

Relationship Between Fertilizing and Drainage in the Occurrence of Brownpatch

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The grass on putting greens tends to grow more slowly and to be weaker in the hot periods of the summer than in the cooler periods of the growing season, when a very rapid and vigorous growth takes place. Many greenkeepers desire to keep the turf growing as vigorously in the summer as during the cooler months of the spring and fall. Abundant fertilization or poor drainage particularly during the late spring and summer may cause a restriction of the root system, and shallow-rooted plants thus produced find it difficult to survive the unfavorable periods of the summer. Abundant fertilization may also cause an overstimulation of the grass which, although producing a turf apparently healthy and vigorous, yet leaves it particularly susceptible to fungus diseases and other injuries that may occur during the hot periods of the year.

For some time there has been a need for more definite information as to the correlation between fertilization and drainage and the occurrence of disease. Many observations have been made, and reports of experimental work at the Arlington turf garden given, as to the greater severity of disease on succulent fast-growing turf as opposed to a harder and slower-growing turf. A careful check on these observations and reports was thought to be desirable, especially on areas which were well drained and those poorly drained. A series of plots was therefore planned which would contain areas heavily fertilized, areas lightly fertilized, and areas not fertilized. These plots were laid out side by side with a series on well drained soil and a duplicate series on poorly drained soil.

The area selected for these tests is located under conditions that are favorable to severe attacks of brownpatch. It is on a low area on Arlington Farm on the bank of a river. The lower part of the area is not tile-drained and is only a few feet above the water level at high tide, and occasionally the water comes up to within a few feet of the turf. Another part of the area is raised four feet above the low level; this section is tile-drained and the water is carried off within reasonable time. The subsoil in this area is a silt loam and the topsoil a rich loam. The plots were 2 years old at the beginning of the 1933 season. The turf was of colonial bent, being selected for the purpose because of its susceptibility to brownpatch.

The whole area is surrounded by trees, so that most of it is shaded a greater part of the day. This retards evaporation of water, and the soil dries very slowly after a rain. The trees also form an air pocket so that winds are checked and the air drainage is very poor. During the past season of 1933 there has been an abundance of rainfall, which has kept the lower part of the area almost constantly soaked with water and supplied the upper part with more water than it would ordinarily have had with artificial watering. At one time during the season a flood from the river brought the water up so that the higher area was under water for several hours. All of these conditions are favorable to severe attacks of brownpatch and under such severe conditions brownpatch was at least slightly active on 89 per cent of the days from June to mid-September and severe attacks occurred on 56 per cent of the days during the same period.

The fertilizer selected for these tests was sulphate of ammonia, since it is readily available to the plants and causes a succulent growth and a quick response of the grass. This fertilizer when applied abundantly makes grass more susceptible to brownpatch, as has been proved in other tests that have been made previously. The treatments were divided into three classes—heavily fertilized, lightly fertilized, and checks which received no fertilizer. The heavily fertilized plots received 23 pounds of sulphate of ammonia to 1,000 square feet during the period from April to August. The first applications were at the rate of 5 pounds to 1,000 square feet. This rate was cut to 4 pounds in the early summer, and 3 pounds were applied during the midsummer period. This amount of fertilizer may not be considered overfertilization on many putting greens, particularly for greens on sandy soil, but for greens located in low pocketed areas with poor drainage and stiff soil it proved much more than is necessary or good for the turf.

The lightly fertilized plots received 8 pounds of sulphate of ammonia for the same period. The first application of the year was at the rate of 5 pounds to 1,000 square feet, and 1 pound to 1,000 square feet in the subsequent treatments. This amount of fertilizer was sufficient to keep a good growth of grass on the plots during the season, and in a drier year when the fertilizer would not have leached out as quickly less might have been applied to obtain a lightly fertilized turf.

During the month of May all of the plots were given fungicidal treatments to check brownpatch so as to give the grass a chance to respond to the fertilizer before the advent of the brownpatch season in June. These treatments consisted of 3 ounces of corrosive sublimate and calomel in the proportion of 1 part of corrosive sublimate to 2 parts of calomel mixed with topdressing and watered. After June 1 only half of each plot was treated for brownpatch and the other half was left untreated for the rest of the season. The treatments during June were at the rate of 2 ounces to 1,000 square feet and during the rest of the summer at the rate of 1 ounce to 1,000 square feet. Where an ounce of fungicide was applied, corrosive sublimate alone was used because of its rapidity in checking the disease, which became so serious that treatments had to be applied frequently.

Brownpatch developed in the untreated areas during most of the summer. There were only a few days when the disease was not active on some part of the test plots. During the summer, only on one or two occasions did any brownpatch appear in the treated areas, and on those occasions the attacks were small isolated spots which did little damage. It was necessary to treat every week, and in some weeks when it was hot and humid it was necessary to treat oftener than once a week.

On these plots, where every condition was favorable to severe and frequent attacks of brownpatch, almost complete control was obtained. At the end of the season some of the untreated plots were almost completely covered with areas injured by the disease, and many of these areas had to be reseeded to reestablish the turf.

During the course of the experiment the occurrence of brownpatch on the untreated plots was noted. A record of severe and light attacks was kept; the accompanying table gives a summary of these records. In making this arbitrary division between light and severe

attacks consideration was given to the total number and size of affected areas as well as to the amount of damage resulting from the attack. Therefore an attack which affected a large proportion of turf might be classed as a light attack if the total damage to the turf was light. On the other hand, if an attack resulted in serious damage to turf it might be regarded as a severe attack even though a relatively small amount of turf was involved. As a general rule, however, there was a direct relation between the area affected and the amount of injury resulting from any attack.

NUMBER OF ATTACKS OF BROWNPATCH ON HEAVILY AND LIGHTLY FERTILIZED PLOTS AND ON CHECK PLOTS ON WELL DRAINED AND POORLY DRAINED AREAS.

	WELL DRAINED			POORLY DRAINED		
	<i>Heavily fertilized</i>	<i>Lightly fertilized</i>	<i>Check</i>	<i>Heavily fertilized</i>	<i>Lightly fertilized</i>	<i>Check</i>
Severe attacks	26	18	12	27	27	18
Light attacks	15	19	18	14	14	24
Total	41	37	30	41	41	42

It will be noted from the table that on the well drained areas the heavily fertilized plots had 26 severe attacks of brownpatch while the lightly fertilized plots had 18 and the checks only 12. The heavily fertilized plots had fewer light attacks of the disease than the lightly fertilized or the check plots. However, the heavily fertilized plots had a total of 41 attacks of disease, which is 37 per cent more than the checks. The lightly fertilized plots had a total of 37 attacks, or 21 per cent more than the checks. There is not a great difference between the total number of attacks on the lightly and heavily fertilized areas, but the attacks that did occur on the heavily fertilized plots were much more severe.

The first occurrence of the disease in the season took place on the heavily fertilized plots, and these attacks were severe. The first few attacks that occurred on the lightly fertilized plots were light compared to those on the heavily fertilized plots. Later in the season severe attacks occurred on both the heavily and lightly fertilized areas. This indicates that when the turf is succulent and growing fast the grass is more susceptible than when it is not. In the early part of the year, when the temperature is not as favorable for the fungus, the disease will not develop as severely if the grass is not particularly susceptible. Later in the season, when temperature conditions are more favorable for the development of the fungus, the disease may attack grass which is not succulent and susceptible.

On the poorly drained area the heavily and lightly fertilized plots had the same number of severe and light attacks, 27 and 14 respectively. The number of severe attacks on the fertilized plots was 50 per cent greater than on the unfertilized check plots. The check plots had more light attacks than the fertilized plots and about the same total number of attacks, but the damage they caused was much less severe. In this area the moisture content of the soil was high at all times and conditions were favorable for the development of the disease. The fungus attacked the grass whether it was fertilized or not, but the unfertilized grass suffered far fewer severe attacks and was not as severely injured.

The heavily fertilized plots had about the same number of severe and light attacks on the well drained as on the undrained areas. This

indicates that when too much fertilizer is applied disease will occur as frequently on well drained as on poorly drained turf. However, the injury is often more severe and the grass does not recover as quickly on the poorly drained areas. On the lightly fertilized plots there were 50 per cent more severe attacks on the poorly drained than on the well drained areas. The poorly drained check plots also had 50 per cent more severe attacks than the drained check plots. In both instances there were more light attacks on the well drained than on the poorly drained plots, showing that when conditions were favorable for fungus growth the attack was apt to be more severe on the poorly drained than on the well drained plots. The total number of attacks on the poorly drained check plots was 40 per cent greater than on the well drained check plots, so that evidently the rapid draining of the water gave the turf some measure of protection from the disease.

Severe attacks of brownpatch can in a large measure be prevented or lessened in many cases by providing good drainage. On putting greens where a healthy and vigorous growth of turf is desired at all seasons of the year every means should be taken to encourage such healthy and vigorous growth. Therefore the green should be provided with drainage, both surface and underdrainage, efficient enough to remove excessive water with reasonable rapidity during wet seasons.

The conclusion may be drawn from these experiments that overfertilization of turf and poor drainage may cause frequent and severe attacks of brownpatch. The time to fertilize and the amount of fertilizer to apply depend on the condition of the grass, the location of the putting greens, drainage, amount of rainfall during season, type of soil, weather conditions, natural richness of soil, and type of grass. It is not possible to give a general recommendation of the amount and kind of fertilizer to apply to greens, since each green must be treated differently, according to its requirements and to the season. It is important, however, to be careful with fertilizers and to apply only as much as is necessary to keep the turf in good putting condition without making it succulent. Turf on poorly drained areas may be much more seriously injured by overfertilization than turf on well drained areas, and when grass is injured by disease or any other condition recovery is much slower on poorly drained areas. Less fertilizer is needed to keep grass in a healthy condition on poorly drained soil, because there is no leaching of plant nutrients; such grass tends to grow more slowly, and less fertilizer is used in a certain period of time.

The title "poor man's weatherglass" has been earned by a species of nonpoisonous mushroom of the genus *Geaster* (earth star), which serves as a barometer on account of its sensitivity to changes in atmospheric humidity. It grows in woods and sandy places and on partly cleared land. The two outer coats of its puffball split into sections which remain united at the top of the ball. These two coats however do not absorb moisture in the same degree, with the result that when the relative humidity is high the sections of the outer coats stand out from the plant, and when the humidity is low the inner coat contracts more than the outer coat so that the sections curve sharply inward. This mushroom is also known as the barometer earth-star.