

fairways was composed of Chewings fescue, which, up to the time of the disease, had made a strong and vigorous growth.

This gives a general idea of the proposition which we had to contend with, and we decided to analyze the situation and see what deductions we could make, with the following results:

1. All the damage done was confined to the area which had been recently woodland and had been cleared for the golf course.

2. Poor drainage had nothing to do with this blight, as the greens which appeared most affected were of the Cape and Redan type, both built up and both under-drained, with no possible chance of having any water remaining there.

3. Wherever the morning sun did not strike the fairways the damage was inconsequential.

4. Although there were four other greens built at the same time, by the same method of construction and with the top soil procured from the same place, these were scarcely damaged at all. Why was this? Our only answer is that they were not in the newly opened woodland.

What, then, can be done to prevent a recurrence of this trouble? From my experience and observation it seems that poor drainage was not the cause of the severity of the blight and that topdressing, such as we gave, did little good—it simply helped the clover. The remedy we now use (and we use it whenever we have hot and muggy spells in July and August) is Bordeaux mixture. We have had several periods during the last two years when the conditions were propitious for a severe attack. Whether the Bordeaux mixture prevented it or not, I do not know; but I do know that we have not had any severe recurrence of the blight. Possibly, as a severe disease makes a person immune from a recurrence, this attack may render the soil more or less immune. I do not know. This is merely a suggestion. The treatment of the fairways with Bordeaux mixture is out of the question, owing to the large area which would have to be treated; it would involve too great an expense.

The Brown-Patch Disease of Turf

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Until recent years practically every brown area that appeared on putting greens during the growing season was regarded as the effect of "sun scald." Now it is known that a fungus is responsible for many, if not for most of them. Drought and heat certainly cause the grass to burn, but the areas injured by disease are quite different in appearance from those injured by other causes. Whether the fungus disease is more prevalent now than formerly is not definitely known, since a critical study of the cause of browning was not made until 1914, when patches appeared in the turf experiments of Mr. Fred W. Taylor at his home near Philadelphia. These patches were particularly abundant on a strain of red fescue which Mr. Taylor transplanted from the Oleott turf garden, located at Manchester, Connecticut. The spots were a foot or less in diameter and very numerous. Mr. Taylor observed that they increased in size concentrically and that a fine white cobwebby covering could be seen on the newly formed patches in the early morning. This indicated a fungus as the causal agent; but laboratory examinations made at that time failed to

disclose the presence of an organism that could be suspected as being responsible for the trouble. Many cases were called to the attention of the writers in 1915. They ranged westward as far as Chicago and northward to the New England States.

The following year there was abundant opportunity to study the malady on putting greens and other pieces of fine turf in the vicinity of Washington, D. C. It was then that the trouble was definitely traced to the action of a fungus and the specific causal agent positively identified. Because of the appearance of the affected turf the name "brown-patch" was given to the disease.

The Disease and Its Characteristics

By orthodox laboratory methods, which involved inoculation of various culture media with material from freshly infected turf and likewise the inoculation of perfectly healthy turf in the laboratory and field, it was proved beyond a reasonable doubt that the fungus causing brown-patch is the one botanically known as *Rhizoctonia solani*. It is a soil organism which attacks a large number of plants in addition to grasses. Prior to this, however, it was not known to attack grasses. *Rhizoctonia solani* produces minute hard black bodies known as *sclerotia*. These form on the dead stems and leaves of the plants attacked and remain in the soil or on the surface until favorable conditions develop for their germination. They function as seeds or tubers and are very abundantly produced. When these resting bodies germinate they produce a fine white cobwebby covering called *mycelium* or "mildew," and it is through the agency of the *mycelium* that grass and other plants are injured, or, under extreme conditions, are killed.

The original infested areas may be very small, not larger than a dollar, or they may be several feet in circumference. The infection may spread concentrically for several successive days, or it may terminate with one night's growth. The grass during the period of active infection has a smoky, withered appearance, such as might be caused by hot water or some strong chemical.

Conditions Favoring Brown-Patch

Brown-patch is a warm-weather turf disease. The conditions most favorable for its growth occur in periods of moist, hot weather of late spring, summer, or early fall. During such periods patches of *mycelium* may be seen on turf in the early morning. A little later these spots take on the smoky or scalded appearance just referred to, and as the day advances and the temperature rises they turn brown as if touched by fire. If conditions favoring brown-patch continue, permanent injury to the turf commonly results, but if cool, dry weather follows, much of the infected turf revives and recovers completely, or nearly so, with the advent of fall. However, there are far too many cases of such complete killing of turf by brown-patch that it has been necessary entirely to remake putting greens which have been attacked by it.

Preference for Certain Species

Some turf grasses are much more seriously injured by brown-patch than are others. In fact, some appear to be nearly immune to it. Bermuda grass and crab grass, for example, have not been known to be attacked,

and white clover likewise seems to escape. Kentucky bluegrass is but very rarely affected. Most strains of the bents and fine fescue are very susceptible, particularly so the velvet bents. Some of the turf-infesting weeds are attacked, including mouse ear chickweed and veronica. Yarrow, which is really a good turf plant, offers but little resistance. Vegetative plantings of most strains of carpet and velvet bents are usually more susceptible to brown-patch than is turf produced from seeding, and pure strains of these grasses are even more susceptible, as a rule, than mixed cultures. Why this is true is somewhat of a mystery.

Time of Appearance and Distribution

No very definite survey has been made to determine the first dates of appearance of brown-patch in the spring or its distribution throughout the United States. In 1917 the first spots appeared in the turf garden at Arlington, Virginia, on June 3. In 1918 they were in evidence as early as May 30, but did not become numerous until July 12. Northward they do not usually develop until late in June. This year, 1921, a few spots were noticeable at Arlington on June 6, and specimens of brown-patch-infected turf were received from Massachusetts about the same date. The disease is likely to appear at any time after May 15 if hot, humid weather obtains. Reports received by the writers indicate that brown-patch occurs from Maine to Minnesota and at least as far south as bents and fescues can be grown successfully for putting greens. In the northern part of its range it usually does much less permanent injury than in the southern part although at least one example of very serious damage to putting greens occurred in New Jersey in 1918.

Treatment

Golfers very naturally will be more interested in learning of the remedy for brown-patch than of the details of the disease itself. In this they are due for some disappointment, since no really successful remedy has been discovered. Numerous experiments have been conducted with a rather long list of fungicides, and about the only one that offers sufficient promise to justify its use is Bordeaux mixture. Experiments indicate that the disease can be held in check by frequent light sprayings of half-strength Bordeaux; but this is a very expensive and tedious method of treatment. The difficulty with the use of Bordeaux or any similar fungicide is that as soon as it is removed from the plants by rain or by mowing, the disease starts new growth. It is not affected by the fungicide that is in or on the soil or on the older stems or leaves of the grass. Among the chemicals that have been used to combat brown-patch are mercuric chloride, iron sulphate, sulphur, and copper stearate; not one has given promising results.

Experiments are still being conducted with fungicides. But while waiting for help, very serious attention should be given to drainage. Poorly drained greens are more susceptible to brown-patch than are well drained greens; and during hot, humid weather it is very doubtful if late night watering is to be advised. An excess of moisture on the leaves of the grass during the night favors the development of the disease. If the spots that first appear are small it is well to remove them and transplant healthy turf. This may be done in many cases with a

hole cutter. In this way infection may be checked. The use of Bordeaux when occasion seems to justify the expense and effort, attention to drainage and watering, and the quick removal of the first infected spots, are about the only suggestions for controlling brown-patch that can be given at this time.

Hope in Resistant Strains.

Just as some species are less susceptible than others to the attack of brown-patch, so there are strains of certain species that seem to be much more resistant than others. This is particularly true of the bents, and it is especially encouraging, since the disease is a serious menace to vegetative propagation of these grasses. It is hoped that strains of carpet bent will be found to be highly resistant if not actually immune to the disease. A careful search is now being made for such strains, and if it is successful it will go far toward solving one of the most serious greens problems.

Power-Mowers for Fairways*

It now seems that greenkeepers in the United States are in a fair way to solve the problem of cutting the grass on fairways. The problem of cutting the rough is still unsettled, and the solution of these problems may effect a radical change in the method and practices now in vogue as to the sowing, fertilizing, and treatment of fairways. Heretofore the efforts of greenkeepers have been directed to the production of turf of dwarf grasses which are easily cut; but it would seem that when the problem of cutting grass has been completely solved, it may be better to use seed of the less expensive grasses, the kinds that grow most readily and thus produce a more luxuriant growth, and then keep it down by proper cutting. When a tractor is developed that will cut all the fairways of a course in a single day of say 10 hours, so that one man can cut the course two or three times a week, there would seem to be no reason why most golf courses should not have a good turf, as fertilizer can be applied until that result is obtained.

It must be remembered that all the cutting units now on the market were designed to be drawn by horses and are neither designed nor built to stand the high speed and rough usage of the tractors whose speeds vary from 4 to 15 miles an hour.

Nothing has been done up to this time but to fit tractors to existing mowing equipment. A great variety of tractor-mowers have come on the market within the last year and are now being tried out with more or less success in different parts of the country; but we are yet a long way from having perfect equipment. It would seem that the study and development of the future should be along the right lines to determine the most effective speed and the speed limits of rotary types of mowers, and that effort should be made to design and construct mowers capable of operation at speeds that are high in comparison with the old horse-drawn equipment. It goes without saying that mowing equipment must be designed with heavier and better gearing, bearings, and automatic lubricating devices; and when the most effective speed limit of the mowing

* The Green Committee expects to prepare a questionnaire covering various phases of this subject, and the answers will be published for the benefit of clubs contemplating the purchase of grass-cutting equipment.