Late Season Golf: To Play or Not to Play

By Dr. John Stier, *Department of Horticulture, University of Wisconsin-Madison*

The focus of November's Wisconsin Golf Symposium on temperature and golf course maintenance was brilliant in its aim to dissect one of the most fundamental controls (temperature) on turfgrass growth and response. The large number of new golf courses finished in the last 10 years has combined with a stagnant economy, increased fuel and fertilizer costs, and weather extremes that have pushed course management to accept if not encourage more late and early season play. Play at such times, though, may or may not merit the extra income if damage occurs which requires extraordinary effort to repair. Unfortunately there is no formula to use to determine if play should or should not be allowed. Instead, such a decision requires the wisdom and insight of a professional golf course superintendent, often in concert with the club manager and/or golf professional.

Why be concerned?

The main reason for disallowing late or early season play is that the turf may be physically incapable of recovering from damage. Traffic at the wrong times, in the form of vehicles, divots, and even foot traffic may kill the turf or severely limit its growth when favorable temperatures return. The absence of living turf during the winter can allow melting snow and moving surface water to cause soil erosion on a micro-scale, resulting in holes and bumpy turf. Certain weed species, particularly *Poa annua*, henbit, prostrate knotweed, and other winter or early spring annuals will fill in bare spots. Traffic can crush plant tissues and weaken the turf, possibly increasing the likelihood for disease even if a protective fungicide was applied since low temperatures inhibit the plant's ability to repair the damage. Autumn and spring periods when the trees do not have leaves are critical times for turf to gather sunlight for the production and storage of carbohydrates: traffic during these periods causes the turf to expend some of the carbohydrates to repair damage, robbing the turf of carbohydrates needed for winter or summer survival when photosynthesis is inhibited by unfavorable temperatures and/or shade.

While a few golfers may appreciate the chance to play an extended season, the potential loss of money and goodwill from closing the course has to be balanced with expenditures related to possible repair and loss of goodwill from the golfing majority during the primary season of play.

Plant growth and development changes by season

Changes in turf growth and development occur slowly but steadily during the autumn, perhaps a little less so in the spring. Turfgrasses begin acclimating themselves for winter as the daylength shortens and temperatures decrease during September and October. New leaves and shoots are smaller and darker green than those produced under more favorable growing conditions. The length of time between production of new leaves and shoots is longer. Instead of a new leaf being produced within five days, it may take seven, eight, or more days to produce a new leaf. While a few days difference in leaf appearance rate may seem trivial, it helps to understand the importance of each individual leaf to a turf plant. For example, a Kentucky bluegrass plant may have two shoots with leaves. Each shoot typically carries five leaves. The oldest leaf, at the bottom of the shoot, usually uses more carbohydrates than it produces and becomes a net drain on the carbohydrate supply of the entire plant. The newest leaf, still emerging from the shoot tip, is also a net drain on carbohydrates. The middle three leaves produce more carbohydrates than are needed-the balance is used elsewhere in the plant or stored for use during times unfavorable for photosynthesis (night, winter, etc.). If foot traffic, or a nine-iron being casually swished in the turf while a golfer awaits their turn, destroys the youngest three leaves on each shoot, the turf density is reduced by 60%. Under favorable conditions, it would take about two weeks to regain 100% density. If the leaf appearance rate is increased from five to eight days because of low temperatures, it now would take three weeks to regain 100% density.

Other physical changes also occur during autumn. Turfgrasses essentially "de-water", that is, the water content of plants is decreased. The lower water content is important for winter survival as too much water reduces the low temperature tolerance of the turf. Think of the situation as the irrigation pipes on a golf course or plumbing in a home: outdoor pipes are drained of their water before freezing temperatures occur to prevent bursting since water expands when it freezes. Turf plants must reduce their water content accordingly or suffer from burst cells and tissues. The reduction in water content, though, comes with a cost. A high water content is needed to cause cells and tissues to expand in what we see as plant growth. Low water content equates to less growth.

Finally, autumn conditions cause turf plants to assume a more horizontal type of growth compared to the vertical growth typical during spring and summer. The horizontal aspect of growth occurs above and below the surface. Leaves tend to grow less upright while more carbohydrates are allocated to rhizome and stolon growth. Axillary buds on the turf crowns form which will develop into new shoots in the spring. While the horizontal growth can theoretically help cover more soil surface to keep weed seed from germinating, it is not necessarily sufficient to offset the reduced growth rate, and damage to plants is even more likely to result in exposed soil than during more favorable growing conditions. Exposed soil is prone to erosion and favors weed development.

Soil temperature ultimately dictates most growth and development of a turf plant. Roots can continue to grow until the soil freezes (Hanson and Juska, 1961). In some years the soil never freezes and roots can grow assuming carbohydrates are available. Since the majority of carbohydrates are stored in the leaves and shoots, a sufficient amount of living vegetation is needed to keep the roots supplied.

Traffic cops needed

Every experienced superintendent dreads the possibility of traffic on frosted turf. Frost itself does not injure our cool-season grasses (warm season grasses like crabgrass are a different matter) but the temporarily brittle tissues are prone to breakage if walked or driven upon. Frost typically occurs during clear nights when the air temperature drops below freezing. Water losses through turf leaf pores or from the leaf surfaces cool the plant. If the leaf temperature is less than the air temperature, atmospheric moisture condenses on the leaf surface. As the air temperature decreases to less than 32 F, the water droplets freeze and frost is formed. Traffic on frosted turf crushes the leaf tissue and the affected leaves die. The result is easily recognized within the next several days as dead leaves outline the footprints or wheel tracks caused by the traffic (Fig 1). Foot traffic alone will usually only kill the leaves, not the entire plant, particularly when cutting height is one inch or greater. The safety margin diminishes at lower cutting heights and heavier traffic.

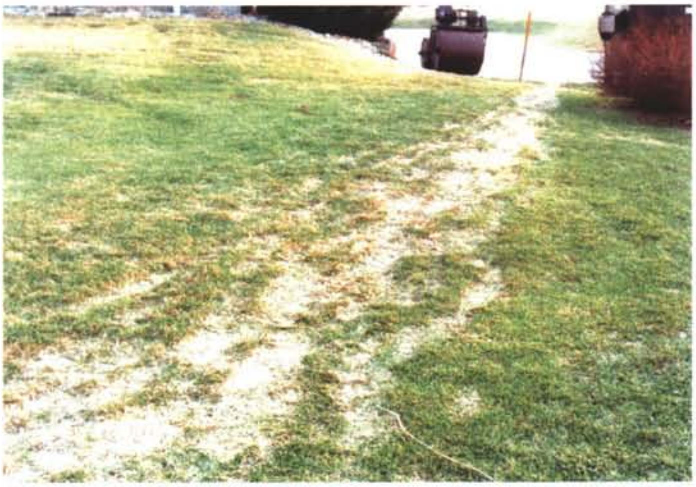

Fig. 1. Foot traffic during an autumn frost killed Kentucky bluegrass leaves, O.J. Noer Turf Research and Educational Facilty, Madison, WI, 2007. Photo courtesy of Tom Schwab.

The worst conditions possible are when traffic occurs over slushy turf especially when followed by freezing temperatures. In such conditions, even cold-tolerant Kentucky bluegrass can be completely killed at the relatively low pressure of 4 lbs per square inch (Beard, 1965). Golf courses where winter activities such as snowmobiling or cross-country skiing are allowed are particularly at risk for such damage. At least 1.5 inches of snow should cover the ground to avoid direct traffic damage to turf (Eaton and Beard, 1986).

Whether its late autumn, winter, or early spring, someone at the golf course is going to have be play traffic cop. That person needs to have sufficient knowledge of where the traffic is occurring or will be likely to occur, the status of the ground at that particular time, and the impact damage will have on the golf course. Damage from late winter cross-country skiing over slushy ground is less likely to affect golf course operations if it occurs in the rough than across a fairway.

Management can affect low temperature response

Soil moisture. Most superintendents I know take great pride in producing the most perfect turf possible. Planning occurs constantly, including during the winter when snow lies three feet deep on the ground. While nature ultimately dictates the potential for success, proper management can sometimes make the difference between success or failure of golf course turf. Suitable irrigation and drainage, or lack thereof, is necessary during the fall as soil moisture will greatly affect soil temperature and therefore turf growth and quality. Wet soils tend to hold heat longer in the autumn but warm up slower in the spring. Depressions in putting greens tend to stay greener longer in the winter but are more disposed to winterkill and slower spring greenup. Thus, wet soils may provide more playable conditions later in the fall but should be left out of play longer in the spring. Soil moisture is affected by drainage which is a function of elevation, slope, and soil type. The effect is easily seen when fast-draining sand-based greens are compared to slower-draining soil-based greens. Turf on push-up greens with a root zone of silt loam soil will stay greener longer in the autumn than greens with a sand-based root zone, but will green up slower in the spring.

Re-routing traffic. The effects of routine traffic during the growing season becomes more noticeable in the autumn and early spring as grass growth slows. Re-routing traffic whenever possible to allow turf recovery during the autumn will help keep high traffic areas at their best the following summer. Putting greens in the shade or other trouble spots will benefit from having temporary greens being used for late or early season play. While no golfer particularly likes playing on a temporary green carved out of the fairway, the few grumbles it causes are likely to have a much bigger payback when the majority of the golfers playing during the summer appreciate the higher quality of the conventional green due to the "rest" it had during late autumn and early spring.

Mowing heights. *Increasing the mowing heights,* particularly on high traffic or stressed areas such as putting greens, during the autumn can have tremendous benefits on improved turf quality. Even slightly higher cutting heights will increase the amount of carbohydrates produced and stored, and often allow the grass to maintain green color longer in the autumn. The extra turf cover will act as an insulator for both temperature and to protect crowns from traffic damage.

Fertilization. Autumn and spring applications of fertilizer can have a profound impact on both apparent and real turf health and quality. Nitrogen fertility needs to be maintained to enhance root and rhizome growth (Hanson and Juska, 1961), but a number of studies have indicated adding too much during the cold acclimation period decreases low temperature tolerance (Stier and Fei, 2008). Consequently, extension recommendations throughout the cool-season zone have appeared to cause a shift to superintendents delaying autumn N applications to late fall, past the time when the N is capable of forcing new shoot growth but when roots are still growing. Late fall N applications have been shown to enhance spring greenup (Wehner et al., 1988) which is desirable for early spring play. However, the current regulatory climate surrounding golf course management causes all aspects of management to be weighed, and some data indicate late fall N applications are especially prone to leaching (Mangiafico and Guillard, 2006). Consequently, additional data are needed to determine the actual uptake of N during autumn applications. Fortunately for us, Dr. Doug Soldat and his graduate student Dan Lloyd at the University of Wisconsin-Madison are beginning a study to determine the actual amount of N uptake at low temperatures. The project is partially supported by the Wisconsin Golf Course Superintendents Association and should yield important information for honing fall fertilization practices. Another area where information is needed is the impact of phosphorus fertilization as restrictions are increasing on P application. Currently the Wisconsin state legislature is considering a statewide ban on turf P applications. Preliminary research has shown phosphorus uptake is curtailed by low temperatures, but the effect is cultivar-dependent (Kneebone and Johnson, 1980). The impact of low temperature P uptake on turf growth and health still needs to be determined, as well as how other practices such as N fertility impact P utilization at low temperatures.

Low temperature weed growth. The restricted growth of desirable cool-season grasses in late autumn and early spring allows low-temperature-loving weeds such as annual bluegrass to take advantage of any open surface caused by traffic or divot damage. Murphy et al. (2005) showed *Poa annua* infestation increased markedly between August to September and October in bentgrass-based putting greens. Our own research at the University of Wisconsin-Madison shows creeping bentgrass to have greatly diminished divot recovery rates between autumn and spring, while *Poa* spp. tend to have much greater growth rates (Steinke and Stier, 2003). From a management standpoint, then, it becomes important to maintain as dense of a turf cover as possible to avoid future weed management problems.

Making the decision

Each year I received calls and/or emails from superintendents or club owners asking about whether they should be allowing play during late autumn or winter thaws. Making the decision to allow or not allow play ultimately comes down to weighing the amount of income and goodwill generated against the impact it has on turf quality and repair costs. The situation provides an excellent opportunity for fostering communication between the superintendent and club management to determine what's best for the course, while enhancing mutual respect for each others' position, knowledge, and professionalism. Each situation is different, and a number of agronomic, economic, and social/political factors have to be assessed to arrive at the best decision.

Literature cited

Beard, J.B. 1965. Effects of ice covers in the field on two perennial grasses. Crop Sci. 5:139-140.

Eaton, W.J., and J.B. Beard. 1986. Snowmobile traffic relationships on turfgrasses. HortScience 21:531-532.

Hanson, A.A., and F.V. Juska.1961. Winter root activity in Kentucky bluegrass (*Poa pratensis* L.). Agron. J. 53:372-374.

Kneebone, W.R., and G.V. Johnson. 1980. Root growth and phosphorus responses among clones of creeping bentgrass at low temperatures. p. 125-133. In J.B. Beard (ed.) Proc. Third Intl. Turfgrass Res. Conf., ASA-CSSA-SSSA and Int. Turfgrass Soc., Madison, WI.

Mangiafico, S.S., and K. Guillard. 2006. Fall fertilization timing effects on nitrate leaching and turfgrass color and growth. J. Environ. Qual. 35:163-171.

Murphy, J.A., H. Samaranayake, T.J. Lawson, J.A. Honig, and S. Hart. 2005. Seeding date and cultivar impact on establishment of bentgrass in soil containing annual bluegrass seed. Int. Turfgrass Soc. Res. J. 10:410-415.

Steinke, K., and J.C. Stier. 2003. Nitrogen selection and growth regulator applications for improving shaded turf performance. Crop Sci. 43:1399-1406.

Stier, J.C., and S. Fei. 2008. Cold-stress physiology and management of turfgrasses. p. 473-505. *In* M. Pessarakli (ed.) Handbook of turfgrass management and physiology. CRC Press, Taylor & Francis Group, Boca Raton, FL.

Wehner, D.J., Haley, J.E., and D.L. Martin. 1988. Late fall fertilization of Kentucky bluegrass. Agron. J. 80:466-471.