Special Bulletin

on

Turf Diseases

Including

Brown Patch - Scald

- Snow Mold -

Prepared and distributed by

O. M. Scott & Sons Co. - Seedsmen - Marysville, Ohio

A Summary of the Recent Findings as to the Causes and Control of Turf Diseases

We felt it timely just now to assemble some of the theories and research relating to common turf diseases and publish them for the convenience of those who are too busy to give the subject exhaustive personal study. Extra copies of this report may be had for the asking.

INTRODUCTION

To those who have been closely connected with the production of fine turf on golf courses it has become evident that the accepted methods and systems of turf maintenance are not entirely correct. Many of the beautiful and seemingly perfect theories of grass culture are breaking down with disastrous results; simultaneously golfers are becoming more exacting in their demands. To satisfy the ever-increasing number of these it will be necessary to find some way to provide healthy, robust turf even during the trying weeks of mid-summer when grass is naturally dormant.

Of importance in finding solutions for the various turf problems is the experimental and research work being carried on by the Green Section, and the various state agricultural experiment stations, as well as the results of practical experience on golf courses. The Green Section has been especially helpful in the past and will be even more so in the future because of placing experimental plots in different sections of the country where the effect of varying soil and climate conditions can be studied. Significant at this time is the research work on the use of lime in overcoming certain turf diseases.

Shall We Lime? Those who were especially interested in golfing turf a few years ago will recall the so-called "white wash" era when a great deal of lime was used on turf as a matter of course. In time it was learned that some of the finer turf grasses would thrive in an acid soil, whereas many weeds would not. There was an immediate rush to the acid soil theory, and thence to the ensuing "ammonium sulfate" era, with lime absolutely abolished. Time has shown that the practices of this era were not entirely correct either, and so now it seems that a swinging of the pendulum to some intermediate point is in order. Experience during the last three years has demonstrated, as we will explain later, that the use of lime has tended to decrease the damage done by—if not actually prevented the appearance of some turf diseases. However, lime has not proven beneficial in every instance and probably never will because of the variable factors of soil, climate, etc.

Soils Part The solution of an individual turf problem can only be found by considering all of the factors affecting the turf. Of these factors soil is most important. It plays a tremendous part in the cause and correction of sick turf. Soil should not be thought of as just so much dirt, but its texture (size of soil particles) and structure (arrangement of particles) should be considered, along with its humus content and chemical properties.

In order that soil may properly support grasses, good drainage is essential to supply air to the roots and encourage desirable bacterial activities. Organic matter is necessary to furnish energy to these bacteria and the reaction of the soil is important in this connection in that acidity retards the activity of the bacteria which make the plant food available. Furnishing soil with the right kind and a sufficient amount of plant food for grasses is one of the most important factors, and yet one which is none too well understood. And then, the one uncontrollable agency influencing the growth of grass is temperature.

A lot of grief on golf courses during the past few seasons can be attributed to an over-abundance of moisture with relatively high temperatures. At such times poor physical condition of soils combined with too much plant food in the form of nitrogen is sure to cause disastrous results.

THE TURF DISEASES

It is unfortunate that one of the most common turf diseases should have become known by such an all inclusive term as brown patch. This has resulted in a tendency to consider all turf that has turned brown, for any reason whatsoever, as suffering from an attack of brown patch. As a matter of fact many other things may affect grass in practically the same way as brown patch and yet have no relation to it at all. Some of these are: improper fertilization, damage by insects, excessive use of certain chemicals, poisoning of the soil, etc.

In order to properly consider the various turf diseases it is necessary, first of all, to identify them. It is not possible to discuss all of the factors affecting grasses in these few pages but the more important ones will be considered briefly.

SCALD

The one turf injury affecting putting greens and other fine turf, which has been very common during the last few seasons is the so-called scald. This term covers a wide variety of diseases and is somewhat misleading as it infers more or less injury by water heated beyond the point endurable by plants. This, however, is not necessarily the cause as frequently the trouble is due to something entirely different.

Identifying Scald Scald usually appears in irregular and indefinitely outlined discolored patches. As contrasted to the definitely defined outer boundaries of brown patch, scald is usually worse near the center and gradually less severe towards the outer edges. At first the grass may have a purplish or bluish tinge, with the leaves rolled and shriveled as though suffering from lack of water, resembling grass clippings in first stages of wilting. After this the development of the injury is often rapid and the grass eventually turns brown, sometimes leaving the ground entirely bare.

As with other turf injury of this nature the development of scald usually begins during periods of excessive heat but the attack may continue even during a spell of cooler weather. Fungi are sometimes associated with scald but it has not been definitely established that these are in any way directly responsible for it. There are no doubt different types of scald which will be differentiated later and some may be found to be parasitic diseases.

CAUSES

Among the probable causes of scald are excessive use of certain fertilizers, accumulation of poisons in the soil, and improper chemical or physical condition of the soil.

Fertilizers Part Some of the most pronounced cases of this injury studied by the Green Section at Washington seemed to have been the most serious where the more slowly available fertilizers, such as cottonseed meal, were used. This is thought to be due to the fact that in some seasons these plant foods are not readily available to the grass soon after application because of unfavorable weather conditions. When the grass does not therefore respond to the fertilizer, additional amounts are often put on which in turn may also decompose slowly and not be immediately assimilated by the plants. Then during the hot weather of late June or early July the process of decomposition goes on so rapidly as to provide too much nitrogen with the result that the grass becomes soft and succulent. There is good reason to believe that this over-supply of nitrogen causes tender turf which is easily injured during unfavorable weather.

In the same way excessive use of strong nitrogen fertilizers such as ammonium sulfate may weaken the grass and cause difficulty in maintaining good turf. Possibly the evident benefits from such fertilizers has encouraged an over use of them with a resulting soft growth of grass. Coupled with this has been the over enthusiasm for acid soils. Excessive acidity is probably harmful to the finer turf grasses and may result in serious injury when the grass is subjected to adverse conditions.

Poisons in Soil The accumulation of poisons, or certain chemicals, in the soil, may also cause scald. Bordeaux mixture leaves a copper residue which is harmful to grass. Sulphur has been known to produce injury when present in an excessive amount. The results of the injuries from these two causes are almost identical and in both of these cases the injury may not show up at all during favorable growing seasons. However, the grass is usually shallow rooted and so not able to survive when the other factors are also unfavorable.

Drainage Another cause for weak turf, under certain conditions, is poor drainage. Injury is sure to result if too much water settles in areas where its escape is slow. Probably the main damage is caused by the exclusion of air. Grass roots must be able to breathe properly if they are to support strong, healthy plants.

OVERCOMING SCALD.

There has been too little opportunity for studying each type of injury designated as scald. However, it seems safe to conclude that the best remedy is to find the cause and overcome this if possible. Each case must necessarily be studied on its own merits.

Use of Lime Experiments conducted at the Arlington Turf Garden have shown that in some instances applications of lime may prove beneficial in reducing or overcoming scald damage. This is especially true where turf is growing in very acid soils. Some established Bent turf plots that had repeatedly turned brown were made the subject of test in 1926. One-half of each plot was treated with ground limestone at the rate of 50 pounds to the 1000 square feet. An almost immediate effect was noticeable in a vigorous and more healthy turf which continued through the following season. The check plots on the other hand continued unthrifty and the scars did not entirely heal over before another attack the following season. These results were further substantiated in 1928, and have been again this year. It should be understood that these tests were made on very acid soils and so the use of lime in other instances might not show such marked results. It is worth trying, however, if you are having this trouble. Do not apply lime promiscuously to all browned turf. Make a test first. Mark off a small strip across the affected area, then apply lime and watch the results. Each case must be treated individually because of difference in soils, climate, etc.

Applying Lime The best time to apply lime is during the spring or fall, although if necessary it can be put on any time. Of the different forms of lime, the one most economical in your vicinity should be used, comparing them on the basis of actual lime content. Ground limestone (calcium carbonate) can be used at the rate of 50 pounds per 1000 square feet of area or roughly one ton per acre. Twenty to twenty-five pounds per 1000 square feet is sufficient in using hydrated lime (calcium hydroxide).

Remember that lime is a chemical and careless handling leads to burning and other injuries to turf. It may be applied alone or with a little soil to give it bulk and aid in its distribution. Lime should not be applied for at least a week after the use of quickly effective fertilizers.

Use of Fungicides The use of calomel and corrosive sublimate has controlled scald to a certain extent in some instances. Where these fungicides have reduced the severity of attack it would seem that some microörganisms were at least partially responsible. However, it does not appear

that any treatments of this kind have ever kept scald entirely in check.

Limiting Fertilizers During seasons when grass is not able to utilize slowly available fertilizers readily, their use should be limited. If turf does not respond to a normal application of these the chances are that the plant food has not become available and so adding an additional amount is courting disaster later on. At Arlington cottonseed meal, soybean meal, bone meal, and urea were found as some of the plant foods that favored this type of injury. *It should not be inferred that these fertilizers in themselves are harmful—it is in their over-use that the harm results. As will be shown later, their use sometimes actually reduces the damage done by brown patch.*

For treating scald caused by the over-use of some of these fertilizers, the mercury treatments as above have been found helpful. There is some evidence that these chemicals may hold in check the microörganisms causing the disintegration of these fertilizer and thus stop the excessive supply of plant foods.

Avoid Excessive Nitrogen Damage to turf because of too much nitrogen should be avoided by the sparing use of highly concentrated fertilizers especially during summer. The grass should not be fed unless it shows a definite need for it and fertilizing should be especially avoided when its only purpose would be to produce a better color. It would seem that turf is probably more healthy when it does not have the real bright green color brought on by excessive nitrogen. Grasses are naturally more or less dormant during July and August, and so nature should not be interfered with too greatly.

Where turf injury is due to poor drainage this condition should be corrected by improving the surface drainage and tiling if necessary. Impervious soils may be opened up by using sharp sand in the top dressing.

When scald is due to the accumulation of copper or other poisons in the soil, neither lime nor any other treatment has been found effective in overcoming the trouble. So far the only remedy known is to replace the poisoned soil, in the affected areas, with fresh earth.

BROWN PATCH

As stated before the term brown patch has been used rather promiscuously, resulting in considerable confusion and retarding the proper study of the real brown patch problem.

Just what is brown patch? It is a turf disease caused by a specific fungus growth which penetrates and kills grass leaves. It enters the leaf through a pore of the epidermis and then grows through and between the cells which make up the tissues. The fungus absorbs food from these cells causing them gradually to break down and the leaf in turn to shrivel up and turn brown.

DEVELOPMENT

Certain conditions are favorable to the development of brown patch. Fungi in general require considerable moisture and so their growth is most rapid if the grass is moist or wet. Certain types producing brown patch develop only during periods of excessive heat whereas some others are active during the entire growing season and some even during winter. As most of the fungi are unusually sensitive to drying out or to strong sunlight they are most active at night.

Because of this fact the real injury to turf usually occurs during the night. In the early morning, after an attack, the affected grass will have a scalded, darkened appearance while the dew remains on the grass and before the direct rays of the sun have reached it. As soon as the dew disappears the grass begins to shrivel and finally becomes brown and dead looking. The attack will usually injure most of the blades in certain areas thereby producing the familiar brown patches.

Brown patch may attack any of the finer turf grasses, although most of the experience with it has been on the bent grasses as these are used more than any other kinds for fine turf. Besides bents, the fescues, blue grass, redtop, crab grass and chick weed are susceptible. There is a difference in the resistance of these to the disease. In some putting greens, heavily infested with chick weed, it has been observed that the chick weed may be very badly checked, whereas the turf did not seem to be at all damaged. Some strains of bent grasses have also shown a greater resistance to brown patch than some others.

Types There are several different types of brown patch, each one probably caused by a different strain of the fungus. Of these the two most common have become known as large brown patch and small brown patch because they ordinarily attack the grass in relatively large or small areas. Among the other kinds are pythium and ring brown patch. The characteristics of these are practically the same and so the general disease will be considered first.

Influencing Factors Several conditions other than temperature and humidity influence the development of the brown patch fungus. Soil conditions, methods of watering, fertilizing and general treatment of turf may be such as either to encourage or discourage this pest. Laboratory tests have shown that acidity of the soil has a direct influence on the browth of brown patch fungi. Too heavy watering, especially at night, may have a considerable influence as the fungus develops more rapidly if there is abundant moisture. The fungus causing brown patch is also influenced by the amounts of plant food available, indicating some connection between brown patch and the kind and amounts of fertilizers used.

AVOIDING BROWN PATCH

The Green Section at Washington has appreciated for a number of years that a combination of conditions is probably responsible for brown patch and other turf diseases. For this reaon they have tried to study the influence of each factor insofar as it might be responsible for certain damage to fine turf. Methods of watering and fertilizing are both closely connected with soil conditions. For this reason it is impossible to isolate each factor and determine exactly its responsibility for a turf disease.

Proper Watering Evidence would indicate that greens are watered too thoroughly during hot weather. Early morning watering would seem better than night sprinkling. Grass is not damaged as much if it goes into the night in a dry stage as the fungi will not have such a good opportunity for development. A light sprinkling to wash off the dew is usually sufficient with an occasional heavy watering to saturate the soil to some depth. Ordinarily, if the water table is not too low, the soil water rises during the night and furnishes the plants with sufficient moisture if there is any day watering at all.

Proper Feeding The continued and excessive use of highly nitrogenous fertilizers is apt to increase brown patch damage. Those fertilizers which quickly release large amounts of nitrogen may produce a soft, lush growth of grass—an easy victim of disease. Most putting greens are fed too much during summer. It is better to let the grass go off color at this time than to produce the luxuriant growth so susceptible to infection. If possible the greens should be brought into good condition during spring and then "hardened off" for summer.

In this connection, substitution of some more slowly available source of nitrogen such as soybean meal or cottonseed meal may be beneficial. Certain plots at the Arlington Turf Garden treated with these fertilizers alone have shown a decidedly greater resistance to brown patch than adjoining plots treated with sulfate of ammonia and compost. It is interesting to note that the difference was not so much in the number or prevalence of the attacks as in their severity and damage.

Proper Soil Conditions In order to determine whether some change in the soil conditions might diminish the damage of brown patch, experiments have been conducted whereby lime has been applied to the turf both in connection with the use of fertilizers and alone. From the research of the Arlington Turf Garden and the practical experience of some golf clubs it has been found that lime will sometimes prove helpful in reducing brown patch losses. Just what the action of this material is has not been determined. Lime may have either a direct or indirect influence. It may overcome the bad effects of excessive use of acid reacting fertilizers or it may release certain plant foods which have been locked up in the soil. Lime will not prove of benefit to all soils under all conditions. Quite often there is a sufficient amount of this applied to turf in the soil used for top dressing. However, those having considerable trouble might find a trial worth while. Mark off a strip on one of the worst greens and apply ground limestone at the rate of 50 pounds per 1000 square feet, then watch the results and determine for yourself whether your soil needs lime. It should be understood that using lime does not necessarily preclude the use of ammonium sulfate. There has probably been a tendency to over estimate the value of the acid reaction of soils brought about by ammonium sulfate, since the influence of nitrogen in the latter has probably been confounded with soil acidity.

We quote from the May issue of the Green Section bulletin as follows:

"There is nothing to indicate that the use of lime alone will entirely prevent brown patch. Its use on certain soils in reasonable amounts, however, will undoubtedly reduce the extent of the brown patch damage and will greatly lessen the amount of mercury fungicides required. To completely control both large and small brown patch it will still be necessary to rely on the mercury fungicides."

(Directions for applying lime given on page 3.)

CONTROLLING BROWN PATCH.

Even under ideal soil, fertilizing and water conditions, brown patch is apt to appear at times. When it does it is most necessary that immediate steps be taken to check the disease before further damage results.

In this connection it might be well to deal briefly with some of the present fungicides or chemical treatments to check brown patch. Probably the first one of these to come into use on golf courses was Bordeaux mixture. It was found, however, that the continued use of this left a copper residue in the soil which was harmful to grass and so it is little used at this time. The successful treatments in use now are those depending upon mercury either in organic or inorganic form to effect the real cure. It has just been within the last few years that the inorganic compounds have become popular chiefly because of their lower cost.

At first thought it may seem that one material is as good as another providing that equal amounts of mercury are applied. This, however, is not the case. There is a wide difference in:

a. The effect on grass, that is, tendency to burn;

b. Duration of the period during which the chemical will protect turf; and

c. Promptness with which it checks the disease.

Inorganic Compounds Of the practical mercury treatments corrosive sublimate (bichloride of mercury) is probably the quickest acting but when used alone it has a tendency to burn the grass and also is without lasting effect. On the other hand, calomel is slowly available, seldom burns, and gives a more prolonged protection. By combining these two (two ounces of calomel to one ounce of corrosive sublimate) the advantage of both may be secured. These materials, both of them inorganic mercury compounds, may be purchased separately or the above combination is offered by several commercial firms. This preparation should not be applied in greater amounts than three to four ounces per 1000 square feet at any time and considerably less than this during hot weather.

Corrosive sublimate is quite valuable in checking large brown patch. The fungus of this disease develops quite rapidly and so quick action is necessary. In contrast, small brown patch develops very slowly and so it is advantageous to use calomel as this will give protection over a longer period of time.

Organic Compounds One of the older preparations which still remains very popular contains chlorophenol mercury (organic). The commercial products usually contain a small percentage of mercury than is contained in either calomel or corrosive sublimate and so they must be

applied at the rate of about one pound per 1000 square feet of area in order to get the same amount of mercury as is contained in three ounces of the combination mentioned.

At least one of the commercial fungicides is made up of chlorophenol mercury with urea to provide a check for brown patch and a stimulation to the grass as well. In some cases turf needs to be fertilized after an attack of brown patch. In deciding which type of fungicide to use the purchaser should compare them on the basis of mercury content. This is the expensive ingredient and also the effective one.

TYPES OF BROWN PATCH

As mentioned before there are several distinct types of brown patch, each one possibly caused by a different strain of the brown patch fungus. Of these the so-called large and small brown patch are the most common. For this reason they have been studied more than any of the other varieties. A brief description of each of the main types is given below.

LARGE BROWN PATCH

As one type of this injury usually affects the grass in rather large areas, sometimes as large as one foot in diameter, it has become known as "large brown patch." In an affected area not all of the blades will be injured so that a scattering of green remains through the patches. Ordinarily the blades only are attacked and not the stems, buds or roots. This makes it possible to restore the turf by stimulating a rapid growth after the disease has been checked.

Observations would indicate that large brown patch is apt to appear only during periods of hot, humid weather as contrasted to small brown patch which may appear any time during the growing season. If the disease is not checked by a change in weather or the use of some fungicide, early on each succeeding day of the first attack a smoky ring of blackened grass is quite noticeable around the margin of the spots. This is the enlargement during the night when the fungus is most active. Of course the affected grass turns brown later in the day.

SMALL BROWN PATCH

In contrast to the particular type of brown patch affecting large areas small brown patch usually affects areas limited to about the size of a silver dollar. There will usually be a number of these spots scattered throughout the green and so giving it a moth eaten appearance. Sometimes these patches are so close together as to give the appearance of large brown patch. Small brown patch usually kills the grass to the ground as none of the blades escape. The affected grass has a more bleached appearance than after an attack of large brown patch.

While large brown patch will occur ordinarily during hot, muggy weather this is not at all the case with small brown patch. It is apt to appear almost any time during the growing season but, on the whole, it probably does less damage because its development is more slow and so the disease can be checked before extreme damage has resulted. However, the injury is often severe in the restricted areas and sometimes the buds and stems are attacked as well as the leaves.

PYTHIUM

One of the new types of brown patch affecting bent grass has been called pythium. This developes during weather favorable for large patch and usually attacks about the same size areas; however, the grass turns a redder shade of brown and every blade of grass within the injured area is usually killed.

So far the only treatments established for it are those used for large brown patch.

RING BROWN PATCH

Ring brown patch has many of the characteristics of large brown patch but apparently is caused by a different fungus. As its name indicates it occurs in rings which in some respects reemble fairy rings, and these may be several inches wide. In its early stages the white jelly growth of fungus thread is plainly visible just at the surface of the soil.

Here again, the treatment is the same as used for large brown patch.

SNOW MOLD

What It Is Snow mold is a common name used to designate one or more of the fungi injuring grass and other plants at very low temperatures. It is hardly a type of brown patch in the true sense of the word, but its damage to grass is quite similar. Its development is brought about by excessive moisture, in connection with low temperatures, caused by melting snow, heavy fogs or rain. The damage is ordinarily associated with snow although this in itself has nothing to do with the disease, except indirectly. It is not at all uncommon to find the so-called snow mold fungi where there has been no snow whatever on the turf. The infection is usually carried about by means of water and as a result an area of green which is washed by much surface water may be badly damaged. It has been observed that when snow falls before the ground is frozen the damage from snow mold is more serious. If this happens, the frost does not penetrate the ground to any marked extent and under this condition apparently the fungus can become active during a thaw at any time of the winter. In sections where snow does not lie on the grass all winter and thaws are frequent this injury may be seen as early as December.

Identifying Snow Mold The damage of snow mold is usually distinguished from other winter killing as the affected spots are often covered with an aerial growth or mycelium which when exposed to the sun takes on a pinkish color so that whole patches may have a pinkish cast. At this time the cob-webby growth is so abundant that the grass leaves are matted and form a thick layer over the affected areas. Some of the patches may not have this abundant growth but instead appear a dirty gray. Thus, these places are easily distinguished from areas where the grass has been killed by some other causes and which are light brown in color.

The so-called snow mold area takes in our northern states and Canada extending as a rule as far south as Cleveland and Detroit, although the disease has also been observed as far south as Columbus, Ohio. Of the turf grasses fescue seems highly susceptible while creeping bent and blue grass are less so.

Checking Snow Mold So far the best means found to check snow mold has been the use of corrosive sublimate (bichloride of mercury). In sections where damage by this fungus is expected during winter, the greens should be treated before the ground freezes by applying from two to four ounces per 1000 square feet of area. The amount should depend upon the vigor of attack in former years and a good plan is to treat some sections with different amounts to determine the necessary treatment. Experiments indicate that other mercury fungicides would control snow mold equally well providing they are used in such quantities as will give an equivalent amount of mercury. The problem of emergency treatments for grass that has become diseased during the winter is a serious one because it is almost impossible to get machinery on the course necessary to apply the fungicide in solution. However, if dry sand or screened soil is available the fungicide can be mixed with this and spread by hand as it is not necessary to water it in during winter. Treatment at this time may not check the fungus completely, but it will usually reduce the amount of damage.

The publication of this bulletin will have been well justified if it leads only to a more complete realization of the complexity of turf problems. These are not to be solved in a hurry and so every possible help should be given those agencies attempting to learn the best turf growing practices, even though at times their new methods seem entirely the reversal of former practices. Changes in greenkeeping practices should be considered in the light of new developments to meet changed conditions.

To approach properly a turf disease, all of the factors affecting it should be analyzed. The weather is probably not as much to blame for our troubles as are the soil condition, drainage, and fertilizing and watering programs.

Doubtless the phase of this report which will prove of most interest to golf clubs is the recent research on the use of lime. However, we hope no one will interpret the findings as a cure-all and expect lime to eliminate all turf problems.

Of particular interest at this time is the discussion of the value of certain commercial fertilizers. No doubt much grief has been caused by the over use of highly concentrated nitrogenous fertilizers and so in turning to the more slowly available sources of plant food the mistakes of the past should serve as a warning against the over enthusiastic use of these latter. Undeniable have been the good results from the use of cottonseed meal, soybean meal, and the like. It has been shown that, in some instances, the substitution of these for compost and sulfate will reduce the damage by brown patch. On the other hand it should be remembered that their over use has been responsible for scald at times.

In publishing this bulletin we are deeply indebted to Dr. John Monteith for his reports of the brown patch research conducted by the Green Section and published in their bulletins, and as delivered in his address before the 1929 meeting of the National Association of Greenkeepers; to the publishers of THE NATIONAL GREENKEEPER *and* GOLFDOM *for their many instructive articles relative to the golf course problem.*

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