WINTER PROTECTION OF GREENS

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During late fall, winter and early spring, turfgrass areas are subject to varying degrees of injury. Such injury is directly related to soil environment, weather — especially temperature and wind — and the amount of traffic — both foot and vehicular. In some years, if climatic and environmental conditions are optimum, little, if any, damage may occur. In other years, only slight variation in one or more climatic factors may produce severe winter injury.

The uncertainty involved in predicting weather and the certainty of damage during adverse winters (with attendant expenditures of time, effort and money to repair the injury) would seem to dictate the importance of using preventive measures if at all possible.

Winter injury may be classified into two rather general and broad classifications — mechanical and physiological damage.

Mechanical Damage

As the heading implies, this type of winter injury is produced by mechanical means. With one exception, it is caused by man and may damage turfgrass directly or indirectly.

Direct injury to turfgrass is produced by traffic — foot and vehicular — when the grass is covered by frost or when it is dormant or semi-dormant and the soil is partially or completely frozen Examples are: (1) bruising (cellular rupture) resulting from traffic on frosted grass — this is especially serious in late fall and early spring; (2) attrition caused by traffic when the soil is partially or completely frozen. Such is especially damaging when the grass is semi-dormant or dormant — it may be killed at this time by "scuffing".

Indirect injury to turfgrass is produced by traffic on partially frozen or wet soil. The injury produced may be immediately evident (visible) or delayed (invisible). An example of the visible type of injury is soil displacement — the footprinting and rutting caused by traffic sliding and slipping, as well as walking or rolling. An example of the invisible type of injury is soil compaction. This is certainly not confined to the winter months, although it may be far more damaging during this period than generally recognized. Traffic on greens, without the protection of living grass, will exert greater pressure (hence, more compacting force) than when the grass is growinng actively. This results, subsequently, in poor growth and may explain "problem areas" which show up in spring and summer for no apparent reason.

Heaving, the one exception to mechanical damage caused by man, is a natural phenomenon caused by alternate freezing and thawing of the soil which simply pushes or "heaves" plants with inadequately or poorly anchored (shallow) roots out of the soil. Heaving may be especially damaging to new stands planted late or without adequate nutrition or on poorly prepared seedbeds.

Methods of preventing or avoiding all of the above types of mechanical damage, with the exception of the injury caused by heaving, may be avoided by simply preventing traffic during the late fall, winter and early spring when adverse weather or soil conditions occur. It is recognized that this is "easier said than done". It is also recognized that, while such may be desirable from an agronomic standpoint, it is not desirable from the standpoint of the club or of the limited number of players who wish to take advantage of each opportunity to get outside during the winter.

Nevertheless, the Golf Course Superintendent does have certain obligations and responsibilities in this area. It is suggested that, among other things, the Superintendent, in cooperation with the Green Committee should: (1) thoroughly acquaint the membership with the potential damage form uncontrolled traffic; (2) budget funds to provide for additional maintenance required to correct injury and to bring the course into top playing condition in as short a time as possible the following spring; and (3) prepare and present programs for diverting play to temporary greens (where such are feasible), for absolute control of traffic during periods of adversity and for re-routing of traffic to avoid damage to critical areas. The club officials are then in a position to determine the affect that "off-season" play will have on the spring condition of the course and to budget additional funds to correct injury or provide alternate playing areas.

Potential damage or losses from heaving may be reduced on established turf by carrying out recommended management programs that insure deep root development. On newly established areas, heaving may be reduced or avoided by earlier planting, good seedbed preparation and providing sufficient nutrition to insure deeper and more profuse root development. Making certain that the soil goes into the winter with an adequate supply of moisture will also protect against heaving. When, in spite of such efforts heaving does occur, then an early light rolling may save some of the plants.

Physiological Damage

This type of damage suffered by plants during the winter months is generally referred to as "winterkill." While most "winterkill" is the result of either disease, desiccation or low temperatures, under certain conditions suffocation and scald may cause severe localized damage.

Suffocation

Turfgrasses, although essentially dormant during the winter months, nevertheless, carry on reduced metabolic (growth) activity, particularly respiration. For this process, oxygen is taken in and carbon dioxide given off. Hence, grass may suffocate (a) if interchange of atmospheric soil gases is reduced or

stopped; (b) if excess carbon dioxide accumulates; or (c) if oxygen supplies are reduced to a minimum. Such conditions exist when an area is poorly drained, the soil saturated for extended periods or the green covered with ice. The degree of damage expected from this latter condition may be directly related to the rate at which the plant is or was growing at the time of coverage. More growth — more damage.

Scald

In addition to the above effects, standing water or ice sheets may act as a lens under certain conditions. When this happens, the sun's rays are magnified to the point where the excessive heat produced may cause a burning or scalding of the turfgrass.

Methods of preventing or avoiding suffocation and scald are related basically to improvement of drainage — surface and sub-surface — to prevent ponding or accumulation of water and to breaking up of ice sheets when they occur. Topdressing, leveling or grading, installation of French drains and avoidance of over stimulation of growth late in the fall or during the winter are techniques and practices which help to offset winterkill caused by suffocation and scald. Ice sheets may be broken up mechanically or by spreading dark materials — Milorganite, Lampblack, Agrinite, Nutronite and other similar products — over the ice. Such materials absorb heat and penetrate the ice sheet, thus permitting an interchange of gases.

Disease

Winter disease, primarily snowmold **(Typhula)** and Fusarium patch **(Fusarium),** often may cause considerable damage to golf course turfgrass in late fall, winter and early spring — whenever moisture and temperature are conducive to their development. There is evidence to indicate that other disease-producing organisms may also cause damage, but they appear to be controlled by the same treatments used for the more prevalent "snowmold" complex.

Snowmold and other winter diseases are readily prevented by one or more treatments with fungicides containing mercury (inorganic or organic), Thiram, cadmium or various mixtures and combinations of the basic compounds. Mixing the appropriate fungicide with Milorganite or topdressing containing peat and applying this mixture in late fall, early winter, will provide protection. (See GOLF COURSE REPORTER, Vol 24, No. 7 — September-October 1956 and GOLFDOM, Vol. 30, No. 10 — October 1956.) More than one treatment may be required if rainfall is excessive or repeated freezing and thawing occurs.

Freeze and Frost Damage

Other forms of physiological winter injury are related to damage resulting from low temperature. Low temperature damage includes desiccation, chilling injury and frost injury. A brief review of the cause and effect of these phenomena may be helpful in preventing or protecting golf greens against winterkill.

Desiccation is basically a wilting phenomenon. It occurs when plants are transpiring moisture in excess of that which the roots are able to absorb. When soil is partially dry, saturated or frozen, the roots simply cannot take in enough water to offset that being transpired (or to meet metabolic requirements) and the plant "desiccates" or dries up. Although more serious during periods when the soil is "on the dry side" or partially frozen, desiccation on high windswept sites occurs at any time during the winter months. The increased air movement causes excessive transpiration hence reducing soil moisture and, under

severe conditions, causing death of the grass plants.

Desiccation may well be responsible for more winterkill than all other phenomena mentioned. It is particularly devastating when it occurs in combination with snowmold and Fusarium patch.

Chilling injury — plants vary in their ability to resist or tolerate low temperature. Many plants native to tropical or sub-tropical regions — flowers, shrubs, etc. — may be seriously injured by temperatures above the freezing point. They are usually killed by the first touch of frost. Nature of the killing is related to a disturbance of the metabolic or physiological activity.

Frost injury — the more common form of low temperature injury is referred to as "frost injury. Frost injury may occur in all plants. Some may be frozen solid without damage, others may be killed at or slightly above freezing. Within the grasses, a difference is exhibited between the warm and cool season groups in this respect. Likewise, within each group; for example, bent, bluegrass and ryegrass.

More important perhaps than spe[illegible] diffe[illegible] **is the fact** that for a **single** [illegible] killing temperature varies [illegible] **the physiological state** [illegible] exposed. Grass th[illegible] is far more [illegible] in late [illegible] for [illegible]

heat of fusion — heat required to convert liquid to solid.

Heat is required in one form or another to turn ice into water. In a like manner, when water turns to ice, heat is released. This is known as the heat of fusion. Quantitively, it is equivalent to 79 plus calories per gram (36320 calories of 144 BTU's per pound of water). Heat of fusion is by far the more important factor involved in using sprinkler irrigation to protect against low temperature damage. The heat contained within the water has usually been chilled to atmospheric ternperature by the time it strikes the plant.

The heat absorbed by the plant surfaces is enough to protect it except when air temperature is very low or when heat is being removed rapidly by a cold wind. Ice may form when the temperature gets a few degrees below freezing. When this happens, continue to apply water until the air temperature is above 32 degrees and all ice has melted. It would appear that grasses might be protected down to 20 to 25 degrees for relatively short "cold snaps".

This technique may be used in fall and especially in early spring — it may, at least, produce gradual freezing or thawing and hence cause less damage. Greens will need to have good drainage — surface and internal — if the system is run for two or three days. It appears that a precipitation rate of about one-tenth of an inch per hour is most satisfactory for this purpose.

Soil Warming

The technique of using electric wires embedded in the soil has been receiving attention for the past few years. It has been [illegible] on p[illegible] Great Britain and Swe[illegible] experiment[illegible] berta ([illegible] Bel[illegible]

Covers

In areas where winter play does not occur; or if it does, temporary greens are used, Golf Course Superintendents employ several techniques to protect greens. Most of these are basically methods for preventing desiccation. They include: (1) hauling of water to greens when snow is absent especially in late winter-early spring when high wind movement occurs before irrigation systems are turned on. (2) The erecting of snow fence and piling of brush to hold snow in place. Snow is an excellent protector or insulator, and if adequate snowfall occurs, this technique is usually quite effective. Collecting and holding snow will offset desiccation and protect against frost injury but increases the chances of snowmold development. Hence, preventive treatments are essential if this technique is employed. (3) Covering the greens with various types of organic mulch, such as straw and peat, which provides adequate insulation and holds sufficient moisture to prevent desiccation. However, it is seldom possible to remove all of [illegible] from the green in the spring and, as a re[illegible] of undecomposed organic [illegible]ns each year. This fur-

ther contributes to the build-up of thatch on the greens. Such an environment is also conducive to disease development. (4) Covering greens, tees and other critical areas with polyethylene appears to offer a positive means of protecting against desiccation. This technique has been used in a number of locations the past few years. For the most part, it has been quite successful. When failures have occurred, they seem to be related to time of removal of the tarps. This technique is discussed in detail in the articles entitled, "Protecting Golf Greens Against Winterkill" and "Plastic Covers Protect Greens from Winter Damage", published in the September-October 1960 and 1962 issues of the **Golf Course Reporter,** respectively.

This past year, Jim Haines of the Denver Country Club and Cameron Henderson, formerly of Buffalo Country Club, utilized this technique to provide satisfactory playing conditions for their membership at much earlier dates than would otherwise have been possible.

Jim covered newly constructed greens and tees on October 30, 1963. He removed the covers on April 8, 1964. Plantings in the Denver area are usually completed by September 20 and opened for play the following July. Growth under the covers was such that the new greens were opened for play on May 23, 1964.

Cameron covered several of his greens in early March, 1964. The chemical used for protection against snowmold was ineffective, and when a thaw occurred in late February, the green had been severely damagd by the disease. Prompt treatment with an appropriate fungicide brought the disease under control. The tarps were used to stimulate growth. Because of fluctuating temperatures, it was necessary to remove the covers in order to mow the greens two or three times.

Editor's Note: Slides were used to illustrate the experiences with polyethylene. Also, to illustrate the continuing problem of "hold down". Techniques employed by a number of Superintendents were shown.

Methods of Preventing Damage When Frost Occurs

The most important factor involved in preventing damage to greens when frost does occur is to avoid subjecting them to **traffic.** Traffic on frosted or partially frozen grass causes the ice crystals to puncture the cells and mechanically kill the plants.

In the event traffic cannot be avoided, **wash the frost off with sprinklers.** Do this early before the sun comes up. If a heavy frost has occurred it is a good idea to use the sprinklers even if traffic is not anticipated. Sprinkling may slow down the rate of thaw as well as release heat as discussed earlier.

In conclusion, it is well to keep in mind that sound management practices are basic to an effective winter protection program. Early fall practices are especially important because it is during the fall that food reserves are being stored. The plants must draw upon these reserves for initiation of growth the following spring — or — each time during the winter months when temperatures conducive to growth occur.

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