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lawn grass diseases in Connecticut.

## DISEASES AND OTHER DISORDERS OF TURF

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## Diseases and Other Disorders of Turf

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From among all of the plants, most of us choose the grasses to carpet the earth around our homes. These lawn areas and other turf maintained for beauty and recreation we like to have green and growing for seven or eight months of the year. The lawn grasses, like all plants, are beset by diseases and disorders but only a few of these diseases are serious in Connecticut and most of them can be controlled.

In this publication we shall report on the diseases of lawn grasses, a field of study long under investigation by scientists at this Station. We shall deal also with the control of those diseases because our researches are aimed at that. All of the lawn diseases are caused by fungi which live upon the grass. As in disease control generally, an ounce of prevention is worth a pound of cure. We emphasize, therefore, those management practices known to discourage turf-destroying fungi. Good management alone usually gives effective control of lawn grass diseases in Connecticut.

### GENERAL CONTROL MEASURES FOR TURF DISEASES

Mowing the lawn regularly with the height of cut at least 1½ inches maintains turf in vigorous condition. Regular fertilization also aids in maintaining healthy turf. However, when fertilizing a lawn one should remember that the fertilizer formulations and timing of applications may influence severity of certain disease outbreaks. Fertilizing improperly may also "burn" the grass and this may increase susceptibility of turf to disease. When fertilizers are applied early in the spring, the initial growth surge of grasses is over before conditions favor development of turf diseases. Fertilizing diseased grass encourages disease. However, a light application of fertilizer after the disease is no longer active is good practice. During dry spells in summer, a weekly watering of 1 inch of water is best for the lawn. One can estimate the amount of water applied by placing an empty container on the turf being watered. Daytime watering allows the turf to dry before night. Frequent sprinklings provide insufficient water for the turf, create moist conditions favorable for disease infection, and favor germination of crabgrass seeds.

### DISEASES OF TURF

#### Snow Mold

Snow mold is a name for a group of diseases of grasses. These diseases develop during the winter, under snow cover, when the temperature is above freezing. In the spring, spots of dead grass appear, varying from an inch to several feet in diameter. At this time, the fungi growing in the grass can be seen with the aid of a magnifying glass. These fungi give the spots a grayish-white or pinkish appearance. If attacks are severe, the leaf blades and crowns of plants may be killed.

All of the snow mold diseases are favored by very moist conditions and temperatures near the freezing point. Snow cover or mulch over the turf during the winter months may create these conditions. Heavy fertilization in the fall prevents the turf from "hardening off" before winter and thus favors development of these diseases. Bent grasses (*Agrostis* spp.) are highly susceptible, fescues (*Festuca* spp.) moderately so, and bluegrass (*Poa pratensis*) is little affected.

In Connecticut, snow mold may be checked by corrective maintenance practices. To permit early "hardening off" of turf when fall fertilization is necessary, the fertilizer is applied early and is chosen to contain little or no nitrogen. Tree leaves and other materials that form a mulch on turf are removed and then cannot produce conditions which favor disease development. Where snow mold has been a problem in the past, treatment of the turf with thiuram when the first snow fall is forecast gives a measure of control.

Several different fungi can cause snow mold "Pink snow mold" is caused by the fungus *Fusarium* (*Calonectria*) *nivale*. Its vegetative structures and spores give the grass a pinkish color in the sunlight, which darkens to a red-brown on drying. The spots are slimy when wet. This disease is most severe on bent, common on fescues, and less common on bluegrass.

Another fungus, *Typhula itoana*, causes a snow mold or "snow scald." Found mostly on bent grasses, the individual plants in the dead area contain numerous reddish-brown resting bodies or sclerotia that are embedded in the leaf and culm tissue. These remain dormant during the summer growing season and grow again during the winter months under the snow cover while the ground is unfrozen, when they infect new plants.

A fungus, yet to be identified, causes a severe snow mold (winter crown rot) by infecting the crown and stolons of the grass as well as the above-ground portions. This fungus forms white mats in dead areas of the turf. The disease is most severe under slowly melting snow cover where it infects bents, fescues, bluegrass, and rye grass. This disease has been reported in parts of Canada, but has not been found in Connecticut.

*Sclerotinia borealis*, another fungus not known to occur in Connecticut has been reported to cause snow mold on several pasture grasses in Canada.

### Bluegrass Leaf Spot and Foot Rot

In Connecticut, bluegrass leaf spot and foot rot are the most destructive diseases of Kentucky bluegrass. Actually these are two aspects of disease development caused by the fungus *Helminthosporium vagans*.

While dry conditions and higher temperatures discourage disease, leaves of vigorously growing plants may be infected during cool (65-70° F.) and moist weather. Thus one would expect the disease to occur in the spring and fall. However, the disease may persist throughout cool, humid summers, as in 1958. In the more severe foot rot, the crowns and underground portions of the plant are infected. A week or two after favorable weather, "fading out" symptoms appear. These are indefinite areas of dead, brown grass in

the lawn with few surviving plants scattered throughout. These areas may be a few inches to several feet in diameter. The disease is most prevalent in shady areas.

In the leaf spot stage, the typical symptom on the leaf is a purplish spot enlarging to an oval outline. As the infected leaf cells die, the center of the spot becomes light brown to straw color. Each usually measures less than one-eighth of an inch in diameter, and may arise from an infection by a single spore. These symptoms appear on the leaves during spring growth and afterwards when long cool, rainy periods prevail. Leaf spot is not serious in itself, but can lead to the foot rot infections.

Application of fertilizer high in nitrogen increases the severity of leaf spot. In fact, applying fertilizer to grass having leaf spot may lead to foot rot which may kill the affected plants. Close mowing encourages foot rot. When weather favors disease development, cutting the grass high (1½ inch) and keeping nitrogen levels low may result in the leaf spot stage. When such weather conditions do not persist infection will stop at this stage. However, if grass is cut short and has plenty of fertilizer, the disease may progress to the foot rot stage. If the lawn has previously had bluegrass leaf spot, postponing fertilization until the weather clears and the sod drains will reduce the severity of disease.

Our experiments indicate that thiuram is effective in Connecticut in reducing the severity of bluegrass leaf spot. Other eastern regions have obtained good control with the use of cadmium compounds and captan. Effective control is obtained by treating the turf at 2-week intervals, starting in May and continuing to the middle of June. Alternatively one can make the first application after a prolonged rainy period in the spring and a second one 2 weeks later. If a severe attack occurs in the spring, several applications may be desirable in late August and September when cool weather returns.

Merion bluegrass, a strain of Kentucky bluegrass, is resistant to this disease and also can withstand summer droughts and close cutting.

The fungus causing bluegrass leaf spot persists throughout the winter on infected refuse. The summer spores can also survive winter temperatures. Spores from infected leaves serve as the principal source of inoculum in the spring. Germinating spores can produce visible lesions within 4 days of inoculation. Successive generations of spores are formed every 1 to 2 weeks during the growing season with infection occurring during cool, wet weather.

### Zonate Eyespot

Bents, fescues, and bluegrass may be attacked by zonate eyespot disease. Yellow elongated spots on the leaves are surrounded by a brown margin, giving the eyespot symptoms. This disease usually develops during warm, wet weather especially in late summer and autumn. Although not normally severe enough in Connecticut to warrant specific control measures, treatments for brown patch or melting out should suffice for zonate eyespot. The fungus causing zonate eyespot, *Helminthosporium giganteum*, overwinters in infected dead leaves.

### Melting Out

Home lawns and golf greens in Connecticut have been known to suffer from melting out disease since the early 1930's. The disease appears during hot, humid weather on bent grasses, fescues, and sometimes on bluegrass. Zoysia, a recently introduced summer grass, is also killed by the disease. It is most severe on newly seeded lawns, but can injure heavily fertilized mature lawns with succulent growth. Water-soaked greasy patches scattered throughout the lawn are the initial symptoms of the disease. The grass in the patches appears to be matted down. Then the grass dies suddenly and the patches turn brown. These patches are of indefinite shape and vary from 2 to 5 inches in diameter. Under extreme conditions, they may blend together to form scattered patches of diseased and healthy turf.

Melting out may be distinguished from bluegrass leaf spot by the following characteristics: (1) melting out occurs during warm weather instead of cool weather, (2) melting out attacks bents and fescues more than bluegrass, and (3) melting out occurs in open areas of the lawn rather than in the shade.

Summer applications of fertilizer and improper watering favor development of the disease. When fertilizing bent lawns in the summer, a number of light applications is preferable to one heavy treatment. Daytime watering is indicated. Where melting out is serious, it may be controlled by fungicides. Thiuram gives satisfactory control on lawns in Connecticut and cadmium compounds have been reported to be effective. In lawns where melting out occurs regularly, bluegrass may be planted in place of bent and fescue mixtures.

Several fungus species of *Curvularia* cause melting out. Overwintering spores of the fungus are the initial inoculum. Further spread of disease is by summer spores. These spores are brown and usually have three or four cells; one of them is short on one side, causing the spore to appear curved. This is the characteristic from which comes the name *Curvularia*.

### Brown Patch

Brown patch is the most prevalent disease of golf greens and lawns attacking bent grasses and fescues. In severe outbreaks the disease may also be found on bluegrass. Symptoms of the disease vary according to the parts of the plants initially attacked. In Connecticut, the fungus causing brown patch commonly invades underground portions of the plant (crowns, roots and stolons). The symptoms here may resemble drought injury and consist of definite brown areas in which the plants remain erect. At other times, the fungus invades the leaves, causing a grayish-black patch to appear in the lawn. The infected leaves soon die and turn light brown. In this case, when the disease is active, the outer one-half inch of the patch may be dark or black, appearing like a smoke ring. The patches enlarge from the central infection and usually reach a diameter of 3 to 4 feet.

Brown patch appears during hot and very humid weather. Sunlight and wind are unfavorable to this fungus. The disease is favored by high nitrogenous fertilization and a neutral soil (pH 7.0). Turf usually recovers from brown patch, but occasionally may be permanently injured.

Several management practices discourage the disease. Watering during the day permits turf to dry before nightfall. On golf greens, morning drying of the grass is speeded by brushing with a bamboo pole or by dragging a hose across the turf. Light fertilization during the summer is indicated. These practices will not prevent the occurrence of brown patch during hot and humid weather, but may reduce injury. Application of a top dressing or light fertilization after a brown patch attack will hasten the recovery of the turf.

Experiments at this Station show that drenching the turf and soil with oxyquinoline sulfate or nabam in a large volume of water gives satisfactory control of brown patch. In several instances an oxyquinoline sulfate drench gave complete control of brown patch for three seasons. One nabam drench has controlled the disease for a single season.

Many fungicides applied to foliage have been reported to control brown patch. Organic and inorganic mercurial compounds have been widely used on non-residential turf, but they are dangerous on home lawns because of their toxicity to man and pets. Thiuram and captan are two nonmetallic chemicals that give satisfactory control. Cadmium compounds are less effective in controlling this disease.

The cause of brown patch is *Rhizoctonia (Corticium) solani*, the vegetative stage of the fungus *Pellicularia filamentosa*. It persists during adverse weather in a dormant form (sclerotium) on or near the soil surface. During periods of high humidity and temperatures between 60 and 95° F., sclerotia begin to grow and attack grass. Leaves may be invaded through natural openings or through the cut ends of mowed grass.

### Dollar Spot

Dollar spot normally attacks bent grasses and under severe conditions it may attack fescues. The disease is first seen as small, brown patches the size of a silver dollar. These patches later turn straw color. The fungus grows on the dead grass leaves, giving the patches a white, cobwebby appearance in early morning. This disease is uncommon on home lawns in Connecticut.

Dollar spot seldom damages turf permanently. The disease may make the turf unsightly, and control may be desirable on commercial turf. Turf that is growing vigorously is unlikely to become infected. Once established in a lawn, dollar spot may be expected to recur each summer. Cadmium compounds have been reported to give control of the disease.

*Sclerotinia homoeocarpa* is the causal organism. Overwintering spores infect the grass in the spring. Secondary infections may come from spores produced in the first attack. The fungus is quite active when the soil temperature is 60-80° F. and the grass is moist from dew, fog, or sprinkling. The disease usually develops during late spring and early fall.

### Copper Spot

Copper spot produces small circular copper-colored spots, which are most conspicuous right after the lawn is mowed. The disease attacks only bent grasses and at the same time as brown patch occurs.

Copper spot causes little permanent injury to turf. When severe, the disease may make the turf unsightly, but the symptoms disappear after a few weeks. Thus no chemical control measure is necessary for the home lawn. If the lawn is limed to raise the soil pH above 5.5, the disease is unlikely to be troublesome. On non-residential turf, the fungicide spray program for brown patch should control copper spot.

The fungus, *Gloeocercospora sorghi*, overwinters in the soil as hard, dark colored fungus tissue (sclerotia). These grow after rainy periods in the summer when the soil temperatures are above 62°F. The disease is most prevalent when the soil is acid (pH 4.5 to 5.5).

### MISCELLANEOUS ORGANISMS

*Algae* grow in damp, shady areas of a lawn, giving it a green slimy appearance, and can be discouraged by reducing the shade, improving soil drainage, and reseeding the area. Algae can be temporarily eliminated by spraying with a copper sulfate solution (1 teaspoon of copper sulfate in 8 gallons of water).

*Mosses* usually grow in lawns of poor fertility and in sparse turf. Shade and wet soil conditions may favor the growth of mosses. Application of fertilizers containing potassium and phosphates, and reseeding with grasses, should keep mosses out of the lawn. More sunlight and better soil drainage favor maintenance of a vigorous turf.

*Slime molds* frequently grow on leaf blades of grasses during wet weather. They may appear as a bluish-gray mold or as a large mass of yellowish growth, depending upon the species present. Slime molds rarely cause trouble on grasses but, when growth is abundant, they may smother the grass in small areas. The masses may be removed by sweeping and the spot can be treated with sulfur or Bordeaux mixture to further discourage growth of the organisms which usually disappear during dry weather.

*Mushrooms and puffballs* may appear overnight in the lawn. These are fruiting bodies of fungi growing on either dead organic matter or in association with roots of trees and shrubs several feet beneath the soil surface. Certain mushrooms grow in a ring in the turf and are called *fairy rings*. The vegetative growth of the fungus beneath the soil that produces the mushrooms is most active at the outer part of the ring where nutrients are released to the soil. These nutrients cause the turf to turn dark green in color. The following year, the turf is thinned out in this area. The pattern of development may proceed over a period of years with the diameter of the ring enlarging to many feet. Mushrooms are produced for only a short period during the growing season. The best method of control is to sweep up and discard them. In Connecticut, a nabam solution (1:400 dilution of 22 per cent concentrate) used as a drench has been found to control mush-

rooms in certain crops, and the treatment may afford some control of mushrooms and puffballs in turf. Cadmium compounds used as drenches are also reported to give some control of mushrooms in turf.

### MISCELLANEOUS INJURIES TO TURF

Injury from other causes is often mistaken for a symptom of turf diseases. Several weather conditions may injure the various grasses differently. Such injury often simulates the definite areas typical of diseased grass. Sunburn injury, occurring after a few hot days following wet, cool weather, may show up in bents more quickly than in bluegrass. Drought injury, occurring after a dry spell, occurs first on thin soils exposed to full sun and later on deeper soils and in shaded areas. Bent grasses are usually more susceptible to drought than are bluegrass and fescues. Thus, in a mixed lawn, drought injury will occur first in the bent grass area. The most satisfactory method for watering lawns is discussed on page 3.

Frost injury is sometimes mistaken for a disease. Crabgrass, a common weed in lawns, is killed by the first heavy frost of the season, causing brown spots in the turf.

Any close cover on the lawn (rug, paper, and piles of grass clippings) on a hot summer day may burn grass beneath the cover. Other discolorations or injury may be caused by fertilizers, pesticides, petroleum products, and urine of female dogs. Circular dead areas, surrounded by a ring of dark green grass, are clues to the injury by female dogs. Gasoline, oil, and grease from power mowers will injure turf, typically in a pattern of dead spots or streaks. Prevention of this injury obviously lies in servicing mowers on non-turf areas and in taking care that fuel does not splash from the tank while mowing. Injury from fertilizers, consisting of brown bands, strips, or spots may become apparent several days after treatment. This injury is commonly mistaken for disease.

Turf may show brown patches when the height of cutting is lowered. Brown patches due to this scalping are more striking in fescues and bents than in bluegrass. Recovery from scalping injury may take several weeks, especially on a turf not growing vigorously.

### FUNGICIDES FOR THE CONTROL OF TURF DISEASES

Chemical control of turf diseases on the home lawn should be considered only after good management has failed to remedy the trouble. Chemicals that are toxic to fungi may also be toxic to turf, humans, and animals. When using these materials, one should read the directions on the label of the package carefully and follow them exactly.

Lawn grasses present difficulties for disease control by protective fungicides. The grass grows rapidly, thus exposing unprotected areas. Also, when the turf is mowed, most of the protected surface is removed in the clippings. Thus, for effective protection, fungicides should be applied at intervals of 10 to 14 days when disease is expected. Foliar protectants are applied as sprays or as dusts.

Pathogens causing several destructive turf diseases spend the greater part of the year on or in the soil. Hence, emphasis for chemical control of these pathogens has been on the development of satisfactory soil drenches rather than on protective sprays or dusts. Two materials, oxyquinoline sulfate and nabam, show promise when used as drenches for control of *Rhizoctonia solani*, the causal organism of brown patch. Drenches can be applied by watering in with a sprinkling can or under pressure with power equipment. For effective results, at least 1 pint of solution per square foot is required to soak the sod and the soil.

*Heavy metal fungicides.* A mixture of mercurous and mercuric chlorides (2:1) has been used for over 30 years for controlling brown patch on golf greens. Turf men are still spraying with these chemicals because they are very effective and are inexpensive. More recently, organic mercurials (phenylmercury compounds) have been introduced that have a few advantages over the inorganics. All of the mercurial compounds are poisonous and therefore must be used with care. Some cause severe skin irritation if not quickly washed off. Mercurial sprays on turf may be hazardous to pets and children. Turf sprayed with mercurial compounds turns yellowish if the materials are not correctly applied. The injury is very severe on turf less than 2 years old. Because of these hazards, mercurial compounds should be used with utmost caution, if at all, by the home owner.

*Cadmium compounds* have recently been developed as fungicides for turf diseases. They are relatively safe to use and do not injure turf readily. Their control of dollar spot, copper spot, snow mold, Helminthosporium blights, and damping off is good, but they are ineffective for brown patch.

*Dithiocarbamates.* Zinc and ferric dithiocarbamates (ziram, zineb, and ferbam) give some control of copper spot, brown patch, and damping off. Nabam, sodium ethylene-bis-dithiocarbamate, when applied as a drench (1:400 dilution of the 22 per cent solution sold commercially, applied at the rate of 1 pint per square foot) promises to control brown patch in home lawns in Connecticut. A heavy nabam drench may also give some control of mushrooms and puffballs. Thiuram, a nonmetallic dithiocarbamate, controls most turf diseases satisfactorily. The dithiocarbamates are less toxic to humans and cause less injury to turf than do the mercurial compounds. However, the dithiocarbamates may increase severity of dollar spot.

In our own research, oxyquinoline sulfate has proven to be a very effective fungicide against *Rhizoctonia*. When applied to the turf as a drench (2 level teaspoons in 3 gallons or 2 pounds in 500 gallons of water and 1 pint per square foot) it gives excellent control of brown patch on home lawns in Connecticut. One treatment may be effective for several growing seasons. This material is safe on turf and nontoxic to humans and pets.

*Captan*, a nonmetallic organic fungicide is effective for controlling several diseases of turf. The chemical is relatively safe to humans and turf.

*Actidione*, an antibiotic, has been reported effective for controlling brown patch, dollar spot, Helminthosporium blights, melting out, and snow mold. In Connecticut, however, the material may injure lawn grasses when applied at effective fungicidal concentrations. Fescues are especially susceptible to

injury by actidione. Even at non-injurious concentrations, the antibiotic may retard growth of the grass.

## WEED PESTS OF TURF

Crabgrass infestations can be discouraged by several management practices. Crabgrass is an annual plant and grows from seed every year. Light watering of turf during the summer encourages crabgrass seeds to germinate. No watering at all is better than light watering. In patches where crabgrass is thick, the grass can be mowed once closely to remove the seed stalks just before the seeds ripen in late July or August. Usually the plants cannot produce a second crop of seed before frost. Chemical control of crabgrass plants is difficult. If crabgrass-killing materials are improperly applied they may be more harmful to permanent turf than is crabgrass itself. Chemical inhibition of crabgrass seed germination during May and June does not have this disadvantage. Either Crag Herbicide No. 1 (2, 4 dichlorophenoxyethyl sulfate) or chlordane are satisfactory for this purpose if used according to the directions on the labels. Chlordane kills insect grubs also.

*Dandelion and plantain* may be removed by several methods. If the infestation is spotty, individual plants may be removed or spot-treated with any petroleum product (kerosene, gasoline, or fuel oil) or with 2, 4-D formulation. This treatment can be applied with a squirt oil can, or daubed on the leaves of the plants with a brush. If infestation is general, 2, 4-D formulations may be sprayed on the turf when the plants are actively growing. 2,4-D will injure or kill most broad-leaf plants, including shrubs and trees. Thus the material must be used with caution, and sprayers in which 2,4-D is used are preferably used for no other purpose.

*Veronica and ground ivy* are occasionally found in lawns in Connecticut. None of the presently available weed killers gives satisfactory control of these pests.

*Chickweed*, common and mouse-ear types, are troublesome weeds in lawns. These weeds are difficult to control with 2,4-D. Weedone chickweed killer (2,4,5-trichlorophenoxypropionic acid) does a satisfactory job of removing these pests.

*Red sorrel* is a troublesome weed when it once infests a lawn. In the process of pulling up the plants many small roots are left behind. These roots will produce new plants. 2,4-D has little effect on sorrel, but it can be killed with Ammate (ammonium sulfamate). This non-selective herbicide, after killing weeds, breaks down to a nitrogen fertilizer in the soil. The soil in the treated area can be worked up for reseeding shortly after the plants are killed.

Several annual weeds (mustard, pigweed, and lambsquarters) may be found in newly seeded lawns. Chemical control is inadvisable. These weeds do not produce seed in a mowed lawn and will not be a problem the following year. When lawns are sown in the fall, the seedlings of the annual weeds are killed by frost.