# Autumn Turf Management for Best Winter Hardiness

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

Autumn is an important period for turf to recover from summer stresses of heat, drought, and golf play. Turfgrasses undergo a number of changes, both visible and within the plant, as daylength shortens and temperatures cool in the autumn. These changes are necessary for the plants to cold-harden sufficiently to survive the winter period when photosynthesis is reduced if not stopped altogether. Most of our turfgrasses have inherently good low temperature tolerance. However, they must also survive a host of adversities ranging from winter desiccation to snow mold diseases. Adhering to good agronomic practices during the autumn can help the turf survive winter and enter the spring looking and playing better.

## Mowing

Turfgrasses thrive on being mowed as it stimulates development of new buds and shoot growth. Each grass species has its own optimal mowing height range (Beard, 2002). Golf course turf is often mowed at the lower end, or even below, the optimal mowing height range. For example, creeping bentgrass putting greens cut below 0.25 inch and Kentucky bluegrass fairways cut at 0.5 inch are surviving below their optimal mowing height. During the growing season irrigation, fungicides, and other practices keep the grass alive. A turf weakened by season-long low mowing may not survive if the winter lasts too long, temperatures get too cold, or fungal diseases are too aggressive. Beard (1973) shows a graph of Kentucky bluegrass having less and less cold tolerance as mowing heights were reduced from an optimum of 2 inches to 1.5, 1.0, and 0.5 inches.

Mowing should continue in the autumn until the turf has stopped producing noticeable clippings. The grass may still be growing, but much of the new growth will be in the form of new bud development on the crowns and stolon, rhizome, or root growth. Mowing height should not decreased during the autumn as the cool nights and warm days are ideal for photosynthesis.

Much like a squirrel or bear, cool-season turfgrasses are busy storing carbohydrates from photosynthesis to use as an energy source during the long cold days of winter. The carbohydrates may also function as an antifreeze, lowering the freezing point of the plant so it can survive low winter temperatures. The mowing height should be raised in cases where the turf has struggled during the summer due to low mowing heights and/or other stresses such as shade. This will increase the amount of photosynthate production and the storage capacity as the shoots and leaves store over 50% of turfgrass carbohydrates (Hull, 1987).

Tree leaves should be removed from turf as they fall to the ground. Coverage of turf from tree leaves will reduce or prevent photosynthesis during the autumn. Extensive leaf cover may also substitute for snow to allow development of gray snow mold. Tree leaves can usually be mulch-mowed into the turf. Research at Michigan State University indicates leaves of some tree-species can reduce weed populations when mulch-mowed into turf (*J. Rogers, pers. communication*).

## Fertilization

A number of experiments show autumn applications of nitrogen can improve autumn and/or spring color (Wilkinson and Duff, 1972; White and Smithberg, 1980; Wehner et al., 1988). However, fertilizer timing and rate can be critical. A number of other experiments show overfertilization throughout the year or fertilizing

during the cold acclimation period reduces low temperature survival of cool-season grasses (Carroll and Welton, 1939; Wilkinson and Duff, 1972; Welterlen and Watschke, 1985). High N rates create more succulent tissues and crowns having a higher moisture content which makes plants more likely to die from freezing injury (Gusta et al., 1975; Tompkins et al., 2000; Webster and Ebdon, 2005).

Nitrogen fertilizer should be applied at rates and times recommended by Dr. Kussow. Nitrogen can be supplied towards the end of the summer golf season as this nitrogen will be useful for turf recovery from summer stresses, development of new buds for the following spring, and stolon/rhizome/root growth. September 1 is usually a good target date in Wisconsin though this may shift a week or two later for the southern part of the state, particularly the Milwaukee area.

Cold acclimation will begin early to late September and nitrogen applied while the foliage is still capable of growth will reduce cold hardiness. A final application of nitrogen, called a dormant application, should be made after foliage has stopped visibly growing (Webster and Ebdon, 2005), or about the time mowers are put away for the year. The turf is still capable of photosynthesizing and will use the nitrogen for proteins, bud development, and root growth.

Root growth can occur at soil temperatures close to freezing (Stuckey, 1941) while most leaf growth stops at approximately 40°F. Rubisco is the main protein which drives photosynthesis: it is also the primary user of nitrogen as it makes up approximately half of the entire protein mass in the plant.

Cold tolerance is enhanced by production of specialized antifreeze proteins which prevent ice from forming in cells (Griffith et al., 2005). Other proteins called lectins protect membranes from damage so cells can survive winter conditions (Hincha et al. 1997). A number of other proteins associated with freezing tolerance are also formed during cold acclimation (Thomashow, 1999).

Water-soluble nitrogen is probably ideal for the dormant application because it can be quickly metabolized by the plant. Slow-release nitrogen sources are not necessarily bad, though most require microbial activity to release the nitrogen and microbial activity is suppressed at low temperatures. Approximately 1 lb N/1000 $ft^2$ is ideal, though somewhat greater rates may be suitable for slow release forms. More work is needed in this area to accurately identify the effects of nitrogen types and rates. Some research also indicates that using a fertilizer with equal to twice as much potassium to nitrogen enhance cold tolerance (Hurto and Troll, 1980; Webster and Ebdon, 2005).

**Irrigation**

The cold hardening process involves a natural dehydration of plant tissues which lowers the freezing potential. Mild drought stress increases cold hardiness (Welterlen and Watschke, 1985). Consequently, irrigation should be reduced as turf begins to enter the cold acclimation period and eventually stopped before the beginning of winter dormancy.

Although the acclimation period is not well defined and varies depending on the species, it appears to begin as daytime temperatures decrease to approximately 50°F. In the southern half of Wisconsin cold acclimation will usually begin in mid to late September and somewhat sooner in the north. Exceptions to withholding irrigation should be made only if turf is being established or to help turf recover from summer drought or other stresses. Even in those cases it is wise to reduce irrigation before low temperatures cause turf to stop visible growth in order to allow the turf to cold harden as much as possible.

**Drainage**

Poorly drained areas should be renovated during the growing season to prevent development of ice cover during the winter. Ice covers can often cause turf death, especially on closely mown turfs like putting greens composed of annual bluegrass (Tompkins et al., 2004; Minner et al., 2006) for reasons that are not completely understood. Likely causes include lack of oxygen and/or increases in toxic gases such as carbon dioxide or cyanide (Andrews, 1996; Lebeau, 1966; Dionne et al., 2002).

Internal drainage will be irrelevant during the winter as soil will usually be frozen if an ice cover exists (though exceptions can exist). Consequently, provisions need to be made to allow surface drainage as rainfall occurs or ice and snow melt. Areas of standing water which are allowed to freeze will be the most likely to die from ice cover.

**Turf establishment**

Areas damaged during the summer may require seeding or sodding if the remaining turf has not filled in by early autumn. Seeding should be done by early to mid-September to give the turf sufficient time to mature before winter. If this is not possible dormant seeding may be necessary.

Dormant seeding is performed late enough in the year that the chance of germination has passed: the seed is expected to germinate early the following spring. Dormant seeding does not have the success rate of late summer seeding as the seed may be killed by low winter temperatures or washed away during winter storms or thaws, but results may be better than waiting until spring.

All seeding requires good seed to soil contact for success, so seeding should be done in conjunction with aeration, topdressing, or raking. Slit-seeding is an excellent method if the equipment is available. It may be better to sod areas expected to have traffic during the autumn as seed will not sufficiently establish.

**Core aeration**

Little research has been conducted on the effects of core aeration on winter turf tolerance. Core aeration during the growing season is known to stimulate root growth and result in denser turf. Core aeration in the autumn should also stimulate root growth by providing oxygen to the roots which will continue to grow long after foliage growth has ceased. On putting greens and tees, especially those on sand-based root zones, it will be important to fill holes with topdressing unless the holes close on their own before winter to avoid winter desiccation of turf around the holes.

Historically core aeration in the fall has been favored as it is less likely to interfere with play than summer or spring aerations. Murphy et al. (2005) found seeding bentgrass in September or October resulted in significantly more annual bluegrass than seeding in July or August. Consequently, fall aeration may increase the amount of annual bluegrass unless core aeration is conducted late enough that seedlings won't survive the winter, e.g., after the average temperature has dropped to below 50°F. More research is needed to determine the effect of timing of core aeration on annual bluegrass populations in Wisconsin.

**Herbicides**

Many perennial weeds such as violet and creeping Charlie are best controlled by herbicides applied in the autumn during the cold acclimation period. Daytime temperatures above 50°F give better results than colder temperatures. Presumably the cold acclimation process causes more of the herbicide to be transported to the growing points (meristems) than when applied in the spring or summer. In addition, weeds that survive the herbicide may be so weakened they can't survive winter. Most herbicides cannot be applied to recently seeded areas. If the situation requires autumn application of herbicides along with new turf establishment, the treated area should either be dormant- seeded or sodded.

**Plant growth regulators**

Many superintendents use plant growth regulators such as Primo™ during the year to reduce clipping

yields and to improve turf quality. Research at the O.J. Noer facility shows Primo can enhance cold tolerance of cool-season grasses (Steinke and Stier, 2004). The final application of the year needs to be applied before the cold acclimation period (early to mid-September) as later applications can delay spring greenup (*J. Stier, unpublished data*).

**Fungicides**

Snow mold diseases are one of, if not the most, important diseases in Wisconsin. Although a number of cultural management practices can affect the severity of the disease under certain conditions, fungicides remain the only truly effective control of snow molds. Without fungicides, closely mown turf can be completely killed by snow mold diseases in Wisconsin. Dr. Jung and his staff at the University of Wisconsin-Madison have passionately studied the various snow mold diseases and published a number of articles on their biology and control (Scheef et al., 2002; Abler and Jung, 2003; Jung et al., 2004; Jo and Jung, 2006). Fungicide controls and strategies continue to change as new products and information become available. Currently one of the best control strategies includes a combination of iprodione, PCNB, and chlorothalonil (Abler and Jung, 2003; Smiley et al., 2005; Vargas, 2005). Fungicides to prevent snow mold should be applied as late as possible in the year while daytime temperatures are above freezing in order to allow fungicides such as iprodione to penetrate into the leaf tissue for longer-lasting protection.

**Traffic control**

Foot and vehicle traffic on turf covered with frost should be avoided. The pressure crushes the leaf tissues and recovery is slow to none due to cool autumn temperatures. If ski or snowmobile paths cross the golf course these should be clearly marked before snowfall. Avoid allowing traffic across high profile areas such as greens, approaches, and tees that will interfere with play during spring repair or be extremely costly to repair. The course should only be open to skiing or snowmobiling when there is at least 3 inches of snow on the ground; lesser amounts can allow extensive turf kill (Eaton and Beard, 1986).

**The final days of autumn**

Autumn can be an important time for turf recovery from summer stresses. Using the best management practices can help avoid turf loss during the winter. Keep mowing until the grass stops growing, fertilize before and after the cold acclimation period, and help the grass cold acclimate by reducing irrigation early in the autumn. Get fungicide applications on all critical turf areas before the grass freezes or snow fall occurs.

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