

Better Turf for Better Golf

X

TIMELY TURF TOPICS



from the USGA Green Section

THE HISTORY AND DEVELOPMENT OF CONTROLS FOR MAJOR DISEASES OF BENTGRASS ON PUTTING GREENS

By MARVIN H. FERGUSON AND FRED V. GRAU

AGRONOMIST AND DIRECTOR, RESPECTIVELY, OF USGA GREEN SECTION

The two major diseases of bentgrass on putting greens are brownpatch (*Pellicularia filamentosa*) and dollarspot (*Sclerotinia homoeocarpa*).

Diseases of lesser importance include snowmold, copperspot, *Pythium*, pink patch and yellow tuft.

Diseases of putting-green turf have come into prominence in relatively recent times. Brownpatch is the only turf disease for which the causal organism had been determined prior to the beginning of turf research by the United States Golf Association Green Section in 1921.

The more intensively maintained turf on our putting greens today may be more susceptible to disease attacks, but it is more likely that diseases were overlooked under the conditions of less intensive maintenance which existed in the early days of greenkeeping. Fungus attacks are much more likely to be noticed on a well-kept, luxuriant putting green than they are on poorly kept turf.

In order to satisfy the demands for more nearly perfect turf on putting greens, greenkeepers have been forced to spend much more time and money in their efforts to control diseases. At the present time disease control is one of the greenkeeper's foremost problems. The magnitude of the problem has stimu-

lated a great deal of research by industry, by State experiment stations and by the USGA Green Section.

Brownpatch is probably the most serious disease of putting-green turf. It was first definitely recognized as a disease in the turf garden of Fred W. Taylor of Philadelphia in 1914. In 1915 the causal fungus was isolated from similar browned patches of turf. It was found to be *Rhizoctonia solani*. This name has been changed recently to *Pellicularia filamentosa* since the finding of the perfect stage of the fungus has been reported.

Brownpatch occurs usually in rings which are nearly circular but which may be irregular in shape because of the fact that several small rings have run together. These patches may vary from a few inches to as much as three feet in diameter. They are characterized by a smoky ring around the edge of the circle in the area of mycelial activity. This characteristic "smoke-ring" may be seen easily in the early morning of a warm, muggy day. Later in the day, the fungus is not ordinarily so active, and the "smoke-ring" is not so easily visible. Often the fungus does not kill all the leaves completely, so that, in the case of light attacks, brownpatch is sometimes difficult to recognize.

Dollarspot was thought for many years to be a different form of brownpatch, and the causal organism was considered to be the same. Greenkeepers spoke of "big brownpatch" and "small brownpatch." In 1926 Dr. John Monteith, Jr., proposed that the name "dollarspot" be used to describe the latter condition. He noted at that time that the large brownpatch occurred more often in the southern portion of the range of bentgrass, whereas the dollarspot disease occurred more often in cooler weather and was more prevalent in the cooler part of the bentgrass range.

It is interesting to note that as late as 1926 he found it necessary to write at length and to offer experimental evidence to prove that these diseases were in reality caused by a fungus rather than by spiders or by weather conditions. Perhaps it is not too surprising to find that laymen believed that diseases were caused by certain weather conditions inasmuch as weather conditions are known to have a marked influence on the incidence of disease.

In 1940 a note in *TURF CULTURE* described the work of F. T. Bennett in England. Bennett worked with American, British and Australian strains of the dollarspot fungus, and he found that some strains of the fungus produced spores while others did not. He considered the fungus to be a species of *Sclerotinia* and suggested the same *Sclerotinia homoeocarpa*. In the course of physiological studies Bennett found that variations in acidity from pH 4.0 to pH 8.0 had no effect upon the growth of the fungus. He also found that the optimum temperature for growth was 68° F. to 78° F. for the British strains and 86° F. for the American strains.

Although several other diseases were mentioned in the introductory paragraph, they are not considered to be so widespread nor so important as are brownpatch and dollarspot. This paper, therefore, is confined to a discussion of these two diseases.

Manipulation of Environment

The two primary contributing factors to disease incidence are weather

conditions and soil conditions. Weather conditions are, of course, uncontrollable. However, there are some practices which may partly offset the influence of unfavorable weather conditions.

Location of the putting green is important in this respect. It has been observed many times that greens in a pocketed area where air movement is restricted are much more frequently attacked by fungi than greens which are located in areas where air can move more freely. The cutting out of underbrush and a few trees may be effective in transforming an undesirable location into a desirable one. Hillside areas are choice locations for greens from the standpoint of freedom of disease, but these may be poor locations from the standpoint of architectural design or ease of maintenance.

While soil conditions are probably on a par with weather conditions insofar as their potential influence on disease incidence is concerned, soil conditions are considered to be a lesser problem because they are controlled more easily. The soil on a putting green is subjected to many operations which are conducive to compaction, poor drainage and poor aeration. Therefore few natural soils are satisfactory under these conditions. A good agricultural soil will, in all probability, be a poor putting-green soil. Obviously, physical characteristics are more important in a putting-green soil than is fertility.

Putting greens are subjected to a number of practices which make them unique in that on no other area do we attempt to grow plants under similar conditions. They are subjected to extremely heavy traffic. On some municipal golf courses as many as 60,000 rounds are played annually. On many courses the greens are mowed daily with power mowers which contribute to compaction. Bentgrass and well-kept putting greens is mowed at heights ranging from 3/16 inch to 5/16 inch. This very close mowing naturally restricts the development of the root system to some extent.

Players demand that putting greens be soft enough to hold a shot. Unless the

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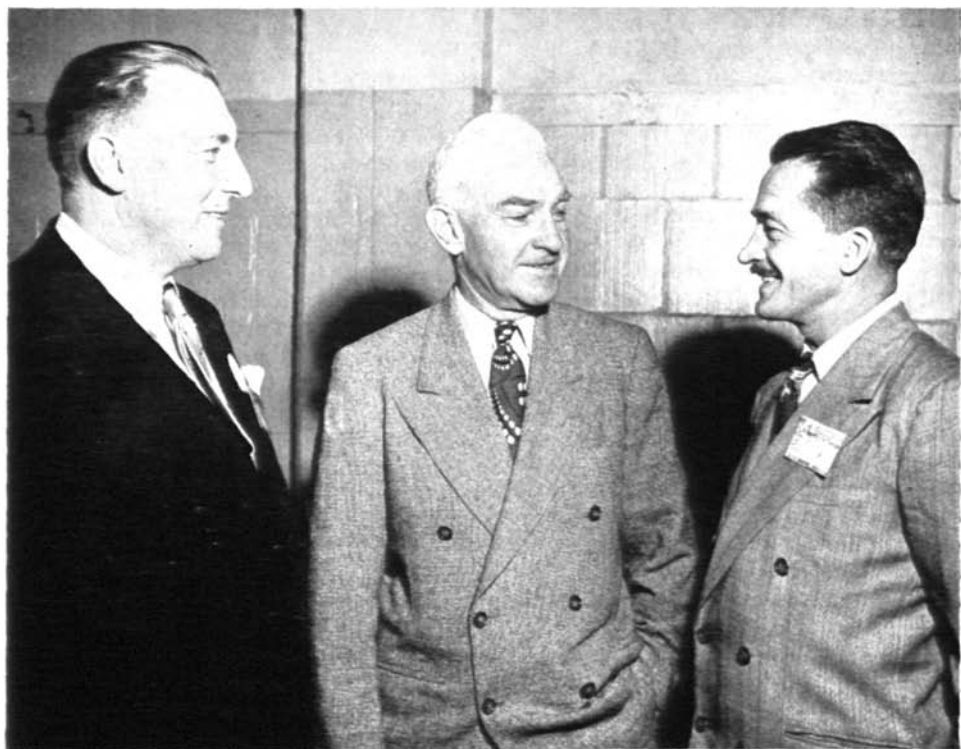


Photo by Dick Turner

Bill Beresford, Greenkeeping Superintendent at the Los Angeles Country Club, and Colin Simpson, Chairman of the Club's Green Committee, discuss the California turf program with Fred V. Grau, Director of the USGA Green Section. The occasion was the 20th Annual Turf Conference and Show of the Greenkeeping Superintendents' Association (national) at Los Angeles in February. Mr. Beresford is President of the Southern California G.S.A. Mr. Simpson is a member of the USGA Green Section Committee.

green was properly constructed, the only way to keep the putting surface soft is to overwater. On a soggy soil surface, heavy traffic soon creates a puddled condition. Thus, a vicious cycle is in operation. Too much water plus traffic produce a compacted, puddled soil which will not take up water properly, will not drain properly and hardens readily when it begins to dry out. Even if the greenkeeper refused to apply excessive water, players going out during and immediately after rain would soon create the same conditions.

It is easy to see how plants become weakened and susceptible to diseases when such conditions for growth exist.

improvement of soil structure which in turn promotes improved drainage, improved permeability, improved aeration and a more extensive root system is one profitable line of attack in making putting-green grasses more vigorous and less susceptible to fungus attacks.

Recently, data have been developed jointly by the Green Section and the Saratoga Laboratories which shed considerable light on the subject of physical characteristics of putting-green soils. These data, which have not yet been published, indicate that much higher percentages of sand and much lower percentages of clay are needed than had previously been thought. In the words of a practical

greenkeeper, "Too much drainage and too much sand make a good green."

Cultivation of turf areas, particularly putting greens, has been tried by many different methods during the short history of greenkeeping in the United States. Only in the last two years has thorough cultivation been possible on a large scale. The development of the Aerifier, a hollow-tined, rolling aerator, has made rapid and economical cultivation of turf areas possible. It is believed that this machine will do much to lessen the effects of diseases because of the role it will play in the improvement of soil conditions.

Water management is closely related to soil characteristics in that poor soil characteristics lead to difficulties in the application and drainage of water. Faulty watering in turn may aggravate existing soil conditions. However, the time of day when watering is done may also be important in disease control.

In the early days of greenkeeping research it was thought that copious watering helped the grass to make a comeback after a disease attack, and therefore recommendations were made to water heavily at any time of day. Later, investigations showed that such watering could do much more harm than good. Although it is recognized that our knowledge is not complete, the present viewpoint is that water should be applied in the early morning, and later in the day only if needed.

Brownpatch and dollarspot mycelium appears to be most active in the early morning when there is dew or guttated water on the grass and when the air is comparatively still. Watering knocks the droplets of dew off the grass blades and leaves a thin, even film of water. This film dries more rapidly than does the dew. Watering at night or in the late afternoon, on the other hand, causes the grass blades to be wet during the night and gives the fungus a longer period during which to spread.

Inasmuch as water is one of our critical natural resources, it is believed that a thorough study of the use of water and methods of conserving water would

be well worth while. James Johnson has reported the results of some studies at the University of Wisconsin. This work has thrown considerable light on host-parasite relations as affected by water congestion in plants.

There is evidence to indicate that the nutritional status of plants may have some effect on their susceptibility or resistance to disease. Johnson reports that the level of potassium fertilization affects the degree of water congestion in some plants. Water congestion, in turn, may make the plants more susceptible to invasion by fungi. Many greenkeepers have reported that the level of nitrogen fertilization has a marked effect on the incidence of dollarspot on greens. At present there is not sufficient experimental evidence to substantiate these reports. There is a need for investigation of such nutritional effects in order to reach a better understanding of the mechanism whereby increased resistance is brought about.

Lime has been used frequently to check attacks of brownpatch and algae. While the value of lime for this purpose has been recognized for many years by practical greenkeepers, the mechanism involved in the action of the lime is not well understood.

It is believed that when a full understanding of water relations, nutritional balance and other management factors is reached, turf may be grown which will be much less susceptible to disease attacks.

Protection by the Use of Fungicides

The first recommendations for the treatment of turf diseases advocated the use of Bordeaux mixture. Tests with this material were begun in 1917. By 1919 its use was rather general.

Several disadvantages were associated with the use of Bordeaux mixture; among them were the unsightly color, the need for frequent application and the phytotoxicity of copper accumulations in the soil.

Other copper compounds were used experimentally, and all of them were found to produce injury after a period of time. Other materials, such as sulfur compounds and formalin, were used,

but the mercury compounds which were first used on turf about 1923 were found to be so effective against both brown-patch and dollarspot that other compounds never found a wide use.

Tests at the Arlington Turf Gardens in 1925 included such materials as Semesan, Uspulun, Corona 620, Corona 640 and mercuric chloride. These tests were continued through 1927, at which time the conclusion was drawn that mercury products were the most satisfactory materials for the control of turf diseases and that mercury should be bought on a pound basis. Since the effectiveness of the mercury compounds appeared to vary proportionately to their actual mercury content, the workers recommended that mercury be bought in the cheapest form.

Subsequent investigations showed that mercuric chloride was the quicker acting form of mercury for the checking of actively growing dollarspot and brownpatch. However, heavy applications, especially in hot weather, produced some injury on turf. Calomel (mercurous chloride) is a slower-acting material and was found to have some value as a protectant against attacks of dollarspot.

The fact that these two materials behaved differently led to their use in combinations. The most common mixture is the 2:1 mixture, wherein there are two parts of calomel and one part of corrosive sublimate. This mixture is sold under the trade names of Calo-Clor and Pfizer Mixture. The two forms of mercury mixed in these proportions are still probably the most widely used ones for the control of turf diseases. Corrosive sublimate provides very quick action, and calomel provides a lasting effect. The mixture is normally applied at the rate of 3 ounces to 1,000 square feet. This rate of application, however, often is reduced by half in very hot weather.

Organic mercury compounds have been used to a considerable extent but have never been popular enough to compete with the inorganic mercury materials for use on turf diseases. Many organic

REFERENCES ON CONTROLS FOR BENTGRASS DISEASES

1. Harrington, George E., 1941:
Thiuram sulfide for turf diseases.
SCIENCE, Vol. 93, No. 2413, 311.
2. Johnson, James, 1947:
Water congestion in plants in relation to disease.
Research Bulletin 160, University of Wisconsin.
3. Monteith, J. Jr., and Dahl, A. S., 1932:
Turf diseases and their control.
THE BULLETIN of the USGA Green Section Vol. 12, No. 4, 87-186.
4. Monteith, John, Jr., 1927:
1927 Experiments on brown-patch control.
THE BULLETIN of the USGA Green Section, Vol. 7, No. 11, 210-216.
5. Piper, C. V., and Oakley, R. A., 1921.
THE BULLETIN of the USGA Green Section Vol. 1, No. 6, 112-115.
6. 1942. Tetramethyl thiuramdisulfide.
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mercury compounds have been introduced but none of them has had sufficient appeal to induce greenkeepers to abandon their stand-bys.

In 1940, when world conditions caused a scarcity in mercury products, the Green Section undertook the task of finding substitute materials for the mercurials. Numerous organic fungicides were available for experimental purposes at that time. The Green Section procured a large number of these materials, many of which were used as accelerators in the rubber industry. By far the most effective material found was tetramethyl thiuram disulfide, bearing the trade name Tuads. Since 1940 this product has been marketed in various forms under several names. Thiosan was the name of

the first product. It contained 50% tetramethyl thiuram disulfide. Later names have been Tersan, Arasan and Arasan SF. The latter two products are being sold for seed-treatment purposes.

Tersan has been used widely during and since the war. It has provided excellent control of brownpatch, and there have been no reports of phytotoxicity, even at very high rates. Its effectiveness on dollarspot, however, is rather poor. Almost all greenkeepers have conserved their limited mercury supplies for use on dollarspot and have used Tersan for the treatment of brownpatch.

There have been some reports that skin irritations have resulted from the use of Tersan, but this danger apparently is not too serious if the workmen use reasonable care.

In 1946 and 1947 workers at Pennsylvania State College and Rhode Island State College investigated the effectiveness of cadmium compounds for the control of turf diseases. These compounds were found to be quite effective in controlling dollarspot. At least two of these compounds, No. 531 and Puratized 177, are now being sold and are used quite widely. These materials appear to give longer-lasting protection than do the mercury compounds, and they also appear to be less injurious to turf.

Disease-Resistant Strains

There is a great deal of evidence to indicate that bentgrasses vary widely in their susceptibility to disease attacks. This fact is of special importance on putting greens because a large percentage of our present-day golf greens are planted vegetatively to a single clonal strain.

Arlington bent is one of the most widely used vegetative bentgrasses on golf courses at the present time. This grass has been growing for seven years in a plot in the Rhode Island State College turf garden. Half the plot is treated with fungicide and the other half is not treated. It is difficult to determine which half has not been treated. Other grasses in the same series of plots have been damaged badly by disease.

The Green Section transferred approximately 130 selections of creeping bentgrasses from Arlington Farm to the Bureau of Plant Industry Station, Beltsville, Md., in 1942. Since that time all but five of the selections have been discarded. Susceptibility to fungus attacks is one of the chief reasons for discarding these selections.

There is little doubt but that a breeding program directed toward disease resistance would produce some superior strains. Such a program is in progress. However, it is a long-range program that will not produce immediate results.

In summary:

1. Demands for more nearly perfect putting greens are causing greenkeepers to spend more time and money for disease control.
2. To place greens in locations where free air circulation exists tends to make conditions less favorable for the growth of fungus.
3. Attention to physical soil characteristics in greens, drainage, aeration, proper water management and cultivation will pay big dividends in healthier turf which is more resistant to disease.
4. Fungicides are adequate and efficient in controlling the most troublesome diseases at the present time.
5. Some selected strains of bentgrass are in use. There is a definite need for more improved strains. Disease resistance is one of the most important attributes of a putting-green turf.

WATER AND OXYGEN

When turf is overwatered, it isn't the water that suffocates the roots; it is the lack of oxygen. Everything else being equal, the most important operation on turf in the spring is aeration of the soil.

Deep-rooted turf, adequately fertilized and with minimum irrigation, will resist the extremes of summer weather with fewer headaches than shallow-rooted turf growing on dense, compacted soils in low oxygen content.