Fungicides Rated for Persistence, Longevity in Three Year Study of

Snowmold Control

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SNOWMOLD probably causes more damage to golf course turfgrass than any other disease in the snow belt — northern United States and Canada. The disease is most serious on the green proper, aprons, approaches and shoulders. Bentgrass tees and fairways are likewise attacked, but in general, damage is less severe than on greens. Under extreme environment — heavy and persistent snow packs with temperatures around freezing — snowmold may cause damage on tees and fairways.

Two organisms — *Typhula itoana*, the "gray snowmold," and *Fusarium nivale*, the "pink snowmold," are responsible for this disease. These organisms are active between 28 deg. and 42 deg F. when excessive moisture is present. This environment exists as the snow pack melts in late winter and early spring. The common name, snowmold, has developed because of this association with melting snow. It should be pointed out, however, that the disease will develop whenever temperature and moisture are favorable irrespective of snow coverage.

Several fungicides have been reported and are known to be effective against snowmold organisms. The list includes Calo-Clor, Phenyl Mercury (Liquaphene, PMAS, etc.), Teresan, Semesan, Cadminate and straight corrosive sublimate. The latter material has proved especially effective against the virulent strain of snowmold found in the Prairie provinces of Canada.

The major problem associated with control of the disease is one of longevity and persistence of the applied chemical. This develops from the necessity of applying the fungicide in late fall or early winter after

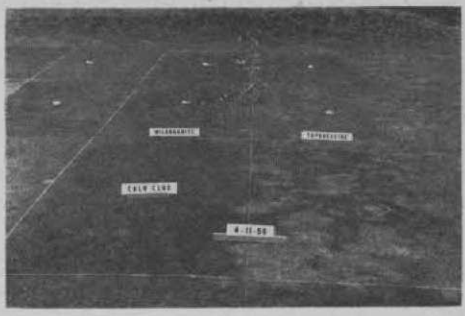

Fig. 1—Plot (left foreground) treated with Milorganite and Calo Clor. Plot at right treated with topdressing alone. Note color and freedom of disease on treated plot. Note also color of the disease-free grass on topdressing plot in contrast to that beyond test area, and on the spray plot located immediately behind topdressing plot.

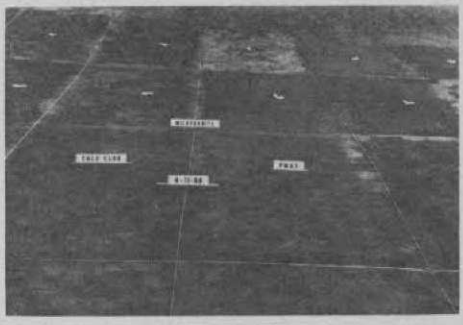

Fig. 2—Plots treated with Calo Clor and PMAS as indicated. Milorganite was used as carrier for both chemicals. Note development of disease along plot borders. Second plot in rear of PMAS plots (toward shed) is a check — no treatment. Note severity of snowmold infestation.

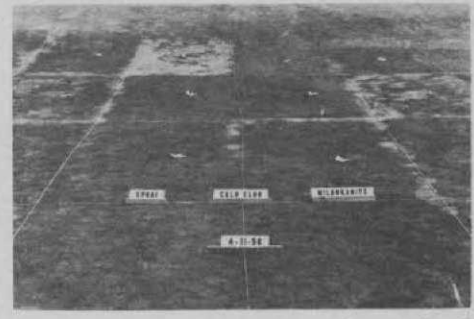

Fig. 3—Plots in immediate foreground treated with Calo Clor. That to the left was sprayed; to right, Milorganite was used as carrier. Note contrast in color and freedom from disease. Check plot located three plots in rear of spray plot. Plot treated with topdressing alone — without chemical — located two plots to rear and one to right of Milorganite plot.

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Fig. 4—Green at Somerset CC topdressed in fall and treated in late November with four ozs. of Calo Clor and 10 lbs. of Milorganite per 1000 sq. ft. Note development of disease along areas where spreader did not lap. Note also severity of disease on untreated apron and shoulder.

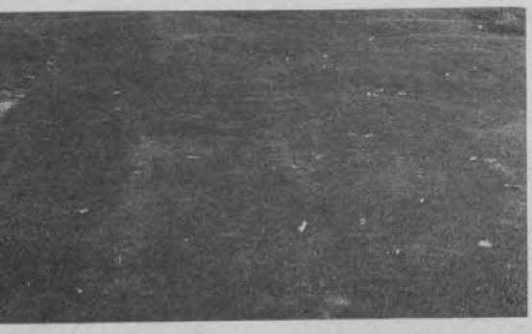
the soil is frozen and prior to the first snowfall which will remain. Another problem is that of holding the fungicide in place when thaws occur in late winter and early spring. Often snow may melt, partially or completely, thus washing out or dissipating the material.

In an effort to find a material which would prolong the effectiveness and persistence of the fungicide, a snowmold test was located on an experimental green at the Toro Research and Development Center in the fall of 1953. This study was continued in 1954, 1955 and 1956. The results of the 1953 and 1954 tests (readings made in the spring of 1954 and 1955) were reported in the May, 1956 issue of GOLFDOM.

Materials and Methods

Certain revisions were made in the 1955-56 study. They were as follows:

Fig. 5—Small area of bentgrass in fairway at Somerset CC treated with four ozs. of Calo Clor and 10 lbs. of Milorganite per 1000 sq. ft. Note development of disease and lack of color in center swath where spreader was exhausted of material midway through run.



(1) Chemicals — only one rate of each chemical was used — PMAS at three ozs. of 10 percent material per 1,000 sq. ft.; Calo Clor at three ozs. per 1,000 sq. ft. In earlier tests, PMAS was used at 1½ and 3 ozs. per 1,000 sq. ft. and Calo Clor at two and four ozs. per 1,000 sq. ft.

(2) Carriers — Processed sewage sludge — Milorganite at the rate of 50 and 100 lbs. per 1,000 sq. ft., topdressing at a volume equal to 100 lbs. of Milorganite, a mixture of topdressing and Milorganite at a volume equal to 50 and 100 lbs. of Milorganite, and water as a spray, were used as carriers.

Sand was omitted from the test in 1955-56. Earlier studies had shown the sand to be of little value, other than providing additional bulk for spreading the chemical.

(3) Milorganite, topdressing and a combination of the two materials were used without chemical.

(4) A series of plots received soluble nitrogen from an inorganic carrier (ammonium sulfate) at a rate to equal the amount of nitrogen contained in 100 lbs. of the organic carrier, Milorganite.

The treatments were replicated three times. They were applied in late November only.

Effectiveness of the various chemicals and carriers was measured by recording the actual number of snowmold spots which developed during late winter and early spring. Color ratings were also recorded during this period. Two or three thaws and subsequent snows occurred, thus providing excellent conditions for evaluating longevity and persistence of the various chemicals and carriers.

The 1955 snowmold control program at the Somerset CC, St. Paul, Minn., although not an integral part of these experiments, serves to illustrate practical application and to support validity of the test results. Following a fall topdressing, the greens were treated in late November-early December, with four ozs. of Calo Clor mixed with 10 lbs. of Milorganite per 1000 sq. ft. The results of this program are presented in the discussion phase of this paper.

Results

Results of the 1955-56 test at the Toro R. & D. Center show:

(1) Three ozs. of Calo Clor per 1000 sq. ft. produced effective control of snowmold, irrespective of carrier.

(2) The three oz. rate of PMAS was effective against snowmold under normal environmental conditions. Under heavy and persistent snow pack and in low areas

where moisture persisted (extreme environment) as on some plots, PMAS failed to render control, irrespective of carrier.

(3) Milorganite and topdressing produced earlier greening than spray treatments.

(4) Effectiveness of the Milorganite as measured by density, vigor and color throughout the growing season, was considerably superior to topdressing.

(5) Milorganite, topdressing, or the combination alone (without chemical) did not effect control of the snowmold.

(6) Soluble nitrogen (ammonium sulfate) produced severe damage resulting in almost complete destruction of the turf.

Some variation between the results obtained in 1955-56, and those of previous years are noted. These variations will be discussed.

Carrier Infestation

Check plots, as well as plots which received carrier alone (without chemical) were heavily infested with snowmold. See Figs. 1, 2 and 3. The degree of infestation was less on plots receiving carrier alone than on the check plot (Fig. 3). Nevertheless, the necessity of using a chemical to effectively control snowmold is obvious, since any degree of infestation is undesirable.

Calo Clor applied in late fall-early winter at a rate of three ozs. per 1000 sq. ft. under the conditions studied, controls development of snowmold, irrespective of carrier or severity of environment (Fig. 3). Effectiveness of Calo Clor may also be noted in Figs. 1 and 2. Figs. 4 and 5 show effectiveness under field conditions. While the three oz. rate was satisfactory under controlled test conditions, it would appear that four ozs. per 1000 would be a more practical and desirable rate for golf course greens. It likewise appears that in the northern sections of the border states and in Canada, an even higher rate may be desirable.

In the 1955-56 test, PMAS at three ozs. per 1000 sq ft. failed to produce the satisfactory control experienced during the previous years of the study. It should be pointed out that certain plots receiving PMAS were completely free of snowmold (Fig. 2); nevertheless, the average infestation for all plots in all replications was such that the overall performance in 1955-56 was rated unsatisfactory. This average was materially influenced by the heavy infestation occur-

ring on plots located in areas classified as having an extreme environment. The failure to control the disease on these plots is probably related to the soluble nature of phenyl mercury, since it appears that under normal environment, PMAS does render satisfactory control. Heavier rates, as well as retreatment with PMAS in late winter-early spring, may produce satisfactory control under all conditions.

Uniformity of Coverage

Uniformity of coverage is essential for effective control of snowmold. This is illustrated in Fig. 3, which shows the development of the disease along plot borders where treatments did not completely abut. Also, the development of disease along spreader borders where material was not lapped (Fig. 4) and where the hopper was exhausted of material midway through one lap (Fig. 5) illustrates importance of uniform coverage. The evidence indicates that where carrier is used with the chemical, it is held in place with little to no lateral movement.

As noted, earlier spray applications are as effective in the control of snowmold as are those in which an organic carrier is used. The convenience of applying chemicals with available spray equipment may, under certain conditions, constitute an advantage for this method. It should be noted that the carrier may be applied dry and the Calo-Clor sprayed over the material in place, as well as mixing carrier and chemical before application.

The major advantage of using an organic carrier appears to be the early greening produced. Plots receiving Milorganite and topdressing alone or in combination "greened up" some two to three weeks earlier than sprayed plots (Figs. 1 and 3). This early greening may be partially explained by the thermal effects produced. The dark material absorbs and holds more heat; hence, raises the temperature of the microclimate enough to permit early growth activity. The presence of available nitrogen at this time stimulates additional growth.

Other than the initial early greening produced by the topdressing, there appeared to be little advantage from using topdressing as a carrier. However, plots which received Milorganite alone or in combination with topdressing displayed continued superiority in density, color and vigor in almost direct relation to the amount of material used.

The rates of Milorganite used in the 1955 test supplied three and six lbs. of nitrogen; in the 1953 and 1954 tests, 12 lbs. of nitrogen; and the rate used at the Somerset CC in 1955, 6/10 lbs. of nitrogen per 1000 sq. ft. In one series of plots in 1955, ammonium sulfate was applied at a rate to supply six lbs of nitrogen per 1000 sq. ft.

Effect of Nitrate Rate Release

It is highly significant to note that damage to the turf in the form of burning or over succulence from even the 12-lb. rate of nitrogen from sewage sludge did not occur, whereas severe damage, actually almost complete kill, resulted from the use of six lbs. of nitrogen from the soluble carrier (ammonium sulfate). The contrasting results can be attributed only to the difference between the rate of release of nitrate from the two types of carriers.

The failure of the Milorganite treated plots to develop succulence and the resultant damage associated with this condition may be partially explained by the slow breakdown of the material. The application was made very late in the fall; low temperatures at that time, as well as during winter, prevented complete breakdown. Subsequent spring temperatures were such that decomposition proceeded rather slowly, with no apparent ill effects. The possibility exists that the grass may be able to utilize some of the early products of decomposition (amino acids) for its very reduced metabolic activity during its period of dormancy. The use of soluble nitrogen at materially reduced rates to produce early greening may be possible; however, the results of this study do not warrant a recommendation as to the rate or time of application.

In the central and southern extremities of the snowmold zone, it would appear that low rates (10 to 20 lbs.) of Milorganite would be preferable to the higher rates (up to 50 lbs.) which appear satisfactory in the more northern areas. Although the 100 and 200-lb. rate of Milorganite gave satisfactory results, it is felt that a maximum of 50 lbs. per 1000 sq. ft. is adequate. Higher temperatures and more infrequent snowfall in the central and southern belts would undoubtedly lead to a release of more nitrates than would be experienced in the northern belts. This conceivably could produce sufficient succulence which, when coupled with rapid drops in temperature, might produce damage to the turfgrass.

Conclusions

Based on the results of experiments and observations conducted at the Toro R. & D.

Center for the past three years, the following conclusions regarding the prevention and control of snowmold on golf course turfgrass seem warranted:

1. Three to four ozs. of Calo Clor per 1000 sq. ft. provide satisfactory chemical control of snowmold.

2. Spray applications of Calo Clor give effective control of snowmold, but grass takes longer to green up than when Milorganite or topdressing is used as a carrier.

3. Milorganite or topdressing may be applied and Calo Clor sprayed onto them with the same results as obtained from mixing chemical and carrier before application.

4. Ten to 50 lbs. of Milorganite per 1000 sq. ft. will produce greening some two to three weeks earlier. Greens so treated will exhibit superior color, density and vigor for an extended period of time in almost direct relation to the amount of material used. Low rates (10 to 20 lbs.) are suggested for central and southern belts; higher rates appear satisfactory in more northern areas.

5. Topdressing used as a carrier produces early greening, but fails to produce the improvement in quality experienced on Milorganite treated areas.

6. The combination of topdressing and Milorganite used as a carrier produces satisfactory results – early greening and superior quality. Prolonged superiority from a quality standpoint is directly related to the amount of Milorganite used.

7. PMAS (10 percent) used at a rate of three to four ozs. per 1000 sq. ft. may provide satisfactory control under normal conditions, but appears inadequate under extreme environment – heavy and persistent snow pack and low poorly drained areas. Retreatment in late winter – early spring, or possibly higher rates may be necessary to produce completely satisfactory control.

8. Uniform application of any chemical is essential for satisfactory control.

9. Treatment of aprons, approaches and shoulders, as well as the green proper, is recommended. Such will protect the bentgrass present on these areas and possibly prevent invasion of weeds.

10. The results of these studies clearly indicate that from a practical standpoint, snowmold can be effectively controlled and greens may be brought into play considerably earlier by correct choice of chemical carrier. Nevertheless, further research on all phases of this investigation is warranted.