Winter Brown-Patch in the South

Bermuda grass, the common putting green grass in the South during the spring, summer, and fall, fortunately seems to be immune to the brown-patch disease. It is different, however, with temporary winter greens of ryegrass and redtop. These latter two grasses are very susceptible to brown-patch in the North during the warm portions of the year, and have also been known to suffer severely in the South during winter when used as temporary turf for putting greens. Frequently on greens of this character the turf will turn brown in patches over night, and is very apt to be killed.

A large amount of experimental work in the control of brown-patch was carried on in the summer of 1925 near Washington, D. C., and the results of the experiments have been published in the Bulletin, and summarized in the articles on pages 219 and 272 of the 1925 volume. Clubs having temporary greens of ryegrass or redtop should familiarize themselves with the control methods which have been found to be the most efficacious in our experimental work, and should be equipped to combat the disease at the first sign of its appearance.

In the control of brown-patch, too much emphasis can not be laid on the necessity for providing adequate drainage, both surface drainage and under-drainage. Perfect drainage does not necessarily mean immunity to brown-patch, but where the drainage is poor the ravages of the disease are sure to be much worse than where good drainage is provided.

A Method of Grub-Proofing Turf

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There can be no doubt that any method which would insure the growing and maintaining of the turf of greens and fairways free from attacks and injury by grubs and earthworms would prove to be a decided advancement over the present methods of golf course maintenance. That such an insurance against turf insect depredation is possible is indicated by the results of the past four years' experimental work conducted at our laboratory, with the object of producing grub-proof turf. While the experimental work is far from complete the information obtained to date is herein presented.

Grubs in turf arise from eggs deposited therein by beetles and certain other types of insects. These eggs hatch, and the grubs feed on the roots of the grass, causing injury, often to such an extent that the turf is entirely ruined. The grub of the Japanese beetle is an example of this type of pest, while there are many native species of grubs found in various parts of the country of similar nature and habits.

Earthworms are objectionable in turf, especially on greens, not because they feed on the roots of grass but because they are constantly bringing up small accumulations of soil, commonly spoken of as worm-casts, which litter the surface of the green and ruin it from the standpoint of appearance and play.

The present-day methods of controlling the above pests in turf
consist essentially in treating the latter with toxic materials (usu-
ally in solution) which penetrate into the soil and kill a certain pro-
portion of the grubs and worms present, that proportion depending
upon the skill of the operator. The present method of controlling
the grub of the Japanese beetle by means of the carbon disulfid
emulsion, as reported in the articles on page 262 of the BULLETIN,
October, 1923, and page 100 of the BULLETIN, May, 1925, and the
method of controlling earthworms by means of corrosive sublimate
solution, are typical examples of this general method of turf-pest
control. These methods have been of great value in checking the
ravages of turf insect pests; in fact, they will probably always play
an important part in control work of this type. Certain habits of
the grubs and worms in question, however, led the senior writer
some four or five years ago to the belief that another and simpler
method of control could be evolved.

Practically all grubs and worms which feed in turf have one
common habit which renders them open to attack from the stand-
point of control. This common habit consists of the fact that all
grubs and worms are constantly taking particles of roots, organic
matter, and soil into their bodies. This material is acted upon by
the intestinal juices of the grubs or worms; the portions of the
mass having a food value are extracted, and the remainder ejected
from the body by the usual processes of elimination. It follows,
therefore, that if the soil can be impregnated with poisonous mate-
rial so that the latter is taken into the stomachs of these grubs and
worms during the course of their feeding, there is every probability
that these grubs and worms will be killed. The experimental re-
results have demonstrated this possibility to be a certainty. In addi-
tion, the experimental results indicate that the types of grasses
commonly employed on the greens and fairways of golf courses
grow remarkably well in poisoned soil.

Let us suppose, as an example, that a certain green is no longer
in a serviceable condition, and is about to be disked, raked over, re-
inforced with compost, and seeded. The poison in the form of a
dry, fine, insoluble powder is spread evenly over the soil and thor-
oughly worked in to a depth of 4 inches by means of a harrow and
rake. The green is then seeded in the usual manner. The upper
4 inches of soil will then contain the poison evenly distributed
throughout while the soil beneath the 4-inch level will be normal.

Let us further assume that at some time after this particular
green has been treated as above, large numbers of Japanese beetles,
May beetles, or other similar species appear and proceed to lay
their eggs in the turf of the green. These eggs may be deposited
in the soil at various depths and hatch into small grubs within a
few days. These young grubs immediately begin to feed in the soil. Within a very few days they have taken sufficient poison into the system along with their natural food to cause their death. It follows therefore that at no time are the roots of the grass injured by the long-continued gnawing of countless grubs.

The work of the last four years, during which many materials have been tested in order to determine their value as stomach poisons for the control of grubs in turf, has demonstrated the outstanding value of two compounds in this connection. These two compounds are acid lead arsenate and sodium silicofluorid. At this stage of the work the acid lead arsenate seems to be the better. Our present method of application consists in spreading the powder on the surface of the soil at the rate of 3 1/2 pounds per 100 square feet and then thoroughly working it into the soil to a depth of 4 inches. This operation is preferably done when the soil is on the dry side. The ground can then be seeded and handled as usual. It is obvious that this operation must be carefully and intelligently performed in order that every portion of the upper 4 inches of the soil may be supplied with its proper share of the poison. If any portion of the green is neglected, it will of course result in a "spotty" control. Future topdressings of this green must, of course, be made with poisoned soil in order to maintain the surface layer. The poison should be mixed with the topdressing at the rate of 2-4/5 pounds per cubic yard.

The question naturally arises, Is the grass harmed by the poison? The effect of arsenate of lead, when mixed with soil, upon the growth of grass has been studied at this laboratory for the past three years. The initial tests were made in 12-inch pots in the greenhouse. Figure 1 illustrates a pot containing creeping bent grass growing in treated soil. As a result of the favorable nature of these pot tests, testing of grass growth in poisoned soil was extended to include field trials. In this test 9 species of grasses are included with 3 plots of each, as shown in Figure 2.

Of the grasses tested to date, the most pronounced success in the growing of grass in poisoned soil has been obtained with German mixed bent (seed) and creeping bent (stolons). (Figures 3 and 4.) Chewings' fescue, meadow fescue, and Kentucky bluegrass have also done remarkably well, while the growth of perennial ryegrass and sweet vernal grass has been fair to good. Poa trivialis and Canada bluegrass have not proved satisfactory. Redtop has done well in pots but has not as yet been tested in the field. It is of course realized that many other species of grass must be tested in this connection, but the above results, embodying a miscellaneous
list of species, are a sufficient indication that the method is essentially sound and worthy of further extensive investigation. It is not expected that all species of grass will do well in poisoned soil, but it is probable that a sufficient number of grasses will be available to take care of the needs of the various sections of the country.

When grass seed or stolons are planted in poisoned soil, germination is from three to six days slower than in unpoisoned soil. For the first three weeks after seeding, the grass in the poisoned soil is somewhat slower in growth than the grass in untreated soil under similar conditions; but all during that period the grass in the poisoned soil is slowly but surely catching up with the grass in unpoisoned soil in vigor and appearance. At the end of six to eight weeks at most, no difference can be noted. For this reason it is well to reserve judgment on the quality of the turf grown in poisoned soil until at least two months after seeding.

In view of the slower germination of grass seed and stolons in poisoned soil it is highly advisable to so regulate the make-up of the surface soil that "caking" does not occur (observe the results of this as shown in Figure 2). This can be done, in the case of heavy soils, by the addition of organic matter and sand to the surface layer.

As regards the length of time over which soil that has been treated with poison will remain grub-proof, it is impossible at the present time to make a definite statement. It may be said, however, that a plot of turf treated with arsenate of lead and seeded three
years ago, is today apparently as grub-proof as the day it was treated. Recent examination of the poisoned turf showed no grubs present, while the untreated turf alongside had an infestation of 240 grubs to the square yard. Whether this turf will remain grub-proof for five or ten years longer, time only will tell; but there is every indication that the grub-killing power of this soil will persist for a long time. If that should be the case it is fairly obvious that insurance against grub injury can be secured for a relatively long period of time and at a relatively low cost.

Acid arsenate of lead now sells on the open market for approximately 14 cents a pound. When used at the rate of 1,500 pounds to the acre (3½ pounds per 100 square feet) it would cost approximately $210 for material per acre. A green 70 by 80 feet in size will require about 200 pounds of arsenate of lead, at a cost of approximately $28. This of course is the initial cost. Divide this initial
cost by the number of years of grub-proof insurance obtained, and it is very probable than the annual cost of the method will be exceedingly small.

There is a possibility that a method can be worked out whereby a green in good tilth can be given a top layer of poisoned soil by means of topdressing. It is estimated that an average of \( \frac{3}{2} \) inch is added to the average well-kept green, by monthly topdressing, during the course of a single season. We are reliably informed that if necessary an inch of topdressing could be applied in a single season without injury. It follows, therefore, that this method may offer a possible solution to the problem of making a green grub-proof without the necessity of tearing it up and reseeding. Extensive experiments are planned for the coming year on this point.

There are various phases of the problem with regard to which adequate information has not yet been obtained, and experimental work is being planned with the object of securing this needed information. One of the most important problems consists in determining the amount of arsenate of lead to use and to what depth it should be mixed. In the case of the Japanese beetle, observations indicate that 4 inches of poisoned soil is unnecessary, that in fact 2 inches will be ample. Whether a depth of 2 inches will be sufficient for earthworms and grubs other than the Japanese beetle, can not be said at the present time. In the same way it may be possible to reduce the amount of poison per square foot when the layer of poisoned soil is less than 4 inches, thus reducing the cost.

The chemical action of such fertilizers as ammonium sulfate, acid phosphate, and potassium chlorid upon arsenate of lead in the soil is not as yet fully understood; but the much-used ammonium sulfate will in all probability have very little chemical effect upon the poison. Under the circumstances, it is suggested that the use of commercial fertilizers in connection with the testing of arsenate of lead in experimental plots be avoided until more tangible information is obtained on their action.

Although the above information is based on four years of experimental work, the writers nevertheless realize that much more work remains to be done before the method can be placed on an extensive-scale basis. In the meantime, and in the absence of complete information, this paper is presented as a basis for those who wish to give the "poisoned-soil method" a trial. It is urged that any such trial, at the outset at least, be confined to small areas of turf, say not more than 100 square feet. Do not enlarge operations until you are sure that it is safe under your local conditions.

The writers are anxious to assist in any possible way and are very desirous of securing reports of trials.

The Maximum Desirable Slope of Putting Greens.—It is rather astonishing how many putting greens of golf courses both in America and Britain are too steep. Apparently such are built without measuring the slope or in ignorance of the limit of desirable steepness. Where the slope exceeds 3 percent or 1 foot in every 33, a ball putted downhill will gather momentum on a perfect putting green. Therefore a 3 percent slope should never be exceeded on a green, excepting, of course, on any mounds or ridges near the back of the green.