J. F. CORNMAN

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Contents

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Snow-Mold

By Arnold S. Dahl

University of Wisconsin

In the northern tier of states and in Canada, where golf courses are covered with snow for long periods in winter and early spring a disease of grass has become increasingly noticeable. This disease, known as snow-mold, causes great damage, particularly to putting greens. It is caused by a fungous organism which remains in the soil in a dormant state during most of the year and attacks the grass when conditions are favorable for its growth. Because of its great havoc in some sections an intensive study of the disease has been undertaken. The purpose of this study is to determine the cause of and the conditions which are favorable to the development of the disease and to devise control measures.

Although snow-mold has been known in this country only a few years it has been recognized in Europe for over a century. There it has been reported as occurring on fields of grain in the Scandinavian countries, and in Germany and Austria. In some years, when conditions have been favorable, great losses have been reported in those countries. Frequently whole fields of grain have been completely wiped out. The organism attacks all the winter grains, but judging from most of the reports rye is apparently the most susceptible. Barley and wheat, though not as susceptible as rye, likewise suffer at times from the disease. Snow-mold has also been reported on lawns in Europe, but only in a few cases. Considering its widespread distribution on golf courses in the United States it is peculiar that snow-mold has never been reported on fields of grain. Last spring, when the snow was melting, an attempt was made to find plants of grain injured by the organism. A survey was made of several fields of rye in various sections, but in no case were injured plants found nor could the organism be detected in the fields examined. It is hoped that a more complete survey can be made to determine whether or not the disease is present on winter grains in this country. Snow-mold causes great damage to putting greens in the United States, particularly in Minnesota, Wisconsin, and Michigan, and has been reported as serious in several regions of Canada.

The disease is noticeable as soon as the snow melts in the spring. When the snow has disappeared, dead areas are found in the turf. These places are sometimes covered with an aerial growth, or mycelium, of the snow-mold fungus. When exposed to the sun this growth takes on a pinkish color, so that whole patches may have a pinkish cast. At times this aerial growth is so abundant that the grass leaves are matted together and form a thick layer over the affected area. When this happens, the grass underneath is usually

killed outright. Other patches may not have an abundant aerial growth nor a pinkish color; instead they are a dirty gray, being thus easily distinguished from areas where the grass has been killed by other causes and which are light brown in color. Patches not having an abundant growth of mycelium are frequently not entirely killed but will slowly recover. Apparently the organism attacks the leaves first, and if conditions continue favorable it will then invade the stems and roots. The relation between the parasite and the host has not been worked out as yet, so that little is known as to what parts of the plants are involved.

The organism causing snow-mold was isolated at Madison, Wis., in February, 1927, by Dr. John Monteith, Jr. Experimenting in a greenhouse, he found that the organism which he had isolated from infected turf on a golf course would cause the disease in grass artificially inoculated in the manner customary in studying plant diseases. Last winter the organism was again isolated at Madison, from local diseased turf and from material received from Grand Rapids, Mich., and Minneapolis, Minn. Pure, or artificial, cultures of the organism were produced, and from a study of these the identity of the organism was found to be *Fusarium nivale* (the Latin word *nivale* meaning "pertaining to snow"). The genus Fusarium contains a large number of species in addition to *F. nivale*, some causing diseases in plants and others remaining harmless in the soil. Most of the Fusaria develop best at high temperatures, but in this respect *Fusarium nivale* is an exception to the rule, growing well at any ordinary soil temperature but attacking grass only at very low temperatures. In the greenhouse experiments successful inoculations with *Fusarium nivale* were made at temperatures ranging from 32 to 39 degrees Fahrenheit. At these low temperatures spores are formed, either in salmon-colored masses of millions of spores, or singly on the mycelium. The organism was found, in the greenhouse, to cause disease in rye, barley, wheat, oats, fescue, creeping bent, and Kentucky bluegrass.

Snow-mold has been studied carefully by European scientists for many years but notwithstanding there is as yet very little known of its life history. It is known, however, that, particularly in Europe, it causes snow-mold during the late winter and early spring, while in late spring it may cause a disease known as foot-rot, in which the crown of the plant is attacked. Late in the season it causes a head-blight of grains. In the United States it has been reported as causing foot-rot and head-blight. It is probable that on golf courses, and particularly on putting greens, it remains in a dormant state during most of the year, attacking the plants only under such temperature and moisture conditions as prevail when the snow is melting. Spores are produced in large numbers on infected plants, becoming visible at times as slimy, salmon-colored masses. These spores are usually carried from one place to another by means of water, and as a result of this an area on a green which is washed by much surface water may be very badly damaged or entirely killed from numerous infections. Often spores are formed early on mounds near a green, later to be washed down onto the green where they cause secondary infections.

It has been observed in Europe that when snow falls before the ground is frozen the damage from snow-mold is very serious. From the limited observations made in the United States on putting greens

this would seem to hold true here also. When snow falls on ground that is not frozen and remains throughout the winter, the frost does not penetrate the ground to any marked extent, and under this condition apparently the fungus can become active during a thaw at any time of the winter. In sections where snow does not lie on the greens all winter and thaws are frequent, the patches of snow-mold may be seen as early as December. Under such conditions it would seem that snow is not necessary for the development of the fungus. It is, however, evident that low temperature and much moisture are necessary. During thawing weather large snow banks create ideal conditions for the development of the disease, and under these circumstances serious losses occur.

Although a great deal of work has not been done to determine the difference in susceptibility of the various grasses, none of the grasses tested have proved to be immune. Fescue appears to be highly susceptible, while creeping bent is much less so. Kentucky bluegrass is more resistant than fescue but not as resistant as some strains of creeping bent.

The Control of Snow-Mold

By John Monteith, Jr., and Arnold S. Dahl

In the April, 1927, issue of THE BULLETIN a report was given of some preliminary experimental work for the control of snow-mold on putting greens. The results of those first trials were so promising that further experiments were arranged in the fall of 1927 to determine whether the same treatment would prove effective in different sections of the country. During the last season the disease was not as prevalent as usual on several courses where experimental plots were placed, and since the untreated areas on those courses were not severely damaged the freedom from disease in the treated areas could not be regarded as altogether conclusive. However, some such tests in Detroit, Chicago, Minneapolis, and Madison, Wis., gave results which indicated that the corrosive sublimate and calomel treatments would check light attacks. These will not be discussed in detail, for they merely substantiate the results already reported in the April issue of last year.

During the past winter many northern courses were severely damaged by a late freeze, and the injury was so extensive that it was difficult to tell how much might have been due to snow-mold. On several courses, however, it was possible to distinguish the snow-mold damage, and some interesting reports of tests with fungicides were received. These results, taken collectively, serve greatly to advance our knowledge of the problem of the control of snow-mold.

On the course of the Grand'Mere Golf Club, Grand'Mere, Quebec, snow-mold is regarded as an important annual problem, necessitating extensive patching in the spring. The chairman of the green committee, Mr. E. B. Wardle, conducted some tests with different rates of application of corrosive sublimate, as suggested in THE BULLETIN. Reviewing his results of the past season, he writes: "The treatment of our greens has resulted in very considerably diminishing the damage caused by snow-mold. Only one green, No. 9, was badly affected, although we followed up the snow as closely as possible with brooms,

sweeping away the mold the same as we have done in previous years. There was plenty of snow-mold present, but we came through with but very little damage; in fact, I do not believe that we shall need to do any patching whatever as far as snow-mold is concerned." He concluded, "I am absolutely convinced that the bichloride treatment helped our greens as far as preventing snow-mold is concerned;" but he also states, "Our experience indicates that 3 ounces per 1,000 square feet is not sufficient."

Practice putting green of the Pine Lake Country Club, Detroit, Mich., showing the old scars of distribution of the disease on this green. It also shows how the damage may affect the putting surface well through the early playing season. At the time the photograph was taken no sign of snow-mold damage was apparent on the other 18 greens, which had been treated the previous fall with calomel and corrosive sublimate

From Detroit we have received the following observations made on the course of the Pine Lake Country Club by Dr. O. W. White, chairman of the green committee:

"In the fall of 1923 we planted our greens to Vermont bent stolons, and the following year no winter fungus appeared. In the spring of 1925 small bare spots dotted the greens, evidently from winter fungus, and in the spring of 1926 big bare patches of from 4 inches to 2 feet in diameter appeared. These did not heal until along toward the end of June. In the fall of 1926, as an experiment, we covered the greens with straw, and the following spring our greens looked as if they were completely ruined; but by carefully nursing them along they healed over by the middle of July. Toward the end of October, 1927, we tried the following: Dividing a green into four sections, we used on the first section 1½ ounces of calomel, on the second section 3 ounces of calomel, on the third section 1½ ounces of corrosive sublimate, and on the fourth section 3 ounces of corrosive sublimate,

per 1,000 square feet, while on all other greens we used from 3 to 3½ ounces of corrosive sublimate per 1,000 square feet. In the case of the lighter treatments we have a small number of winter fungus spots this year, but where the heavier application was made the greens are entirely free from the disease.

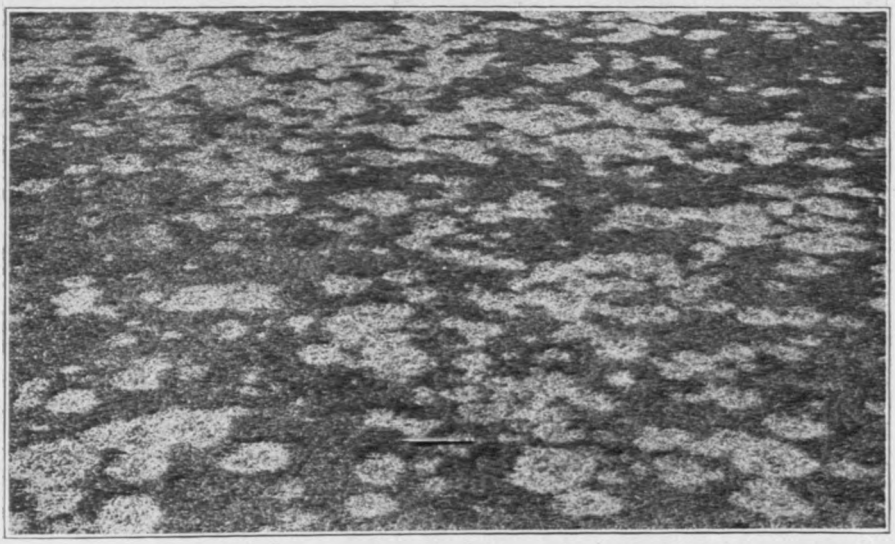
"To mention a further experiment, at the time of covering our greens with straw, in 1926, we left uncovered a practice putting green, which, by the way, was about one year old, and the following spring this green showed very little damage. Last October we purposely left this green uncovered and did not treat it in any way, with the result that it is very badly infected this spring with winter fungus. We are now convinced that by the use of corrosive sublimate in October or early November our troubles from winter fungus are at an end."

Another report, indicating like Mr. Wardle's that heavier treatments are needed in some sections, came from Mr. J. W. Harrison, of the Pine Beach Golf Course, who wrote: "Our Pine Beach course is located in central Minnesota, near Brainerd. We have 18 Washington bent grass greens, and are considerably troubled each year with snow-mold. Last fall we treated the greens with 2 ounces of bichloride to 1,000 square feet, but were not relieved. As an experiment, we divided one green into squares, treating one square with 1½ ounces per 1,000 square feet, one with 2 ounces, one with none, and one with arsenate of lead. Between the square given 2 ounces and the one with no treatment there was a rather distinct line, though the treated square, while less seriously affected, nevertheless called for some patching. This seemed to indicate that a heavier treatment might perhaps check this trouble."

Mr. T. McClenahan, greenkeeper of the Mayfair Golf and Country Club, Edmonton, Alberta, Canada, reported as follows: "Each green was divided into four equal parts by running a weeding line north and south through the center and another east and west. The amount of corrosive sublimate for one quarter was put into a 50-gallon barrel and sprayed on with a pump fitted with agitators which keep the solution mixed. As soon as one quarter was done we thoroughly watered it in. It was a rather slow job, but results have shown that it was time well spent. Where we applied 1 ounce per 1,000 square feet, the fungus appeared, but not nearly as badly as in previous years. Where 2 ounces were applied, faint traces of snow-mold could be seen. Where 3 ounces were applied, there was absolutely no trace of the fungus and the turf looked good and healthy. One interesting fact came to light, namely, that provided the corrosive sublimate is properly dissolved, more than 3 ounces per 1,000 square feet can be put on with perfect safety; for example, the spot in the center of the green where the lines crossed received a double dose, but when the snow left it was the healthiest spot on all the greens. Previous springs our 9th green was covered with snow-mold. This green is in a rather shady spot, and the snow melts on the front of the green but remains piled up at the back. As the snow melts at the back and the water runs down it deposits the fungus on the front of the green. In a case like this I think that 2 ounces per 1,000 square feet will take care of the back of the green, where snow is lying, but the front must have a heavier application."

The treatments reported above were all put on the previous fall

before snow-mold developed. The question often arises as to what treatments should be given a green after the disease has appeared. On many courses where the disease does not occur every year it appears impractical to put on the fall precautionary treatment. It is thought best to wait until the fungus appears and to try to control it then if possible. There is little information available as to this type of delayed treatment. There are several objections to the use of chemicals for such purposes. The disease may develop to cause serious losses before it is detected, even when the greens are carefully watched during the winter. Anyone who has tried to treat northern greens with chemicals during the winter months will appreciate some of the difficulties of such work as well as the danger of making deep wheel or foot impressions in the turf during periods of thawing when snow-mold is active. However, applications of chemicals can be

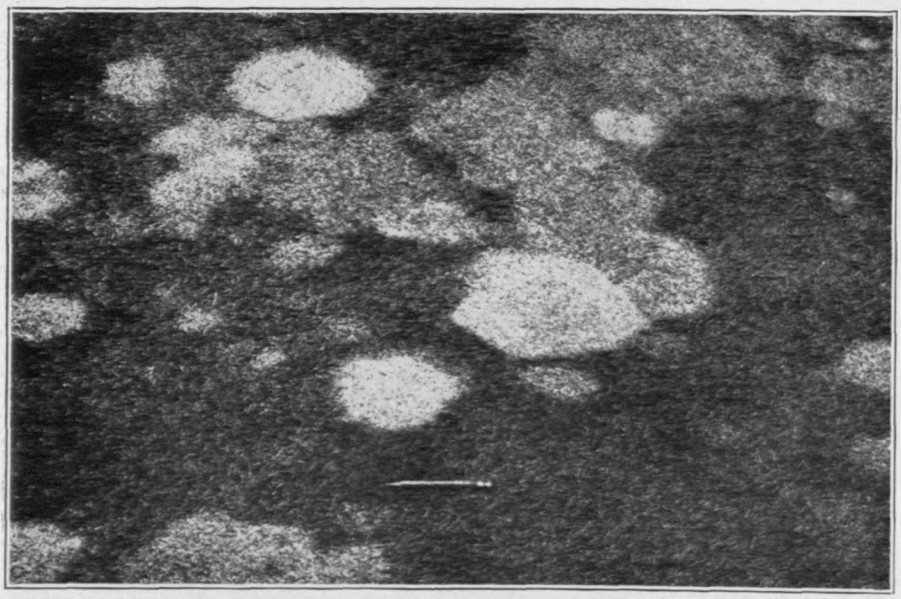


Snow-mold injury on No. 2 green of the Masonic Country Club of Western Michigan, Grand Rapids, Mich. The light areas in the photograph show the damage caused by the fungus. Note the pencil in the foreground, which serves to indicate the size of the affected patches

made with safety if proper precautions are taken, and such treatments offer a promising recourse in emergencies, especially for clubs in the southern part of the snow-mold region. Early in January Mr. A. E. Arnold, greenkeeper of the Masonic Country Club of Western Michigan, reported a severe attack of snow-mold on all his putting greens. Following our suggestion, he applied corrosive sublimate at different rates, mixing it with sufficient sand to give bulk for even distribution. This method made it possible to put on the chemical without water. The weather throughout the remainder of the winter was such that the disease did not develop much more seriously on his course even on the untreated parts. However, he did report that on his treated areas the disease was soon checked and the turf recovered quickly in the spring. The severity of infection on one of his greens is shown in the accompanying illustration. On a near-by municipal course of Grand Rapids, Mr. L. H. Gork, city forester,

also conducted similar tests and found that the midwinter treatment with corrosive sublimate checked the disease.

The experimental work to date therefore indicates that the preliminary results of control treatments reported in April, 1927, can in general be expected to be effective throughout the snow-mold belt. The lighter application of 1 ounce to 1,000 square feet will apparently check mild attacks of the disease, whereas even the heavy application



Control of snow-mold by midwinter treatments of corrosive sublimate. Diseased patches on No. 1 green, Sleigh Municipal Course, Grand Rapids, Mich.

The few lighter spots are the patches which were practically killed by snow-mold before any treatment was applied. The other patches, gray, are the diseased areas where a treatment with corrosive sublimate the second week in January checked the snow-mold fungus and the turf had started to recover from the damage when the photograph was taken, April 3, 1928. Note the pencil in the foreground, which indicates the size of the patches.

of 3 ounces to 1,000 square feet must be exceeded to prevent injury where the fungus is unusually destructive. It is also apparent that an application of 1 or 2 ounces of corrosive sublimate to 1,000 square feet in midwinter or later, after the disease is active, is worthy of much further testing on courses where no preventive treatment has been applied the previous fall.

Fall burning of the rough.—We repeat that in the fall it is generally good practice to mow the rough, clean it up, and compost the salvaged material, or burn it. This practice will get rid of hosts of weed seeds and insects, and will make the rough more presentable the following season.

Humus in Soil Stores Water.—One of the important explanations of the desirability of having a quantity of humus or decomposing organic matter in the soil is found in the capacity of humus for soaking up and storing water which is thus made available later for use by growing plants. Experiments have revealed that 100 pounds of sand can hold only 25 pounds of water, and 100 pounds of clay soil

can hold only half its weight of water. In contrast, 100 pounds of decaying organic matter may hold as much as 190 pounds, or nearly twice its weight of water. Most soils are mixtures in varying proportions of sand, clay, silt, and organic material. As a rule the greater the proportion of organic matter contained in the soil the greater its water-absorptive capacity, and the greater reserves of moisture it will retain for resistance to drought and hot weather.

Photograph by Albert A. Hansen, Purdue University, La Fayette, Ind.

A demonstration of the value of rolling following seeding

The entire area shown in the illustration had been newly sown with grass seed, but a good catch was secured only where the soil had been compacted by footprints, and particularly by the wagon tracks which appear in the picture.

Rolling following seeding compacts the soil around the grass seeds, resulting in better germination and minimum mortality in the seedlings. Rolling may be a deciding factor in the success of newly seeded grass areas. The saving of expensive seed, to say nothing of the time involved, is a good argument for rolling all new seedings.

Lime in Some Typical Sands and Its Effect on Soil Acidity

By O. J. Noer, Madison, Wis.

In some districts clover is prevalent and does not seem to diminish as a result of consistent use of sulphate of ammonia. Large quantities of lime carbonate in the sand used in top-dressing mixtures is responsible in many instances.

While clover prefers and grows best in non-acid soils, soil reaction is probably only one factor in its control. Casual inspection also seems to indicate that white clover is somewhat more tolerant of acidity in the soil than some of the other legumes. Nevertheless it can be eradicated. Judicious feeding to encourage the grasses and thus maintain a dense turf makes it difficult for clover to establish itself. In this connection only enough phosphoric acid and potash should be applied to satisfy the demands of the grasses, because in larger

amounts both tend to encourage clover, particularly if the soil is non-acid or only slightly acid. Close inspection of turf on greens frequently discloses the presence of minute clover plants, ready to spring forth and encroach upon areas of thin turf. Bare areas resulting from improper feeding, winterkill, or the ravages of fungus or insect pests, often become infested with clover and serve as centers from which it rapidly spreads.

Glacial sands in limestone sections frequently contain appreciable amounts of lime carbonate. It is sometimes present in beach and lake sands in the form of shell fragments. Wherever these are present the sand should be looked upon with suspicion. Last year the possibility of sand contaminated with lime carbonate counteracting the acid-producing power of sulphate of ammonia was pointed out. Since that time a number of sand samples have been examined and the lime carbonate content determined. The results are summarized in the accompanying table.

LIME CARBONATE CONTENT OF SOME SANDS USED IN TOP-DRESSING MIXTURES

Source of Sand	Lime Carbonate Content	
	Per cent	*Pounds per ton*
Wisconsin:		
Michiwaukee Golf Club, Milwaukee	37	740
Lake Lawn Golf Club, Delavan	20	400
Illinois:		
Beverly Country Club, Chicago	15	300
Edgewood Valley Country Club, La Grange	23	460
Ridgemoor Country Club, Norwood Park	16	320
Westward Ho Country Club, Chicago	21	420
Indiana:		
Indianapolis Country Club, Indianapolis	31	620
Meridian Hills Country Club, Indianapolis	31	620
Highland Golf Club, Indianapolis	31	620
Broadmoor Country Club, Indianapolis	32	640
Ohio:		
Canterbury Golf Club, Warrensville, No. 1	22	440
Canterbury Golf Club, Warrensville, No. 2	16	320
Pennsylvania:		
Philmont Country Club, Philadelphia (Scholey)		None
Philmont Country Club, Philadelphia (Drinker)		None
Springhaven Country Club, Philadelphia (Blaisdell)		None
Crystal Sand Co., Bridgeton, N. J.		None
Pittsburgh Field Club, Pittsburgh		Trace
New York:		
Hempstead County Club, Hempstead, L. I.		None
New Jersey:		
Newark County Club, West Orange		None
Virginia:		
Virginia Hot Springs Co., Hot Springs		None
District of Columbia:		
Potomac River sand		None

Some of the sand contains as much as 400 to 700 pounds of lime carbonate per ton. Evidently sands in the midwestern states must be looked upon with grave suspicion. Several samples of sand from Minneapolis, tested with muriatic acid, showed the presence of considerable lime carbonate; but exact determinations of the amounts were not made. Apparently eastern districts are obtaining satis-

factory sand as far as lime carbonate content is concerned. This difference in lime carbonate content may partially explain why clover is more prevalent and harder to control in Milwaukee, Chicago, Indianapolis, Cleveland, and Minneapolis than in Pittsburgh, Philadelphia, and New York.

Several clubs in Milwaukee desired to secure lime-free sand. Samples of sand were requested from companies whose pits were located in a non-limestone section of the state. Two were found to be lime-free, one from Portage and the other from Amherst Junction. The Portage sand was too fine-grained, but the sand from Amherst Junction was satisfactory in all respects. It costs about $2 per ton f. o. b. Milwaukee, and $2.25 at Chicago. In Cleveland a silica sand free from lime carbonate was also found.

While 10 per cent of lime carbonate may not seem unreasonable, yet the amount of lime carbonate applied to the green may be large. A thousand pounds of sand at each top-dressing would contain 100 pounds of lime carbonate, and at least 65 pounds of sulphate of ammonia would be required simply to neutralize the lime. This does not leave any excess to create soil acidity. It is doubtful if greens ever receive this quantity of sulphate between successive top-dressings; and where sand of higher lime content is used, greens are becoming more alkaline in spite of the repeated use of sulphate of ammonia.

There is no practical and economical method of removing lime carbonate from sand. It is necessary to search for suitable material in non-limestone sections.

The surface soil in limestone regions is often acid. The original lime carbonate has been leached out. Yet limestone soils are rarely as acid as those in non-limestone regions, and consequently it usually takes longer to obtain sufficient acidity to eradicate clover completely. In these regions it is important to eliminate lime from top-dressing mixtures and thus secure maximum benefit from the sulphate. Where clover is absent from greens regularly receiving lime-contaminated sand, the turf is usually so dense that clover is unable to gain a foothold; but infestation will begin once the turf becomes thin.

The soil used in top-dressing mixtures sometimes contains up to several per cent of lime carbonate, particularly in limestone regions. In such regions lime-free soil is more frequently found at higher elevations on knolls than in the valleys and draws, due to the more thorough leaching.

Another source of lime is the well water of limestone regions used for sprinkling greens. While the amount is exceedingly small per gallon of water, in the aggregate it may be considerable, due to the large quantities of water used. Here again removal is impractical.

The presence of lime carbonate in suspected sand can be determined by pouring muriatic acid upon it. Effervescence occurs if lime carbonate is present. A more exact determination can be quickly made by a chemist.

Why the white tee box?—Most tee boxes are painted white. There seems to be no necessity for this, and it has the disadvantage of making ugly things more obvious. White shows up more plainly the scratches, pencil writings, and carvings of caddies. Why not paint tee boxes a color in harmony with their surroundings? Olive green would be admirable for the purpose. It looks well even when faded.

Pulverized Poultry Manure and Poultry Manure-Tankage

By B. E. Brown

Bureau of Chemistry and Soils, United States Department of Agriculture

Commercial poultry manure collected from cars in which poultry has been shipped is richer in plant food than that obtained under average conditions on the farm. In the latter case the manure gets mixed with litter or some soil to such an extent that the nitrogen in the air-dried manure will average only about 2.5 per cent, while the manure collected from railroad cars, or where no chance for contamination occurs, will run from 5 to 6 per cent in the prepared commercial product. Not only will the litter and soil decrease the nitrogen content in ordinary poultry manure, but losses are apt to occur through volatilization of ammonia, due to failure to provide suitable storage conditions or to add materials to prevent the loss. In the case of commercial poultry manure considerable care is exercised to collect the material as soon as practicable, and it is then treated and dried in such a way as to avoid loss of ammonia and other plant food constituents.

Another commercial product on the market is chiefly poultry manure with which has been incorporated some poultry offal. The manure and offal are ground and thoroughly mixed during the course of drying. This product contains even more nitrogen than commercial poultry manure due to included blood and other more highly nitrogenous materials associated with the offal. An analysis of this material, which might be called poultry manure-tankage, showed it contained about 7.4 per cent of ammonia (about 6 per cent of nitrogen), and a relatively higher percentage of phosphoric acid and potash than the average run of poultry manure.

These richer commercial products contain a maximum of the original plant food constituents, are uniform in physical condition, thereby enabling one to distribute them evenly, and usually can be expected to give a good account of themselves on lawns, fairways, and putting greens, provided they are applied uniformly and at not too heavy a rate. It will be advisable to make the applications light and increase the number of applications rather than attempt one heavy application and take chances on "scorching" the grass. Such materials should be applied during showery weather, or if practicable the grass should be well watered with a hose to wash the material into the soil.

Poultry manure, either ordinary or commercial, or poultry manure-tankage, is also to be recommended for incorporation with the soil in the vegetable or flower garden.

[In THE BULLETIN for June, 1928, on page 112, we presented a table showing the percentages of nitrogen, phosphorus, and potash contained in a number of common fertilizers, including poultry manure. Several inquiries have been received as to whether the nitrogen contents claimed for certain poultry manure products on the market were false in view of the fact that they greatly exceeded the percentages indicated in THE BULLETIN. The table given in that issue was by no means complete. The article by Dr. Oswald Schreiner, which appeared in THE BULLETIN immediately following the table to which we refer, pointed out that there were many good fertilizers on the market, the labels of which were not likely to be misleading since buyers are protected from such frauds by the laws of several states. However, to avoid any apparent injustice to those interested in

poultry manure-tankage products we publish this article by Mr. Brown, of the Bureau of Chemistry and Soils, United States Department of Agriculture. There are at least two such by-products of the poultry slaughter-house business which are commonly used on golf courses, namely, *Bestivall* and *Premier Brand*.—EDITORS.]

Bur Clover as an Adjunct to Bermuda Grass Fairways

By Henry P. Smith

Eight years ago, when the land was purchased and cleared for the Spring Lake Country Club course at Waco, Tex., we had expected that a large part of the tract was sandy loam in character, but it developed that it varied considerably, running from sandy to gravelly, and a large part of it stiff or hard clay when dry, or a puddled, tight soil—"buckshot," as they call it in this country. The fairways, after planting, were heavily coated with stock manure, which developed a fair growth of Bermuda grass, but they were still quite hard, and thin in places.

Bur clover patches on the course of the Spring Lake Country Club. In the background, along the wooded stretch, is seen the line of the 12th fairway, which is a solid strip of Bermuda grass occupied by bur clover in the winter and early spring. The patchy area in the foreground will in all probability be completely covered by bur clover the following spring

I noticed patches of clover of various kinds that appeared to reseed annually, dying down in the spring. Wherever these patches appeared the Bermuda grass came up through them in the spring healthier and more vigorously than elsewhere, and there was a distinct softness or cushion effect to the feet when walking over these areas. I concluded that this might be a solution of our difficulties; and looking into the various varieties of clover that might be best for the purpose I decided upon bur clover, as it not only appeared to yield a maximum amount of nitrogen, but its extensive root system would

have a tendency to aerate or renovate these tight soils as well as add humus to the soil. A valuable addition, however, would be derived from the subsequent cuttings.

We have a limited water supply, barely sufficient to maintain our 18 greens in good condition throughout the long, hot summer months, and were it not for the annual contribution of humus, nitrogen, and renovation of the bur clover, it is doubtful if the grass could go through the very dry and hot summer without severe deterioration. With an adequate water system, which we hope to install in the very near future, we will have fairways second to none in the South.

While my experience in the East in respect to golf course upkeep would make me very shy of introducing any kind of clover in the fairways, particularly on sandy soils, nevertheless I believe that many of our southern courses could be considerably improved by treating them in the same manner as we have done, particularly those that are of hard clay or with very poor soil conditions.

Some varieties of clover grow better in the South than others. They are, or should be, extensively used as cover crops, and they make excellent pasturage, particularly when combined with Bermuda grass, providing all-year grazing. Bur clover comes in the fall and winter, when the Bermuda grass turns brown after the first frost, and disappears in the spring when the Bermuda grass starts growing. Thirty to fifty per cent of the fertilizing value of bur clover is in the roots and stubble, the nitrogen being taken from the air and deposited in the nodules (wart-like lumps on the roots). A good crop of clover should add the equivalent of not less than 200 pounds of nitrogenous fertilizer to an acre annually.

The inoculated seed should be sown broadcast in the early fall, using from 12 to 18 pounds to the acre. If seed in the bur is used, 20 to 30 pounds to the acre should be sown. If the seed is sown after the middle of August it is not a bad idea to boil the seed one minute, which tends to soften the seed coat and aid in rapid germination. The seed must, however, be inoculated after boiling. It can be sown in July, August, September, or October, and will come up when conditions are favorable.

Bur clover will grow on any type of soil, and can be depended upon to add humus and nitrogen to the soil annually without sacrificing the regular summer crop at the farm, and is the cheapest legume that serves as a winter cover crop. It does not require reseeding, but perpetuates itself if given half a chance. It is also splendid to plow under as a green-manure crop.

There are a number of varieties of bur clover obtainable from seedsmen. The majority of the clover areas on our course are of California bur clover (*Medicago hispida*). Interspersed through these patches we also have the Southern bur clover (*Medicago arabica*), which is very similar in all particulars, with the exception of a brownish center to the leaf, some spots small and some considerably larger.

[California and Southern bur clovers grow almost equally well between the 91st and 100th meridians. This belt divides the western area, for which the California species is most suitable, from the eastern area, which is more favorable to the Southern bur clover. Bur clover will not thrive on soils deficient in lime; hence, before attempting to grow clover in the Southeastern Coastal Plain and Florida, it would be necessary to supply this need.—EDITORS.]

Winter Rules

The winter and early spring months always give those in charge of golf courses in the northern half of the United States the unpleasant task of dealing with some unreasonable members who feel that membership in a club should carry with it absolute freedom in the use of all parts of the house and grounds. There are, of course, many ways of restraining such unbridled enthusiasts, but it is doubtful that any method has proven entirely effective while still preserving "peace and good will."

Our attention has been called to a method used at the Columbia Country Club, Chevy Chase, Md., which may appeal to others faced with this problem. An appeal by the green committee to the golfing members of the club was distributed in the form of an attractively printed folder. The purpose was to educate the players to a better understanding of the whys and wherefores of one of those mysterious actions of the ever-puzzling green committee. The folder reads as follows:

"Owing to the adverse conditions, from a maintenance standpoint, to which the golf course is subjected under our climatic conditions in the late winter and early spring, it may be found necessary at times to close the course for a day or two in order to protect the turf and the soil and preserve a satisfactory surface for subsequent play.

"It is desired that you be acquainted with the reasons for closing the course at such times as you may find the 'Golf Course Closed' sign posted in your locker room though the weather is fine overhead. It is the desire of those charged with the maintenance of your golf course, not to restrict your privileges thereon but to protect the course from injury that may be caused by play during the infrequent intervals in which the turf is very soft.

"The alternate freezing and thawing of the soil during the late winter and early spring months is one of nature's greatest aids to golf course maintenance in this latitude. This weathering process restores the natural granular structure of the soil by breaking up the hard, packed mass that results from the heavy play and the trampling by laborers and packing by equipment during the summer and autumn months. This granular condition of the soil is very essential to the proper development of the turf grasses and to the durability of the turf, and if the course is allowed to rest from the time the frost leaves the ground until the soil settles naturally and the surface moisture has evaporated, the surface will be left smooth and the soil in ideal condition for growing grass when the season for growth begins. On the other hand, if the course is used while the frost is leaving and the soil is very soft and soggy, this newly restored granular structure will be broken down before the grass has gotten the benefit of it. Aside from the interference to this natural turf expedient, many of the grass roots that serve to feed the grass and bind it into the mass known as turf are broken by pressure of the foot as it sinks into the soft soil, and a considerable period of the early growing season is required for nature to repair this injury.

"Another matter which is of more concern from a player's standpoint is the rough, bumpy surface of the putting greens and fairways resulting from deep foot impressions made by the players and caddies when playing on the course immediately after a thaw. A few players

and their caddies at such times may leave the putting greens in very bad condition for themselves and others who may wish to play after the ground has dried out. A bumpy surface on a putting green is difficult to overcome, and usually when such a condition occurs in the late winter or early spring a good part of the best golfing season has passed before that very desirable true surface can be restored.

"These are some of the reasons why the unwelcome sign 'Golf Course Closed' may be found at your club occasionally; but be assured that this will not occur more often nor for any longer periods than is deemed absolutely essential for your maximum enjoyment of the course during the golfing season.

"When in doubt as to the condition of the course, a telephone call to the club may save a disappointing trip or a wasted day.

"Yours for the best golf course possible, and for you the best golfing season ever!"

Stepladder tees.—These ancient relics may still be found on occasional golf courses. It is next to impossible to grow grass uniformly on them, and if the grass does grow in spots it is an expensive task to keep it mowed. It would be economy to obliterate the steps by filling them in with soil and reducing the incline, and would add much to the attractiveness of the tee and its surroundings. We have seen tees twelve feet high easily reached by an incline and the turf kept in an excellent condition.

Tricky holes or shots are never good ones.

QUESTIONS AND ANSWERS

All questions sent to the Green Section will be answered in a letter to the writer as promptly as possible. The more interesting of these questions, with concise answers, will appear in this column. If your experience leads you to disagree with any answer given in this column, it is your privilege and duty to write to the Green Section.

While most of the answers are of general application, please bear in mind that each recommendation is intended specifically for the locality designated at the end of the question.

The relation of fertilizers to the growth of clover.—Does cottonseed meal introduce clover on soils where legumes occur naturally?—(Colorado.)

ANSWER.—Cottonseed meal in itself would not introduce clover, but if clover seed gets into a green through top-dressing or by natural distribution the 3 per cent of phoshoric acid and 2 per cent of potash contained in the meal would favor the development of the clover. At the same time some phosphoric acid and some potash are necessary for the best development of grass, especially on soils which may be deficient in one or both of these fertilizing constituents. The compost with which putting greens are fertilized usually takes care of this need, but occasionally on some soils a deficiency of phosphoric acid or potash is shown by the quick and vigorous growth of grass after one or both of these fertilizing elements are supplied. An excess of either phosphoric acid or potash would stimulate the growth of clover and

various weeds, but with an occasional application of cottonseed meal, which is relatively low in these elements and high in nitrogen, clover is not stimulated at the expense of the grass. Apparently the best means of supplying a little phosphoric acid and potash to the turf each year is the use of the organic form of fertilizer, since organic matter is beneficial to soils, helping to conserve soil moisture and open up and otherwise improve the physical condition of the soil. Cottonseed meal is rather high in price at present, but other organic fertilizers, such as activated sludge, soy bean meal, pulverized poultry manure, and castor bean pomace, which are relatively low in phosphoric acid and potash, may be used in its place. Once greens are well weeded the turf should receive what it requires, and in the spring and fall growing seasons a little phosphoric acid and potash are safe to use. The supply of nitrogen should, however, be kept up, as it will stimulate the grass; but apparently clover does not require much artificial nitrogen, since due to its peculiar root system it is able to make use of the nitrogen which is taken from the air by certain bacteria which inhabit its roots. Usually some weeds and clover are introduced into a green through top-dressing, but if the nitrogen content is kept high in fertilizers there need be no fear of stimulating these beyond a good development of the grass.

Selecting bent strains.—We are considering putting in some bent greens. We notice from the literature that comes into our office that there are several kinds of bent advertised. Which do you consider the best grade to buy?—(Michigan.)

ANSWER.—You do not indicate whether you wish bent from seed or stolons. There is much discussion as to which is the better for putting greens, and since both types have their ardent supporters it is difficult to determine which is really preferred by the "average golfer." Of the bents commonly grown from seed, Rhode Island bent and South German mixed bent both give satisfactory results in your locality. Colonial bent and Prince Edward Island browntop are similar to Rhode Island bent. There are different grades of both of these bents. The seed of highest purity and germination is, of course, the best for sowing on putting greens, where it is desirable to have as little mixture as possible with weeds and the coarser grasses. There is also seed of different strains of creeping bent on the market, but so far these strains have not been sufficiently tested in your locality to warrant general recommendations. Of the strains of bent planted by the stolon method, the two which have given most satisfactory results are the Washington and the Metropolitan strains. Both of these are of nearly the same texture, showing, however, some minor differences in color and disease resistance. Apparently the choice of a bent for greens is much like the choice of an automobile; there are several satisfactory types on the market, and the final choice should be left to the individual or club. The Green Section has a newly established cooperative planting on a course in your locality, and it is suggested that your committee visit that course and judge for itself which type is best suited for your district. Although this planting is comparatively new, it will, nevertheless, give you an opportunity to see the characteristics of the various bents as grown in your climate. On this course you will see the grasses on small experimental plots and also on greens under actual playing conditions.

Acid soil and sulphate of ammonia best for putting greens.—We have had the soil on our bent putting greens tested and find it is slightly acid. Should we try to sweeten it? We have also tried a special commercial fertilizer on one patch of grass, while we have used compost alone on another; the fertilizer gave very much better results. Should we discontinue using compost?—(Georgia.)

ANSWER.—A slightly acid condition of the soil is desirable, as fine turf grasses thrive in such a soil, while some weeds are discouraged. You have evidently a slightly wrong impression regarding the use of compost. Usually compost contains slightly less than 1 pound of nitrogen, half a pound of phosphoric acid, and 1 pound of potash, per 100 pounds. Putting green turf only occasionally requires more phosphoric acid or potash than the compost supplies. Also if phosphates and potashes are supplied in excess of the turf requirements, clover, chickweed and various other weeds may be encouraged. Putting green grasses, however, require nitrogen in addition to that contained in compost. The best form of nitrogen, other things being equal, is sulphate of ammonia, which also aids in acidifying the soil. Sulphate of ammonia should be used several times during the year in addition to compost. Apply it at the rate of 3 pounds in hot weather, and 5 pounds in cooler weather, per 1,000 square feet. Mix the sulphate in a sufficient quantity of dry soil to insure an even distribution, and follow the application by thoroughly watering the sulphate into the turf. The brand of fertilizer you are using is a comparatively expensive source of nitrogen. It contains 7½ per cent available nitrogen, while sulphate of ammonia contains 20 per cent, or nearly three times as much; at the same time the sulphate can usually be obtained at less cost per ton. You would be well advised to try sulphate instead of the fertilizer you now use, making applications whenever the grass seems to lag or need stimulation.

Essentials of a machine and tool house.—We are completing a nine-hole golf course and are anxious to obtain data relative to the essential features that should be embodied in a shed for the shelter of machines, tools, shed and fertilizer and for use as a work shop.—(Florida.)

ANSWER.—We would suggest that your shed should be about 18 feet deep and of any width to meet your requirements. At one end of the shed should be an enclosed room with a work bench. This room can be used as a greenkeeper's office, also for the storage of chemicals, spare parts and small tools. The room should be fitted with a lock as a guard against thefts. The shed should have a concrete floor, at least in part, so that fertilizers could be piled in the shed without danger of becoming damp. On such a floor compost could be piled and sifted also, or kept dry during wet weather; also soil or seed could be mixed on such a floor. The shed should be high enough so that wagons and implements could be backed or driven into it. The front of the shed, which runs lengthwise of the building, should be made up of large sliding doors, and several windows should be placed in the rear. The shed should contain bins lined with zinc for storage of smaller quantities of seed. Larger quantities of seed or fertilizer can be kept in bags. Racks for hand tools should be arranged in the shed.

Killing poison ivy.—How may we get rid of poison ivy in our rough?—(Massachusetts.)

ANSWER.—Sulphuric acid will kill any plant with which it comes in contact and is much used in the killing of dandelions, plantain, and crab grass. A sharp stick is dipped into the acid and then thrust into the root crown of the weed. Care must be taken not to get the acid on the hands or clothing. Poison ivy may also be killed by thoroughly spraying it with kerosene oil. Also a solution of salt brine (3 pounds to 1 gallon of water) will kill the plant if applied with a sprinkling can or a sprayer. The kerosene and salt brine will kill the foliage of most other plants also, but if the applications have not saturated the ground the roots of the grass will not be killed and the grass will recover. Most weeds, however, will be set back considerably, if not killed. Most of the commercial weed killers consist chiefly of arsenite of soda, and heavy doses of this will kill any vegetation. The arsenite should be applied as a spray in a solution of 5 pounds to 50 gallons of water. Fifty gallons of this solution would be sufficient to remove the weeds from 3,600 square feet, and at this rate would probably not destroy the grass.

Controlling earthworms.—Can we control earthworms on our greens with arsenate of lead?—(Illinois.)

ANSWER.—On most soils arsenate of lead will prevent earthworms from being active at the surface. Apply the arsenate to the putting green at the rate of 5 pounds to 1,000 square feet. It is well to mix the arsenate with dry soil in order to increase the bulk of the application and hence insure a more even distribution. The banks of the green and areas within 10 or more feet of the putting surface should also be treated, so that worms from the outside will be poisoned before reaching the putting area. After broadcasting the material evenly over the desired area it is well to drag a mat over the turf in order to work the arsenate of lead down to the soil by brushing it off the grass blades. An application of arsenate of lead will keep out earthworms for considerably over a year on some soils, but on others more frequent applications may be required.

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, 1928.

District of Columbia, ss:

Before me, a notary public, in and for the District of Columbia, personally appeared Kenneth Welton, who having been duly sworn according to law, deposes and says that he is the joint editor, managing editor, and 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, editors, managing editors, and business manager are: Publisher, United States Golf Association, 110 East Forty-second Street, New York, N. Y.; editors, managing editors, and business managers, John Monteith, Jr., and Kenneth Welton, 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) KENNETH WELTON, *Joint Editor.*

Sworn to and subscribed before me this 4th day of October, 1928.

(SEAL) (Signed) F. E. SINGLETON.

(My commission expires May 4, 1933.)

AS WE FIND THEM

This is the season when little Sonny up North is being "sewed up for the winter"—likewise the putting greens.

Some greens are all tucked away under a heavy blanket of straw—much joy in mousedom.

On one course heaps of branches and underbrush are piled around the green to "catch the snow and hold it on the green to protect the grass."

On the next course the men are busy well to the windward of greens putting up snow fences to "catch the snow and keep it from the green to protect the grass."

Sounds like a rebuttal for the perennial fall debate: "Katy did—Katy didn't."