

an overproduction of that soft growth most likely to be damaged by this disease. Observations of several years have indicated that the excessive and exclusive use of any one fertilizer rich in nitrogen is apt to increase the damage caused by large brown-patch.

EFFECT OF LIME ON BROWN-PATCH

Numerous observations on the fertilizer plots at the Arlington turf garden and on golf courses have indicated that a deficiency of lime might in some way account for some of the lack of vigor of turf and the great damage from brown-patch. A few preliminary

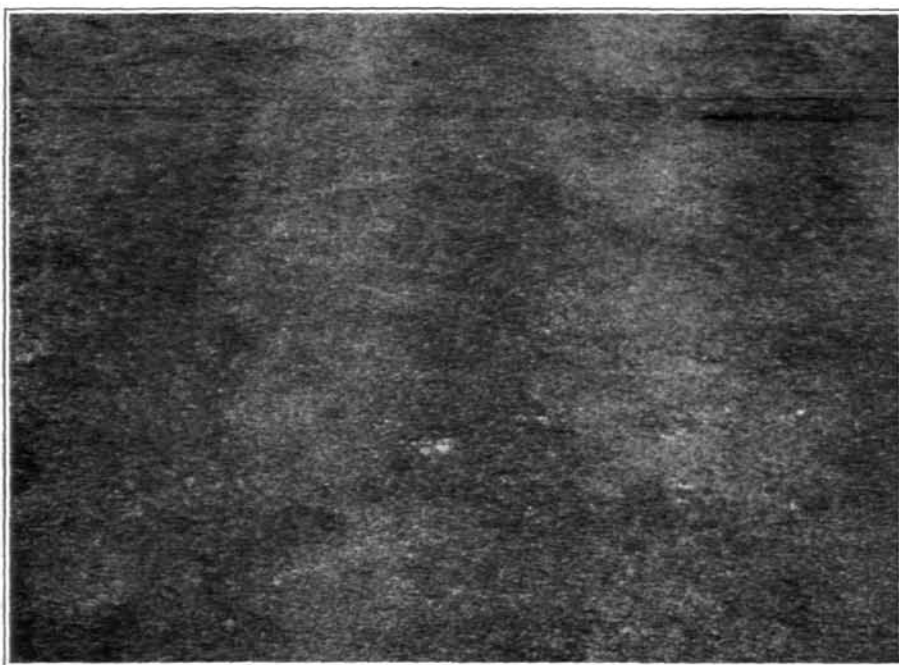


Fig. 5.—Th's plot of Metropolitan creeping bent was given an application of lime at the rate of 1 ton to the acre on July 10, 1928, when small brown-patch was scattered over the entire area of the plot. The photograph was made three weeks later, and shows the recovery due to the application of lime. No fungicides were used on this plot in 1928. Compare with Fig. 6, which shows the plot adjoining on the left.

trials with lime during 1926 and 1927, in conjunction with other investigations reported elsewhere in this discussion, indicated that lime in certain cases might reduce the brown-patch losses. As a result of these previous observations a number of tests were planned for the season of 1928. Figures 5 and 6 show examples of the results obtained. During the seasons of 1926 and 1927 the turf in these plots had been uniformly treated with regular monthly top-dressings of compost and sulphate of ammonia and had been protected against brown-patch by periodic treatments with corrosive sublimate and calomel. The applications of mercury fungicides were discontinued in 1928, and in June of that year small brown-patch became generally distributed over the two plots. The turf between the diseased patches did not have a healthy color and failed to show the usual response to fertilizers. On July 10 hydrated lime at the rate of one ton to the acre was applied to one of these plots. The other was left untreated for comparison with the limed plot and thereafter both

were fertilized and otherwise cared for alike. The limed turf in a few days turned a dark green, healthy color, and the scars of brown-patch were soon obliterated by the new turf. The adjoining unlimed plot still had the yellowish green color of unthrifty turf, and small brown-patch continued to be very much in evidence. As shown in these figures, when the plots were photographed on July 30, there was a most striking difference in the two plots in favor of the lime treatment. The limed grass continued to grow much more vigorously than that in the unlimed plot throughout the remainder of the summer.

In another series of tests, on several plots of German mixed bent, one plot was treated with lime and then divided into four squares

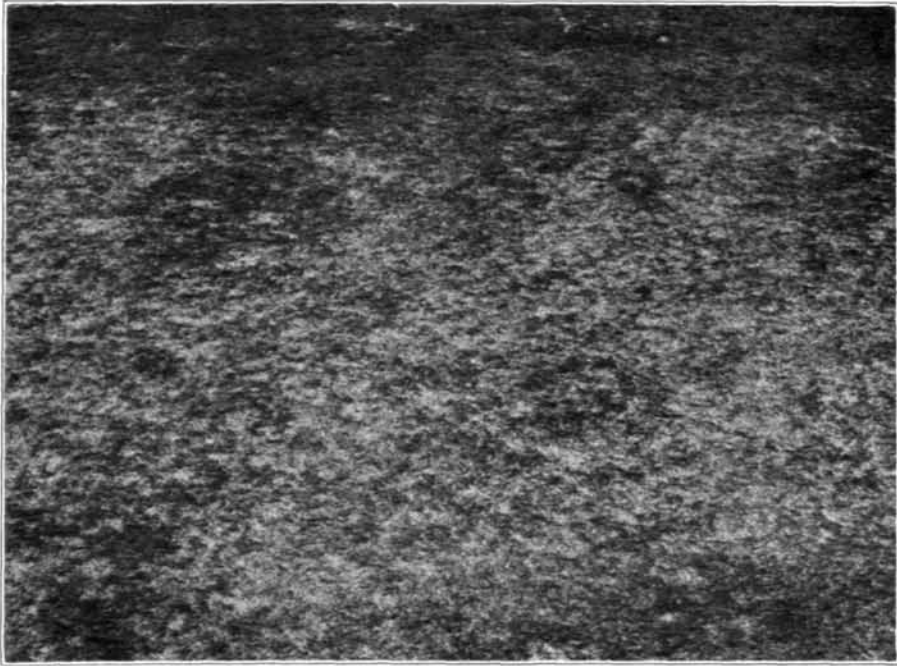


Fig. 6.—Plot of Metropolitan creeping bent which previous to July 10, 1928, had received the identical treatment as the plot shown in Fig. 5. When the latter plot was limed July 10, 1928, the plot in the accompanying illustration was left as a check, being treated with neither lime nor any other chemical. The small brown-patch scars in this plot did not heal, whereas almost all trace of the disease had disappeared from the adjoining limed plot shown in Fig. 5 at the time the two plots were photographed, July 30, 1928.

which were given different rates of sulphate of ammonia. One of these squares was left as a check without any sulphate; the second received an application of sulphate at the rate of $2\frac{1}{2}$ pounds to 1,000 square feet a month; the third received this same application every two weeks; and the fourth was given the same application every week, which amounted to the very heavy rate of 10 pounds within four weeks. The adjoining plot received no lime, but was likewise divided into four parts and treated with similar amounts of sulphate of ammonia. When large brown-patch first became active on this series of several plots it occurred on all with the exception of the one receiving lime. The plots receiving lime and sulphate of ammonia are shown in figure 7 and the adjoining plot receiving sulphate of ammonia alone is shown in figure 8. The other plots in the series which received different combinations of fertilizers were affected

with disease in much the same manner as the one shown in figure 8. Later in the season large brown-patch appeared in the limed plot shown in figure 7 but the injury was slight and recovery rapid.

Figure 7 also shows another interesting point brought out in this series. The upper left corner appears darker, due to the more vigorous growth of turf in this quarter where heavy applications of sulphate of ammonia had been used. On the other plots in this series where lime had not been used, sulphate of ammonia, even though mixed with fertilizers which contained phosphorous and potash, failed to give the grass the characteristic color of well fertilized turf. Whether this difference was due merely to a change in acidity of the soil, to a release of other plant foods, or correction of some toxic condition, is not known. From the practical standpoint it makes no

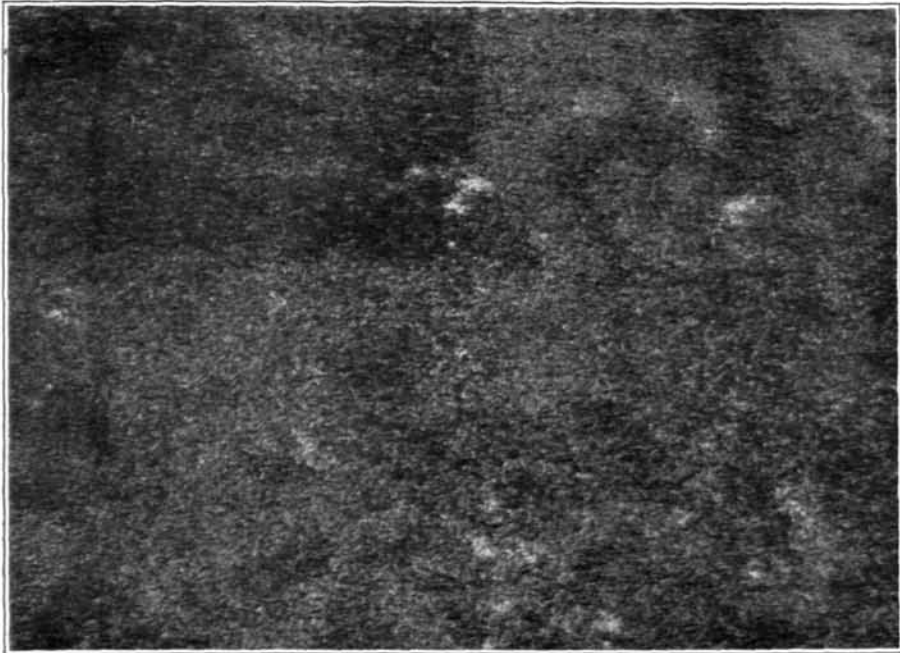


Fig. 7.—Limed plot of German mixed bent. There was no trace of large brown-patch in this plot when the photograph was taken, July 30, 1928. In addition to receiving the application of lime, this plot, like the adjoining plot shown in Fig. 8, had been divided into quarters, which were treated with sulphate of ammonia at different rates. The heaviest rate in this case was used on the quarter in the upper left, resulting in the darker color of its more vigorous growth. All the grass in this plot was more vigorous than the grass in any part of the plot shown in Fig. 8. The scattered light spots in this illustration show the scars where weeds had been removed shortly before the plot was photographed, for like the bent the weeds were more vigorous in the limed plot.

difference whether the action of lime be direct or indirect. The fact of importance to golf clubs, which was brought out in these tests, is that lime on some soils can bring about beneficial results which none of the fertilizers nor combinations of fertilizers tested were able to accomplish. The heavy rate of sulphate of ammonia used on the quarter plot shown in the upper left of figure 7 is more than should be used on golf courses. This extreme rate, however, serves to illustrate how sulphate of ammonia may be used to advantage when soil conditions are favorable, whereas it may utterly fail to aid turf, or may be actually harmful, when soil conditions are unfavorable.

Many tests have been made on golf courses which indicate the value of lime on certain soils for checking the ravages of brown-

patch as well as increasing the vigor of turf. One of the most convincing of these tests called to the writer's attention was that on the course of the Upper Montclair Country Club (New Jersey), in the late summer of 1928. Mr. R. F. Arnott and Mr. William Braid of that club visited the turf garden at Arlington, and after seeing the results obtained there with lime they felt certain that the unthrifty appearance of turf on some of their putting greens resembled the turf on the unlimed plots at Arlington. However, instead of drawing hasty conclusions and applying lime over their greens in the customary indiscriminate manner, they chose the wiser method of delaying any general application until they determined whether their turf actually needed lime. Across one of the poorest greens they marked off a narrow strip, on which they applied lime. In a few days they had no difficulty in determining positively as to whether



Fig. 8.—Large brown-patch on German mixed bent. This plot had been divided into quarters, which were treated with sulphate of ammonia at different rates. The heaviest rate was used on the quarter in the lower left, where a conspicuous large area of diseased turf developed. Compare with the adjoining plot, shown in Fig. 7, photographed the same day.

lime would benefit their greens. The limed band across this green soon turned a dark, healthy color, in striking contrast to the yellowish, unthrifty turf on the unlimed portion. Soon after this change had occurred there was an attack of large brown-patch on this green. The disease was generally distributed throughout the unlimed portion but did not affect the limed strip. Several interesting patches occurred along the borders of the limed area; instead of the usual circular patches there were semicircular spots, where the disease had developed up to the border line of the limed portion and there stopped. The rest of the green was then limed and the entire green soon appeared uniformly healthy. After this simple and convincing test had been made it was possible to use lime with entire confidence on that course wherever the turf showed a similar unthrifty condition.