

Ice Cover: Its Role in Winter Injury

Intermittent ice formation on golf greens and fairways is a common event for the northern areas of Europe and the United States. However over the last few years ice formation has increasingly been singled out as the cause of, or strongly associated with, winter injury. Ice cover injury occurs either directly from continuous ice cover or as part of freeze injury - low temperature kill.



▲ Ice injury is a function of continuous ice cover. *Poa annua* compared to creeping bentgrass is susceptible to injury when continuous ice cover exceeds 45 to 60 days

CONTINUOUS ICE COVER INJURY

The first type of ice injury is the direct result of a continuous ice cover. In the early to mid 1960's Dr Jim Beard conducted a controlled laboratory study where he looked at the survival rate of three cool season turfgrasses under a continuous ice cover and two turfgrasses under field conditions (Ref 1, 2). He found that creeping bentgrass could survive 120 days of continuous ice cover, however annual bluegrass - *Poa annua* - loss occurred after 60 days, with substantial loss around 75 days.

In a recent Canadian field study, both annual bluegrass and creeping bentgrass were subjected to 45 days of continuous ice cover and then the ice was removed. 75 days after initiating the study, and 30 days after removing the ice cover, creeping bentgrass still maintained its cold hardiness, while annual bluegrass was dead (Ref 3). From that Canadian study it might appear that ice needs to be removed from an annual bluegrass turf once 45 days of continuous cover versus 60 days. From these two studies I would suspect the critical time where annual bluegrass begins to suffer from ice cover is between 45 and 60 days of continuous ice cover.

The reasons commonly proposed for ice injury are the build up of toxic gases and/or the development of anoxic conditions, and the loss of cold hardiness. With herbaceous plants, carbon dioxide (CO₂) accumulation under ice cover is a major contributor to plant death (4). Interestingly, intermittent thawing helped eliminate the CO₂ build up and injury to the plants in this study did not occur (4).

The loss of cold hardiness occurs under ice cover but varies among turfgrass species. Under continuous ice cover annual bluegrass loses its cold hardiness, while creeping bentgrass is not affected (3). The loss of cold hardiness in annual bluegrass is likely due to the anoxia - lack of oxygen - conditions that develop under an ice cover (3).

Although ice injury to creeping bentgrass is remote, and certainly not an issue in most of the world, I wonder about its role in winter injury to creeping bentgrass on golf courses in the Rocky Mountains or Scandinavia where ice cover may exceed 120 days. It is not uncommon to observe creeping bentgrass greens in these areas that have suffered winter injury believed to be caused by a combination of ice and freeze injury. It might be possible that prolonged anoxia conditions in areas where ice cover is excessive may reduce creeping bentgrass cold hardiness, making it more susceptible to freeze injury.

Beard (5) reported differences among creeping bentgrass cultivars to ice cover. He found that seeded creeping bentgrasses, especially 'Seaside', are less tolerant of ice coverage than the vegetative cultivars like 'Toronto'. In addition, the colonial bentgrasses were considerably less tolerant than the creeping bentgrasses. Although published over 39 years ago - and the creeping bentgrass cultivars used may not be relevant at this time - the idea that variability among cultivars to ice coverage exists may make it difficult in extreme situations of ice cover to say "creeping bentgrass is not affected by ice covers".

ICE IN ASSOCIATION WITH FREEZE INJURY

In most of the Midwest and Northeastern United States, a continuous ice cover exceeding 45 days is unlikely. The winter weather pattern is generally broken with intermittent periods of thawing that melts the ice. Where 'ice injury' plays a more likely role is as a component of freeze injury. In this role the freezing of water that would occur with a rapid drop of temperature in or around the growing point during or after dehardening of annual bluegrass.

The critical precursor to freeze injury is the loss of cold hardiness through dehardening and subsequent rehydration of the annual bluegrass crown region. Rehydration of the crown region initiates in late winter or early spring. Between creeping bentgrass and annual bluegrass, annual bluegrass has a relatively high crown hydration level. Thus making it more susceptible to freezing.

Although ice covers contribute to the decline in cold hardiness, the most important factor in dehardening is temperature (6). In the case of annual bluegrass the dehardening process can occur quickly when soil temperatures exceed 8degC (46degF) for 48 hours (7).

As we move out of winter into spring Dr Karl Danneberger helps you to assess the damage that ice can cause.

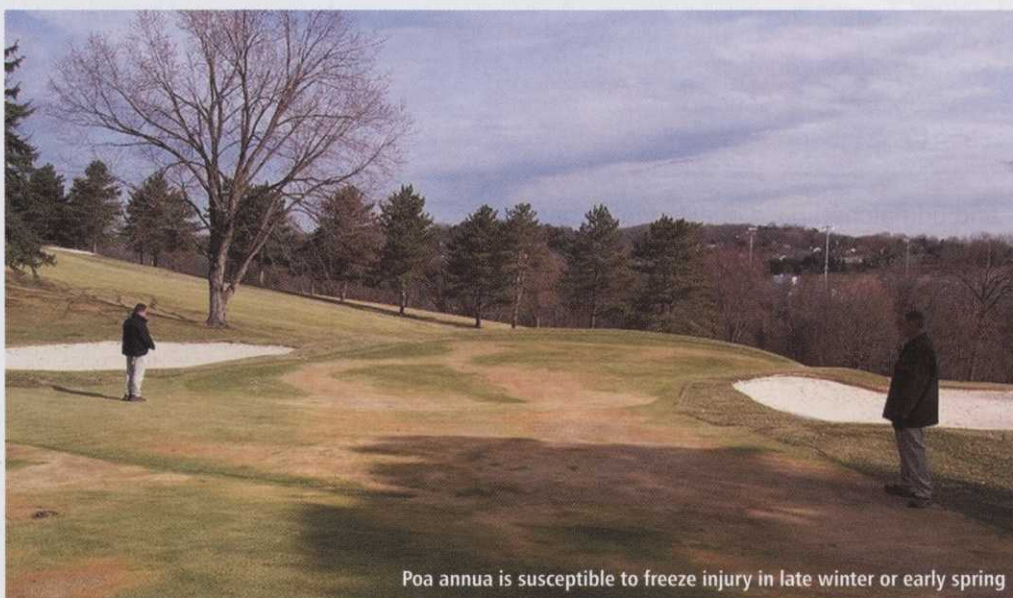


▲ Although creeping bentgrass rarely suffers injury from ice cover or freeze injury, in extreme situations like the Rocky Mountains or possibly in Scandinavia it might occur

It is at this point during late winter, when annual bluegrass begins to rehydrate, that it is most susceptible to a rapid drop in temperature and water freezing. The ice that is produced in and around the crown can cause death. With annual bluegrass, it is usually the lower portion of the crown where root initiation occurs that is highly susceptible to freezing. A common occurrence in freeze injury is to observe an initial green-up of the annual bluegrass followed by a rapid death. The green-up usually lasts three days followed by death due to a desiccating process resulting from lack of root production.

What cultural practices can be instituted to minimise ice injury and/or freeze injury? Numerous articles have been written that discuss management programmes for reducing freeze and/or ice injury (8). A few key points in developing a management programme for reducing injury should centre on:

1. Produce a healthy plant going into the winter. A weak annual bluegrass plant with low carbohydrate storage is not going to tolerate ice cover or be resistant to freeze injury as a healthy plant. Shaded areas are more prone to freeze injury than sunny areas, probably due to the carbohydrate status of annual bluegrass (9).
2. Eliminate poorly drained areas. Annual bluegrass growing in areas where water accumulates is at high risk to rapid freezing during freeze/thaw cycles (10).



Poa annua is susceptible to freeze injury in late winter or early spring

In conclusion, winter injury is normally a combination of several factors, one of which is ice cover. A continuous ice cover alone is not a common event for most northern golf courses. However, freeze/thaw cycles in late winter can create a situation where excessive water in and around annual bluegrass crowns can create freeze injury from the ice formed from the freezing of water.

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