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as a "tandem" infestation. When two or three fungi infest a lawn at the same time, diseases are harder to identify, and much harder to control.

Disease-inducing fungi are generally always present in or on the sod, in degrees below infestation levels, in the mat and thatch (dead, decaying material or litter, such as roots, stems, or leaves). When the mat and thatch become too abundant, as they do when grass clippings are not removed, the fungi may begin to grow rapidly. Other conditions which affect the development of the fungi are: temperature, humidity, injury to the turf through excessive wear, and improper cutting, which lower the resistance. When such conditions exist, healthy turf may be transformed into bleached, barren patches.

Parasitic fungi are referred to as diseases because they kill or severely injure the grasses.

Infestations may result from one of three classes of fungi. Of the Class Basidiomycetes, which includes the bracket fungi, smuts, rusts, and toadstools, only the last two are prominent as turf pests.

The Class Ascomycetes, or sac fungi, includes parasitic mildews and pathogenic scabs and blights.

Class Phycomycetes includes the water molds of which the Pythium blight is a good representative.

Identification of a single diseased area can sometimes be made simply by observing the results of fungal activity on the grass; perhaps a correlation can be made with a universally common descriptive name, such as "dollar spot." A good, close look should be taken by placing a plug, taken from the edge of a suspected area, in a dish overnight with a piece of moistened paper towel. If there is an infestation present, a "cobwebby" growth of mycelium or fungus threads should be seen on the blades of grass the following morning. Sample plugs can be kept fresh by moistening them in a wrapper of aluminum foil, or a polyethylene bag.

Microscope Helps Identify Fungi

If no identification can be made with the naked eye, a few blades of dying grass should be placed on a slide for microscopic examination. Using a key to turf fungi available from some of the chemical manufacturers, or a textbook, the exact species of the infestation can be ascertained.

Powdery mildew, shown here on Kentucky bluegrass, causes leaves to turn first grey-white, then pale yellow in the final stages of the disease. The fungus is first seen in isolated growth on the upper leaf surface.

Sometimes the most obvious signs of infestation are not observable until the last stages of infection. In this case, all effort should be made to determine the fungus species, and the control methods, before too much damage is done.

A novice in the field of fungus control should have his diagnosis checked by either a government agency specialist or a local turf management expert.

Records of outbreaks should be kept by those in fungus control. This record should include: the species of fungus, grasses affected, specific location, date of occurrence, and environmental conditions a week prior to the outbreak (weather, extent of lawn use, management practices such as fertilization, etc.). Control practices and results of treatments should also be included for future reference. This will eventually lead the CA to a planned program of lawn fungus prevention and correction.

Chemicals and Application

A number of fungicides are available for turf disease control. This article includes the common names of a few of the active ingredients now marketed. These active chemicals may be obtained in "single component" form or formulated with other ingredients to produce a "broad spectrum" preparation. The latter, gaining in popularity, is used for controlling and preventing a number of fungus diseases with one application, although applications often must be made several times a month when heavy infestations are expected.

Cadmium-based compounds, such as cadmium carbonate, cadmium sebacate, and cadmium chloride are effective against "dollar spot." Mercury-based compounds, such as calomel (mercurous chloride) and corrosive sublimate (mercuric chloride), help combat infestations of brown patch.

Some others which are used in fungus control are: cycloheximide, dyrene, thiram, zineb, methyl mercury dicyandiamide, and phenyl mercury acetate. Fumigation with formaldehyde or methyl bromide is sometimes practiced for eradicating fairy rings.

The most popular preparations are the water soluble or wettable powder forms. When properly agitated these types can be applied with any sprayer.

Application to the soil by syringe injection is sometimes called for in cases of fairy rings, for example, when the turfgrass may be injured by surface applica-

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tion of a chemical such as phenyl mercury acetate on Kentucky bluegrass.

Increasing in popularity is the granular form, which requires less time for preparation, less bulky equipment, and requires less handling.

Choice of application method will depend upon the formulation, the area to be treated, and available equipment.

In order to help the contract applicator better cope with fungus disease problems, here are some of the more common turf diseases, descriptions, and control methods for them.

Anthracnose

Anthracnose, caused by an imperfect fungus (species without sexual reproduction) of the genus Colletotrichum, can be a serious problem with cultivated grasses and is often found in conjunction with a condition known as melting-out. Anthracnose is recognized by irregularly outlined patches of blighted turfgrass. The infected areas range from 2 inches to 10 to 20 feet in diameter. From a distance, CAs can see reddish-brown patches which are caused by lesions or wounds on the leaf blades. Blades of grass may have a cobwebby growth of the fungus on them in the early morning. Progression of the disease causes a light-tan coloration throughout the infected area. When infected leaves begin drying out, they appear on close examination to have black spots as a result of the spiny black fruiting (spore-bearing) bodies which will reproduce the disease. Anthracnose is common throughout the United States, attacking mainly fescues, bents, bluegrasses, and ryegrasses. The disease survives below infestation levels in organic debris on the soil surface.

Successful chemical control of this pest has not been developed. Cultural practices, such as high, balanced fertilization, and irrigation at field capacity may reduce the problem.

Brown Patch

Brown patch, caused by an imperfect fungus, *Rhizoctonia solani*, is characterized by irregular circles up to 2 feet in diameter, in areas where mowing has been close. The circles have an over-all purplish color, later turning to light brown as the diseased leaves dry out. When mowing has been high, blighted areas may extend up to 50 feet in diameter.

Brown patch becomes evident mostly during warm, humid weather. Diseased areas are best recognized when the grass has dried out about midday, especially after mowing. The "smoke ring" effect of brown patch gives the infected area a sunken appearance. This effect is seen in the morning when there is dew on the grass.

Temperature plays a large part in the development of this fungus. From 64° to 69° F, the fungus grows below infestation levels. At 73° F it will spread, penetrate, and infect the grass leaves. Infestations flourish at temperatures around 80° to 85° F. Brown patch may completely blight a considerable stand of turf in 6 to 8 hours at temperatures in this range. Grasses susceptible to brown patch include bents, bluegrasses, and Bermudagrass.

For control, cultural and chemical practices go hand in hand. Fertility of the soil affects the development of the fungus. When the soil is balanced with fertilizer, the disease effects are not great. If the pH (acidity or alkalinity) is high or in the alkaline range, and there is excess nitrogen present, the disease usually gets the upper hand. If the soil is acidic, i.e. the pH is below 7, which is neutral, low nitrogen fertility fosters fungus development. Also conducive to development is excess water during periods of high humidity. Over-watering and over-feeding of grass should be avoided during the hot, humid summer months.

Fungicide applications should be made weekly when the weather is right for brown patch development. Mercury-based fungicides, such as calomel and corrosive sublimate in a 1:1 mixture, applied at the manufacturer's recommended rate, are the most popular. Since the compounds can injure grasses if not used properly, label directions must be followed exactly.

Dollar Spot

Dollar spot is a widespread fungus disease of short-cut bentgrass caused by *Sclerotinia homoeocarpa*, an imperfect fungus. It is so named because the infected area is usually not larger than a silver dollar. Individual leaves appear blotched with yellow green, later bleaching to a straw tan. A fine cobwebby growth or white fluffy mass can be seen on each of the "dollars" on mornings when dew is present. The cool nights and warm days, (70° to 80°) which form dew, also foster dollar spot development. If this disease is left to run its course, the spots may merge and produce large damaged areas. Spread of the disease is in a circular manner from the center of infection, but it may also be spread by moving sprinklers over the disease area and from transporting and spilling infected clippings over the lawn.

Dollar spot thrives during periods of low moisture, and if not controlled, may ruin a stand of turfgrass. The grass will recover quickly, however, if a good con-

Brown patch on St. Augustine grass. Characteristics of this disease include irregular circles up to 2 feet in diameter. The circles are first purplish, then turn light brown. Brown patch is most evident during warm, humid weather, in areas where mowing has been close. Besides St. Augustine, brown patch also attacks bents, bluegrasses, and Bermudagrass.

trol program is followed early. Fungicides containing cadmium, such as cadmium chloride or cadmium oxyquinolinate, when used in conjunction with a good management program which includes fertilizing with nitrogen and irrigating to a point below runoff, should give ready control of dollar spot. Some others which were successful in trials are: methyl mercury compounds, thiram-based compounds, and captan-based compounds.

Copper Spot

Copper spot appears identical to dollar spot except that the infested areas are a true copper color. Copper spot is also similar in that it thrives in warm (65° to 75°), humid periods. Attacking mainly bentgrass, copper spot, *Gloeocercospora sorghi*, is a pest throughout the United States, but is most damaging in coastal areas. Control measures are the same as those recommended for dollar spot, except that grass infested with copper spot should not be watered as much as when dollar spot is present.

Cottony Blight

Cottony blight, known also as grease spot, fire streak, and damping-off, is caused by water molds of the genus *Pythium*. These fungi are very destructive, and once conditions are right for their development, are capable of destroying stands of lawn grasses within 24 hours. Complete remaking of the lawn is often necessary after an outbreak.

Cottony blight, and other fungi of the genus *Pythium*, develop mainly in poorly drained areas, and may attack any species of grass. The common names are descriptive of its appearance. At the onset of infection, it appears as small (up to 4 inches diameter) irregular spots. The leaves turn dark as if water-soaked. Later they shrivel, become matted, and have a "greasy" light-brown color. Since low water runoff areas are favorable for development, it is common to see the fungus streaking by the spreading of the pathogen in running water. This fungus also appears as white "cobwebs" on dewy mornings.

A dithiocarbamate, such as zineb, is effective, along with a good management program, in eliminating this hard-to-control disease. Cultural practices include: providing good drainage; maintaining balanced fertilization; and keeping the soil within the acid pH range (below 7) by giving it sufficient water (if the pH is over 7) to leach out the alkaline components. Overwatering, however, will result in the same conditions that the program is trying to eliminate. Accompanying fungicide applications of zineb at the rate of 2 oz. of 50% wettable powder in 5 gallons of water per 1000 sq. feet should be made at 5 to 7 day intervals when the temperature is in the 80° to 95° range. If the temperature goes above 95°, applications should be made every 3 to 4 days for effective control.

Fairy rings are common where decaying matter is abundant in soils. Mushrooms appear in an arc or complete circle when mowing is infrequent. Although the "mushroom circles" are apt to attract attention from the neighbors, CAs will find most customers especially dislike this turf defect. Soil fumigation with methyl bromide is a common control measure.

Fairy Rings

Fairy rings are common in soils with excess decaying matter. Caused by a number of different fungi of the "toadstool" type, the common name is descriptive of the growth pattern of these organisms. Radial growth is caused by the yearly extension of the underground mycelium or "root" system. Each year during damp periods the mycelium send up fruiting bodies or "toadstools." Although the circle of "mushrooms" attracts curious attention to the phenomenon of the fairy ring, the fungal mycelium can nevertheless damage turf severely by cutting off water from the grass roots. The pattern of infestation is usually as follows: first, an inner area of grass is encircled by a stimulated zone (caused by excess nitrogen produced by bacteria in the old growth zone of the mycelium); this is followed by a circular strip of dead grass, all within the ring of toadstools. Another zone of stimulation appears just outside the ring.

Control and eradication of fairy rings is accomplished either by drenching, or removal of infested sod and fumigation. Drenching technique, which supresses growth, involves removing small plugs, 2 to 4 inches deep and 6 to 8 inches apart, around the outside and throughout the affected area and inserting a fungicide by means of a battery-type syringe. Either phenyl mercury acetate or a cadmium compound, at twice the recommended amount for foliar application, squirted into the plug holes, should do the job. The plugs should be replaced and the area drenched with not less than 1 inch of water. (Phenyl mercury acetate should *never* be used on Merion Kentucky bluegrass.)

Fumigation with methyl bromide follows standard fumigation techniques with modifications. After removing all of the infested sod, taking care not to spill any on healthy turf, the area should be covered with a fumigating canvas

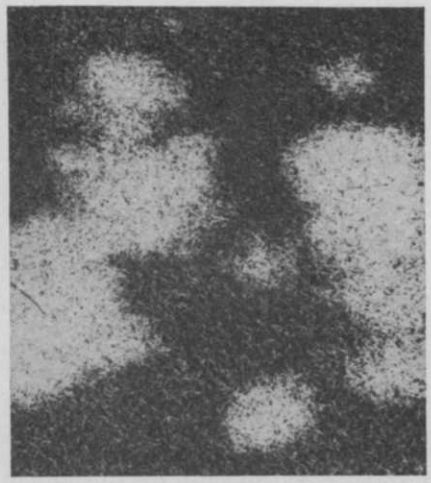
or plastic cover. Evaporating pans should be placed at regular intervals and be accessible from outside the cover. Odorized methyl bromide is then inserted under the cover into the pans at 2 lbs. per 100 sq. ft. After 36 to 48 hours, the soil should be allowed to aerate for 7 to 14 days before remaking.

Fumigation with formaldehyde is less dangerous but requires more time under cover and a longer period to aerate. Either type of fumigation is hazardous and should not be attempted by anyone who has not had previous experience with the chemicals and the techniques involved in their use.

Snow Molds

Snow molds are caused by any of several fungi which thrive in cool, wet, humid conditions like those found in the snow belt of the United States in late winter or early spring.

Gray snow mold, also called snow scald and winter scorch, is caused by a small basidiomycete called *Typhula itoana*. First noticed after spring thaw as light yellow areas about 1 to 2 inches in diameter, the infection centers soon enlarge and turn grayish white due to the strands or growing fungus and the decomposition of the grass leaves. Small fungus bodies (sclerotia), no larger than 3/16 inch diameter, can be found embedded in the infected blades of grass. The sclerotia appear yellow or light brown in the early stages, turning dark brown as they mature.



Snow mold (left) and leaf spot (right) are common diseases lawn spraymen are called on to control. As with all turf defects, prevention is more important than remedial treatment. Remind your customer that good turf management, with fertilization, proper mowing, aerifying, verticutting, and other practices, are necessary precautions if a fine lawn is to be enjoyed. And remind him, too, that chemical treatment requires a pro!

Pink snow mold, caused by *Fusarium nivale*, is also recognized as a yellowish, irregular circle, although it's actually an ascomycete. Under snow cover on unfrozen ground, the white mycelia develop over the grass blades. With the melting of the snow, the mycelium turns pink upon exposure to the sun. This fungus usually attacks only leaves, but occasionally will damage crowns and roots of grasses, making complete reseeding necessary.

Control methods for the snow molds include cultural practices which attempt to prevent conditions which harbor the fungus, and chemical methods which will kill a snow mold if one is present.

Since nitrogen assists growth of molds, just as it does for grasses, refraining from nitrogen application in late fall will hinder the growth of molds without harming the grass. Early fall fertilization will help grass "harden." Gathering mower clippings and not putting straw over the lawn for winter will eliminate "hiding places" for the molds by reducing thatch or soil surface debris.

Fungicides containing mercury, such as 2 oz. calomel and 1 oz. corrosive sublimate per 1000 sq. ft., will provide satisfactory preventive control of these fungi in areas characterized by snow molds. Application should be made before the first snowfall, during a midwinter thaw, and after the first spring thaw.

Melting-Out

Melting-out, leaf spot, leaf blotch, brown blight, and zonate eyespot are all caused by various species of *Helminthosporium*. The character which all *Helminthosporium* fungi have in common is an ovular spot or lesion on the leaf blade. Sometimes the lesions expand in concentric circles, producing a zoned appearance. These lesions vary in color according to species from dark brown to reddish purple. Advance of the infection causes the individual leaves to yellow at the tips and gradually work back to the base of the plant.

Melting-out is one of the diseases which will respond if turf is mowed at a maximum height (1¼ inches or higher). Fertilization with nitrogen will quickly increase growth rate of the grass and help combat the disease if the weather is not wet.

Application of zineb, 50% wettable powder, at 1 lb. per 1000 sq. ft., or captan, 50% wettable powder, at 2 lb. per 1000 sq. ft. in 10 gallons of water, will give good chemical control of *Helminthosporium* diseases. Other fungicides which will work are dyrene, thiram, and cyclohexamide.

Red Thread

Red thread, *Corticum fuciforme*, is a basidiomycete which does great damage to almost all of the cultivated grasses in the cooler, more humid portions of North America and Europe. It first appears as irregular blighted patches up to 3 feet in diameter. On close observation the fungus is seen to be a small dark green spot on the grass leaf. The leaves begin drying out, as the disease advances, and turn tan. In the final stages, the dead leaves have fine threadlike filaments of fungus at their dried-up tips which are a characteristic coral-pink color.

Fungicides containing mercury or cadmium compounds applied along with fertilizer to speed up growth and aid recovery should combat red thread.

Rust

Puccinia graminis, better known as rust (one of several species), appears 10 days after infection as light yellow flecks or lesions on the leaf blades. These lesions gradual-

(*Continued on page W-11*)

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On the road for a two-day field trip which followed lecture sessions in this year's Ohio State Roadside Development Short Course, delegates paused to inspect roadside rest stations and test plots where herbicides and other turf chemicals are tried out.

Ohio Roadside Course Shows CAs What's New in Highway Weed and Turf Spraying

Contract applicators hungry for lucrative highway weed and turf jobs were treated to a mouth-watering feast of information at the 21st Annual Short Course in Roadside Development at Ohio State University recently.

Nearly 200 delegates, comprised of CAs, landscape architects, and highway officials, attended the informative seminars which began October 2 in the Departments of State Building, Columbus, Ohio. The course lasted through Oct. 5, but a two-day field trip through Ohio countryside terminated the gathering this year.

While the Ohio program, which is sponsored jointly by the university, and the Ohio Department of Highways, covered many fields not of interest to CAs, the lectures on weed control, turf maintenance, and highway spraying in general, were of particular interest.

One important address was on fertilizing roadside turf. Zenas H. Beers, Midwest Regional Director of the National Plant Food Institute in Chicago, outlined chemicals and techniques for maintaining vigorous grasses on roadsides.

One highlight of the field trip was an actual demonstration of a new sprayer developed specifically for MH-30 by the F. E. Myers & Bro. Co., of Ashland, Ohio.

Called the RW-29, the Myers machine was described as the first device built exclusively for spraying MH-30, the new growth-retarding chemical from Naugatuck Chemicals, Naugatuck, Conn.

A problem the Myers engineers had to solve was the necessity for absolute regularity in dispensing chemical. Application of irregular quantities of the growth regulator would cause uneven grass growth, and thereby eliminate the advantages of using the chemical.

Since millions of dollars are spent for mowing roadside turf each year, the combination of Myers machinery and Naugatuck chemicals was of great interest to the short course students.

After the Myers demonstration, which was held at the intersection of highways 250 and 71 near Ashland, Ohio, delegates were taken on a tour of Myers production facilities and were invited to a luncheon in Ashland.

Several busses were chartered to carry delegates on the two-day field trip, during which all aspects of roadside maintenance were examined by touring actual problem spots, and scenes of special interest to the landscape architects.

The Ohio short course is an annual affair open to all interested parties for a nominal registration fee. Dates for next year's program will be announced later, a course spokesman told *Weeds and Turf*.

A rainy, gray morning was evident as Roadside Conference delegates sat in parked busses to witness a demonstration of a new roadside sprayer built by the F. E. Myers and Bro. Co. of Ashland, Ohio. Truck and sprayer can be seen at lower left as experimental quantities of MH-30, new growth-regulating chemical from Naugatuck, is spread over the roadside slope. Myers engineers say the new machine, called the RW-29, was developed especially for MH-30 applications.

Use Chlordane to Control Sod Webworm, Purdue Staffer Says

Although sod webworms are ruining many lawns, Dr. Glen Lehker, Purdue University extension entomologist, points out that the worms could be controlled with a chlordane dust or spray. One-half pint of a 45% emulsifiable concentrate will treat 1,000 sq. ft., Lehker notes. Dieldrin, DDT, and heptachlor are also recommended.

Regardless of the material used, Lehker cautions CAs not to water the turf until all webworms have been killed, which usually occurs in 72 hours. The chemical must remain on the grass blades where the insects feed.

To assist CAs in identifying sod webworms, Lehker notes that the worms are from ¼ to ¾" long, and live in silk-lined tunnels at the base of the grass plants. Injured turf is strewn with bits of chewed grass blades and there are numerous fine webs between the stems.

Mulching Aids Weed Control

CAs who do contract spraying of home gardens should remind customers that mulching is also an important factor in weed control. Not only are weeds hindered by this process, but mulching also keeps soil cooler and allows for better root growth.

Distinguished service awards in honor of outstanding contributions to the Florida turfgrass industry were presented by Ralph White, Jr., (second from left), president of the Florida Turfgrass Association. Recipients were (standing left to right with plaques) Willard Fifield, Frank Holland, and Col. Frank Ward. Other awards included a scholarship in turfgrass management which was given to Harry Meyers, turf student at the University of Florida. Nearly 400 delegates registered for the annual conference.

"Ten Years of Progress—Where Do We Go From Here?" Theme of 10th Annual Fla. Turfgrass Conference

"If the present population trend continues, Florida will be the third largest state in the Union," Dr. Gene Nutter, executive director of the Golf Course Superintendents Assn. of America told almost 400 delegates to the 10th Annual Florida Turfgrass Management Conference. "This presents a real challenge to the CA," he stated.

Dr. Nutter's address, "Ten Years of Progress in Turf Management," and the talk by Dr. G. C. Horn, conference coordinator and associate turf technologist at the University of Florida, "Where Do We Go From Here?" were the keynote speeches of the three-day conclave of Florida spraymen, held at the University of Fla., Gainesville, August 28-30.

At the annual banquet, Florida turfmen heard Jacksonville mayor Hayden Burns (standing above at microphone) in an after-dinner speech, "Communism vs. Democracy." In one of the field demonstrations (below), delegates heard Jack Cabler (standing at right) explain work he is doing with growth regulators, such as MH-30, on Bermudagrass. Cabler is a Graduate Fellow in Botany at the University of Florida, Gainesville. The experimental plot shown below was one of several the turf experts visited.

Hold Nematode Symposium

A symposium on nematode control, directed by Dr. A. A. Di Edwardo, assistant nematologist at the University of Fla., was the first ever held on nematodes in turfgrasses in this country. Dr. Di Edwardo reported that he is spending most of his time working on parasitic nematodes that affect turf, and that he expects much valuable information for CAs will result from his studies.

Discussions and demonstrations of the use of chemicals in controlling the growth of grass were also highlighted at the meet. "Controlling the Growth Rate of Bermudagrass with Chemical Regulators" was the title of a speech by Jack Gabler, who is doing his Ph.D. thesis on this problem. Gabler reported on the results of his experiments and demonstrated his findings at the research plots at the Turf Research Unit.

Growth Regulators Praised

Research workers at the Horticultural Unit reported on growth-retarding studies in which CCC, Phosfon, and MH-30 were controlling the growth of Ormond, Tifgreen, and Pensacola bahia. Materials were giving excellent control after 20 weeks, during which time no mowing was necessary. "The future of this study is obvious, and we shall follow the reports carefully in future conferences," Dr. Horn told the conference.

Other areas under discussion included golf courses, playlands, parks, and cemeteries; retail dealers and garden suppliers; horticultural spraymen and lawn service agencies; and turf nurseries.

Col. Frank Ward Honored

An award of appreciation from the association was presented to the retiring executive secretary, Col. Frank Ward, for his long service. Col. Ward served the organization as president, member of the board of directors, and then as executive secretary. Newly appointed secretary Walter D. Anderson was then introduced.

Other new officers of the Fla. group are Ralph W. White, Jr., president; Gene C. Nutter, vice