This results in small bare spots usually surrounded by a few yellow blades. This usually occurs in the spring or early summer, before Poa annua would normally fade out due to high temperatures.

Sod Webworms (Crambus spp)

Sod webworms are the larvae stage of the lawn moth's life cycle. These worm-like insects are light brown and 1/2 to 3/4 inches in length. Their segmented body has stiff hairs protruding from dark brown, circular blotches. Adult moths are a dull-grayish-brown.

The female moth flies over the turf in a jerky, zig-zag pattern dropping eggs into the grass. Eggs hatch in about 6 to 10 days and larvae begin to damage turf by chewing the blades. Blades are often cut in half and sometimes the entire plant is severed at the crown. The foliage may be almost completely stripped off in patches, and these areas have a yellowish-brown appearance similar to drouth damage.

Sod webworms spin silk-like tunnels in thatch or debris and remain hidden during the day. Since their life cycle is no more than six weeks, most species have several generations during the growing season. All grasses are vulnerable to attack by sod webworms, but bent and bluegrass are susceptible to the greatest injury.

White Grubs (Many spp)

White grubs are one phase in the life cycle of various beetles: May, June, Japanese or European chafer. These insects are about 1 to 1 1/2 inches in length, with a brown head, six prominent legs, and the hind section of their segmented body is smooth and shiny. The grub does damage by chewing and feeding on grass roots. This allows the turf to be rolled back like a carpet, and damaging grubs are easily exposed. The greatest concentration of grubs is generally near green areas bordering destroyed turf.

Burrowing deep into the soil, grubs hibernate during the winter. As the soil warms in the spring, they move out of hibernation and resume their root-destroying activities. White Grubs destroy turf from late spring through early fall. During mid-summer grubs pupate and emerge from the soil as adult beetles. Beetles remain above ground for only a few short weeks and then burrow into the soil to lay eggs for a new life cycle.

White grubs are a favorite diet for raccoons, skunks and moles. They feed on these insects by tearing up the turf and burrowing through the soil.

INSECT CONTROL

Insects that attack turfgrass at or below the soil surface can be controlled only by directing the pesticide at the soil surface and watering it in to contact the pests. Foliage-feeding insects can be controlled by directing the insecticide at the turfgrass foliage. Watering in an application directed at foliage feeders will move the insecticide below the area where the insect pest is feeding and the desired control will be lost. In some areas, preventative applications of insecticides will minimize damage from soil insect pests. More than one pest may be causing damage at the same time. Each may require different timing and placement of insecticide for control. Be sure to consider this when you develop a treatment schedule.

VERTEBRATE PESTS

Vertebrate animals may damage large areas of turf while they are searching for grubs or other soil-infesting insects. They include: mice, voles, moles, skunks, raccoons, foxes, squirrels and birds.

Control of turf-damaging insects also helps control damage by vertebrate animals, because it reduces their food supply.

PHYTOTOXICITY

When a chemical burns a plant to which it is applied, it is said to be phytotoxic (plant toxic). If the plant is a weed and the chemical a herbicide, the result is good, but usually the word phytotoxic is used when a pesticide adversely affects plants.

Some symptoms of phytotoxicity include:

1. Leaf drop
2. Stunting
3. Overgrowth
4. Discolored foliage
5. Leaf curl
6. Stem distortion

The cause of phytotoxicity may be easy to determine or it may be subtle and hidden. Pesticides can cause phytotoxicity. Other causes that create similar symptoms are:

1. Insects and disease agents.
2. Insufficient moisture.
3. Improper fertilization.
4. Other adverse growing conditions.

Factors that contribute to pesticide phytotoxicity include:

1. High air temperature during and immediately after pesticide application.
2. Excessive rates of pesticide application.
3. Too little water.
4. Uneven distribution of pesticide.
5. Mixing liquids or emulsifiable concentrates with wettable powders.
6. Mixing fertilizers with pesticides.
7. Variety and species differences.

Take special care to avoid injury to landscape plants and turfgrass when using herbicides.

Some herbicides leave residues in spray tanks that will injure desirable plants. Use separate sprayers for herbicides.

ENVIRONMENTAL CONCERNS

Drift and Vaporization

Steps that may be taken to reduce drift and vaporization are:

1. Apply pesticides when wind speeds are low.
2. Use lowest practical operating pressure and largest practical nozzle opening.
3. Keep nozzle as close to target as possible.
4. Avoid using airblast sprayers and dusters when working near sensitive plants and areas inhabited by animals.
5. Do not apply herbicides with airblast sprayers.

When possible, select products with low volatility. To control the adverse effects of pesticide movement:

1. Use special precautions when using pesticides on slopes.
2. Select the least hazardous pesticide that will do the job.
3. Use minimum doses, mulches, and, if possible, maintain a buffer.
4. Consider the chances of heavy rainfall.
5. Regulate the amount and duration of irrigation.
6. Be aware of the potential for ground water contamination.
7. Avoid carrying treated material or the pesticide residue from the target area to adjacent areas.

Applicators must be familiar with the persistence of pesticides they apply to ornamentals and turfgrass, especially where:

1. Adjacent areas may be affected.
2. Treated soil is used to grow other plants, or
3. Humans, pets, or other animals are present.

Repeated applications of some pesticides to the same area may cause harmful residues.

Application

Methods of application vary with:

1. The kind of pesticide.
2. The host.
3. The target pest.

Application equipment must be able to deliver a thorough coverage of the correct amount of pesticide to the plant parts which need protection.

Low pressure, low volume sprayers or granular applicators can be used for control of:

1. Soil pests of ornamentals.
2. Diseases or insects on turfgrass.
3. Weeds.

High pressure hydraulic or air blast sprayers are not often used on ornamentals or turfgrass. You can use them for spraying large trees.

Protecting Animals and People

Keep animals and people away during application, and until spray has dried or dust has settled. Keep them away from areas of potential drift and runoff. Remove toys, pet food dishes, birdfeeders, and other articles from the site before applying a pesticide. Do not use pesticides when people or pets cannot be excluded during the re-entry period specified on the label.