

## 1927 Experiments on Brown-Patch Control

By John Monteith, Jr.

During the summer there were comparatively few attacks of large brown-patch on the Arlington Turf Garden and none of these caused the serious damage so often resulting from this disease. Small brown-patch, on the other hand, appeared early in the season and occurred repeatedly throughout the summer, on several occasions causing much damage to turf which had received no preventive treatments. Observations on control of large brown-patch were therefore unfortunately limited and the results reported here are in the main those obtained in experiments for the control of small brown-patch.

Efforts were chiefly devoted to further testing the effectiveness of various chemical compounds containing mercury. Following in general the plan of the preliminary tests of the previous summer a large number of experiments were conducted to compare the inorganic mercury compounds with the two commonly used organic preparations, Uspulun and Semesan. Some new trade mixtures were tested; much additional work was done with calomel and corrosive sublimate; various combinations of mercury fungicides and nitrogenous fertilizers were kept under observation during the season; and a number of promising new control measures were worked with in a more or less preliminary way. As a result of this season's experimental work we feel much more confident in our knowledge of the possibilities and limitations of the mercury fungicides. Much of the other work is still too preliminary to justify any general conclusions and it will not be reported until tested for at least another season.

### Organic and Inorganic Mercury Fungicides

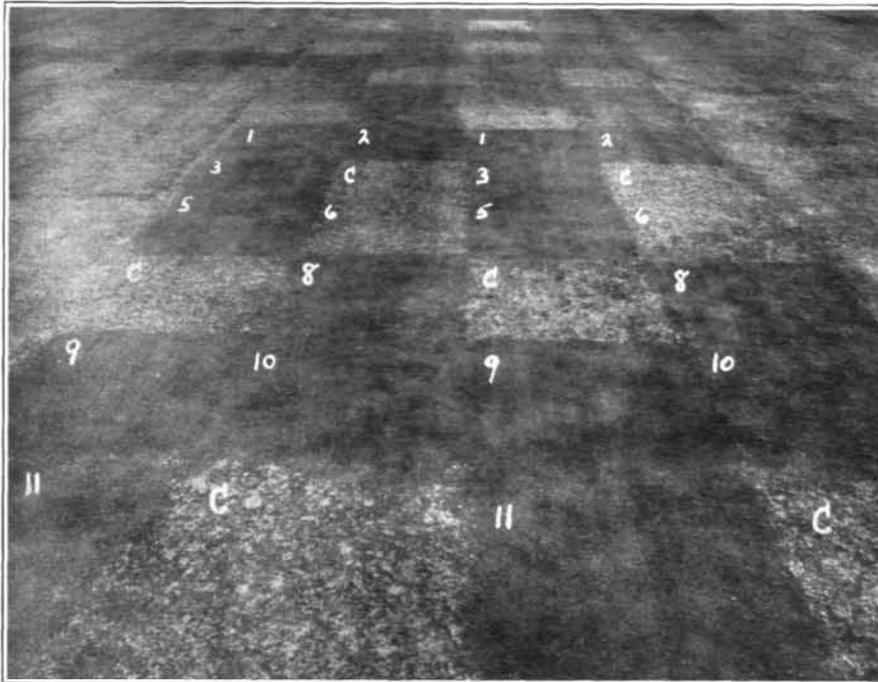
In our previous work with a number of organic mercury preparations and corrosive sublimate it became evident that each would control brown-patch. This suggested the possibility of finding an equally or even more effective chemical among the less expensive inorganic combinations readily available on the market. Therefore, during the summer of 1926 a group of these chemicals were selected and tested in a series of adjacent plots at Arlington, as reported in the October, 1926, BULLETIN.

In arranging these tests the chemicals were applied at such rates that each plot received a like amount of mercury. Since the percentage of mercury contained in the different compounds varies over wide limits, there was a big difference in the quantities used on the individual plots. Below is given a table showing the percentage of mercury in each compound tested and the weight of the chemical required to give one pound of mercury:

Chemical	Percentage of mercury	Pounds required to carry 1 lb. mercury
Mercuric oxide .....	92.61	1.08
Mercuric sulphide .....	86.22	1.16
Mercurous chloride (calomel).....	84.98	1.18
Mercuric cyanide .....	79.41	1.26
Mercuric chloride (corrosive sublimate).....	73.88	1.35
Mercurous nitrate .....	71.48	1.40
Mercuric sulphate .....	67.62	1.48
Semesan .....	16.50	6.06
Uspulun .....	16.50	6.06

The column at the right will have perhaps more significance if one thinks of it as representing the number of pounds needed for a green of slightly over 6,000 square feet—based on the usual recommendation of one pound per 1,000 square feet for Semesan or Uspulun. It will be noticed that the amount of Semesan or Uspulun used was approximately five and a half times greater than that of the mercuric oxide and five times greater than calomel.

The results this year repeatedly confirmed those obtained the preceding season. With the exception of mercuric sulphide, all controlled the disease. Most of the time it was practically impossible to pick out one of these plots as superior to the others. This is shown in the



#### CONTROL OF SMALL BROWN-PATCH WITH SEVERAL MERCURY COMPOUNDS

Each treated plot (16 square feet) received the same amount of mercury (see table in text). This illustrates the similar effect obtained from the different chemicals with the exception of the sulphide. The spotted check plots, which received no fungicides, show how generally the disease was distributed throughout the area tested. The series at the left was on Metropolitan creeping bent; that on the right was on Washington creeping bent.

- Plot No. 1 received corrosive sublimate.
- Plot No. 2 received mercuric sulphate.
- Plot No. 3 received Semesan.
- Plot No. 5 received calomel.
- Plot No. 6 received mercuric sulphide.
- Plot No. 8 received mercurous nitrate.
- Plot No. 9 received mercuric oxide.
- Plot No. 10 received Uspulun.
- Plot No. 11 received mercuric cyanide.
- C represents check plots, no fungicides.

accompanying illustration in which the dark squares of healthy grass are practically uniform in appearance. When compared with the badly spotted check plots, where no preventive treatment was used, with the exception of mercuric sulphide, they show how effectively these chemicals checked small brown-patch.

Late in the summer some tests were made with a mixture of metallic mercury in powdered chalk, using an amount of mercury equal to that used in the above series. It was found that this also was effective in checking the disease and that mercury in this form was apparently as efficacious as when combined in any of the above chemical compounds. Therefore, considering simply the control of small brown-patch, when comparing values among any of these chemicals, it seems that the chief item to be considered is the actual amount of mercury they contain.

There are, however, other factors that must be considered other than that of control of the disease. One of the most important of these is the effect each chemical has on grass. All of the mercury preparations that have proved to be effective in controlling brown-patch are liable to injure turf if used in excess. For reasons thus far undetermined, a dose of any of these chemicals which at one time is found to be perfectly safe, at another time under somewhat different conditions may prove to be greatly excessive. Also, as with other chemicals, some strains of grass are more susceptible to injury than others, but these differences vary in the same way with all of these mercury compounds. From the standpoint of injuring turf, mercuric cyanide is apparently impractical for use on golf courses. We have used it many times without observing any serious burns, but on other occasions it has caused severe injuries. Mercuric chloride (corrosive sublimate or bichloride of mercury) has long been recognized as a dangerous chemical on greens if used carelessly or in excess. It is by no means as dangerous as the cyanide, but rates second on the list from this standpoint. It nevertheless has several points in its favor, and in spite of occasional injuries it undoubtedly will continue to hold an important place in brown-patch control. Of the group which controlled the disease, calomel again proved to be least likely to burn the turf. Calomel and corrosive sublimate will be discussed more fully later.

The duration of the period in which a chemical will protect turf from brown-patch is another factor worthy of consideration. It has been found that none of them will offer protection for any definite period. An application which at one time may prevent the disease for four to six weeks at another time may be effective for but two to four days. In a general way the conditions which limit the period of protection for one mercury compound likewise shorten the time that any of the others remain effective. There were, however, some differences noticeable in the plots throughout the season. The cyanide and bichloride plots usually were the first in which the disease reappeared, whereas the calomel plots were the last of the series to become reinfected. At times these differences were apparent for several days, but many times they were of little importance.

The promptness with which a chemical checks a disease is also important, especially in the case of large brown-patch. The cyanide and bichloride, which are more likely to injure turf and give the shortest protection, appear to be the most rapid in checking the fungi causing both types of brown-patch. Calomel, which gives the longest protection and is least liable to injure turf, proved to have the disadvantage of being the slowest to check these diseases. In most cases, however, calomel acts quickly enough in controlling small brown-patch, but in controlling large brown-patch it is usually too

slow. It acts as a preventive just as the other mercury compounds, but when applied to check a rapidly developing case of large brown-patch its action is delayed long enough to permit the disease to produce bad scars.

#### Calomel

In the preliminary tests in 1926, calomel gave very promising results when used against small brown-patch. The more prolonged protection, relative freedom from burning and reduced cost made this chemical stand out as one of the most promising of the group of mercury fungicides. During the past summer numerous tests were made to determine its value and limitations.

Calomel, throughout the season, proved to be an excellent fungicide for the control of small brown-patch. It regularly protected the turf longer than any other chemical containing an equal amount of mercury and at times this increased period of protection was sufficiently long to make this an important point in its favor. The tests this year showed that it was by no means the "fool proof" chemical, from the standpoint of burning, that the preliminary tests indicated. The discoloration of turf due to uneven application or excessive amounts of calomel usually does not become evident as soon as that resulting from excess of the other mercury compounds. In some cases the discoloration did not appear for three or four days after the calomel was applied. However, it repeatedly proved to be the least likely to burn of any of the mercury compounds which control brown-patch, and in no case did we observe any actual killing of turf unless it was used in quantities several times in excess of the recommended rate. The injury was usually confined to a uniform yellowing and unhealthy appearance which, though unsightly and decidedly objectionable, resulted in nothing more than a temporary injury of comparatively short duration. The lesser injury and slowness with which it appears is probably due to the fact that calomel is practically insoluble in water, and it is probably only gradually changed to some other more available compound in the soil. This slower action is objectionable when used against an active case of large brown-patch, for at such times immediate action is desired.

Following a report of results at Arlington last season, a finely ground grade of calomel was marketed under the trade names Calogreen and Turfcalomel. It was claimed that, due to their more finely divided condition, these preparations would be much more effective against brown-patch than the ordinary grade of calomel. Our tests showed that in the more finely divided form, calomel is likely to be somewhat more quickly available. This results in a little more prompt checking of disease, but also tends to make it somewhat more likely to burn and shortens slightly the period of protection. One of the chief objections against the finely ground material was due to its tendency to form large lumps while in the packages. This made it difficult to mix thoroughly with water or with compost and defeated the chief object of fine grinding, that of providing more even and thorough distribution. Early in the season this objection was brought to the attention of the chemical companies producing Calogreen and Turfcalomel. It was suggested that a mixture be made with this finely ground calomel and some inert material which would be harmless to grass, but which would serve to prevent any lumping of the fine particles of calomel. Both com-

panies quickly cooperated in furnishing us such mixtures, which were then tested at Arlington. The most promising of these was the one containing finely ground clay as a filler, which gave a bulky mixture that had no tendency to form stubborn lumps.

#### Combinations of Calomel with Other Mercury Compounds

Since calomel acts slowly and for that reason is not desirable for control of active large brown-patch, an attempt was made to combine it with a more quickly effective chemical to provide a combination treatment which would have the advantages both of the immediately active chemical and of the more lasting calomel. Since corrosive sublimate and the oxide of mercury check large brown-patch almost immediately, these two appeared to be the most promising for such a mixture since they possessed certain other desirable features besides that of lowest cost. An application of one ounce of corrosive sublimate per 1,000 square feet proved to be entirely satisfactory in checking active large brown-patch. Therefore a mixture of one ounce of corrosive sublimate with two ounces of calomel was applied to a number of plots and it was found to give the desired results. Other proportions were tested, but it appeared that the ratio of one-third corrosive sublimate and two-thirds calomel was best. The demonstration plots of the turf garden, which are cared for as putting greens should be, were treated with such a mixture previous to the meeting of greenkeepers in August. When a mixture of these two chemicals is combined with a little fine clay, to add more bulk, it makes a very satisfactory brown-patch remedy.

We found that the oxide of mercury was likewise effective in combination with calomel, used in the same proportion as was the corrosive sublimate and calomel. There are two common oxides on the market (red and yellow), which proved to be equally effective against these turf diseases. The oxide is less likely to burn than is corrosive sublimate and lasts a trifle longer. It should prove to be a valuable chemical for this work.

#### Method of Application

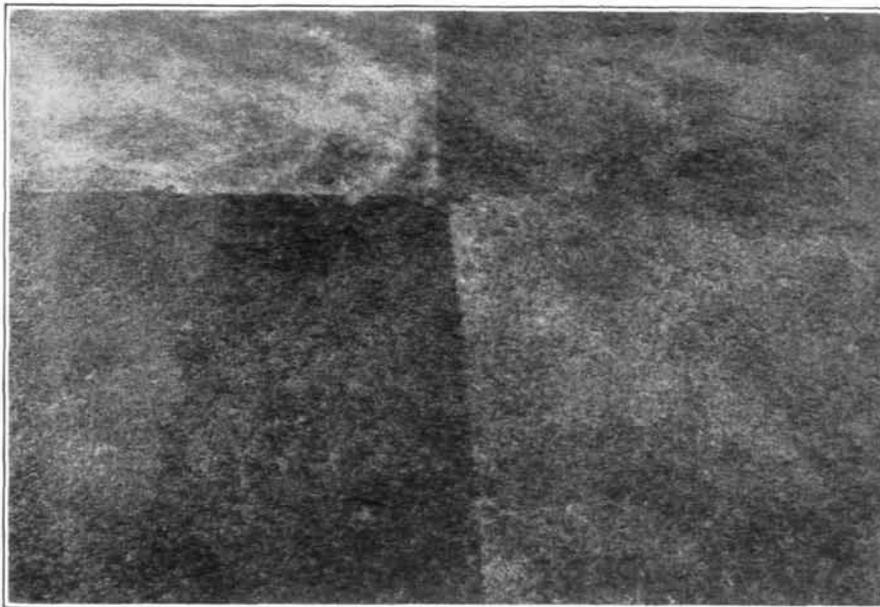
In using any of these chemicals, either alone or in mixtures, it appears advisable to use the full amount (about three ounces of the calomel, corrosive sublimate or oxide, and one pound of Semesan or Uspulun) for the early season applications. At such times the danger of burning is greatly reduced and the lasting effect of the chemicals during this period is greatly prolonged. In the middle of summer it is wise to reduce the amount to one-half or less. This avoids serious injury but necessitates more frequent application.

Any of these mercury chemicals may be used in water, or mixed with enough soil to give sufficient bulk for even distribution. This latter method has many advantages, provided there is someone available on the course who can scatter the mixture uniformly over the turf. Our tests this year again showed that by mixing the chemical in moist soil and allowing it to stand overnight or longer, there was a decided reduction in the amount of burning. The greatest danger from burning occurs when the chemical is applied in water. Mixing with sand usually does not reduce the burn below that of the liquid method. However, if care were used in making the application and the quantity were reduced sufficiently during hot, humid periods, any of these methods could be used with safety.

#### Mercury Fungicides Combined with Fertilizers

The use of fungicides and fertilizers combined in a single treatment is a labor and time saving procedure. Our tests this season have confirmed those of previous summers in showing that it is entirely feasible to use such combinations and that neither the fungicidal nor the fertilizing qualities of either ingredient are decreased thereby. When greens need plant food a mixture of this kind is to be recommended, but if brown-patch occurs when turf already is amply provided with food it may be dangerous to use fertilizers with the fungicide. This is especially apt to be the case where large brown-patch is prevalent.

The most desirable fertilizers to use when treating turf with the dry method of application proved to be those of the organic group, including cottonseed meal, soybean meal, Milorganite, or poultry manure. All of these gave good results when combined with corrosive sublimate or calomel. When a little fine compost or sand is added to such a mixture it can be quickly broadcast over turf.



BURNING WITH CORROSIVE SUBLIMATE

The square at the upper left received an application of corrosive sublimate, at the rate of one-half pound per 1,000 square feet, mixed in sand. A like amount of corrosive sublimate was applied to each of the squares at the right, mixed with cottonseed meal (one pound per 1,000 square feet). For the plot at the upper right the mixture was prepared the previous day. The mixture for the plot at the lower right was prepared just before it was applied. The plot at the lower left received no treatment. This illustrates how it is possible to reduce the severity of chemical injuries by mixing with cottonseed meal and allowing the mixture to stand for several hours. It will be noted that this is a heavy application of corrosive sublimate. The plots were treated July 29 and the photograph was made August 2.

If corrosive sublimate is mixed with cottonseed meal (or other similar fertilizers) and allowed to stand for some time, the severity of burns is greatly reduced—just as is the case in mixing with soil. For this purpose the mixture should be slightly moistened. In the accompanying figure this reduction of burning with bichloride is illustrated. While reducing the amount of injury, such a mixture

apparently does not reduce the effectiveness of the mercury compound, but tends to increase the period it will control the disease.

When using chemicals in liquid, either in a sprayer or sprinkling device, it is more desirable to use one of the soluble fertilizers. Ammonium sulphate, Ammo-phos, or urea have for some time proved to be satisfactory for such purposes. The combinations are much more likely to produce injury to turf than are the insoluble mixtures referred to above. Of these, urea is perhaps the greatest risk from the burning standpoint. Nevertheless, even the mixture of urea with the mercury chemicals can be used with comparative safety if the total quantity is reduced during periods when turf is most sensitive to chemical burns.

During the season there has been a mixture of this type widely distributed for brown-patch control. This has been sold under the trade name of Nu-Green and has a composition equivalent to one-half Uspulun or Semesan and one-half urea. At Arlington this compound was tested in comparison with similar plots where other combinations were used. Thus one pound of Nu-Green was compared with a plot receiving a treatment of one-half pound Semesan and one-half pound urea; another plot receiving one and a half ounces calomel with one-half pound urea; and another receiving one and a half ounces corrosive sublimate and one-half pound urea. All of these plots controlled brown-patch equally well. Nu-Green proved to be effective against brown-patch, but we hesitate to give it our full endorsement, due to the fact that in purchasing fungicide and fertilizer in this particular form one pays an excessive amount for the nitrogen it contains.

#### Mercury Compounds with Arsenate of Lead

A number of clubs have recently treated their greens with arsenate of lead for grub control. The question was raised as to whether this chemical would in any way affect the action of the mercury compounds in checking brown-patch. Our tests at Arlington have indicated that arsenate of lead alone will not check brown-patch. Applications of different mercury compounds to soil which had been poisoned with arsenate of lead were as effective against diseases as like applications on soil which had received no lead treatments.

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#### STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE BULLETIN OF THE UNITED STATES GOLF ASSOCIATION GREEN SECTION, PUBLISHED MONTHLY AT WASHINGTON, D. C., FOR OCTOBER 1, 1927.

District of Columbia, ss:

Before me, a notary public in and for the District of Columbia personally appeared G. T. Cunningham, who, having been duly sworn according to law, deposes and says that he is the business manager of The Bulletin of the United States Golf Association Green Section, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, United States Golf Association, 110 East Forty-second Street, New York, N. Y.; editor and managing editor, R. A. Oakley, Washington, D. C.; business manager, G. T. Cunningham, Washington, D. C.

2. That the owner is the United States Golf Association, a corporation organized and existing under the law not for profit and having no capital stock.

3. That there are no outstanding bonds, mortgages, or other securities.

(Signed) G. T. CUNNINGHAM, Business Manager.

Sworn to and subscribed before me this 22nd day of September, 1927.

(Seal)

(Signed) BERNARD CONNOR.

(My commission expires July 30, 1932.)