Field Assessment of Winter Injury on Creeping Bentgrass and Annual Bluegrass Putting Greens

GCSAA/IGCSA Cooperative Research Project – 2004 Report

D.D. Minner, F. Valverde, D. Li and N. Christians - Iowa State University
J. Ausen – Hyperion Field Club, President IGCSA
J. Newton – Veenker Memorial Golf Course

See web site for picture report http://turfgrass.hort.iastate.edu/extension/

Introduction:

In 2001 John Newton, (CGCS) Veenker Memorial Golf Course, constructed a native soil green to develop cosponsored projects between the GCSAA, IGCSA, and Iowa State University. The winter injury study is the first to be conducted at this facility. As each winter unfolds we are faced with many questions: 1) should I truck water to my greens, 2) should I invest in a cover, 3) should I topdress heavy, 4) should I remove the ice and when, and 5) did my snow mold control damage turf? Those that make it through the winter with no injury gain faith that their strategy is working and those that loose grass are left in disbelief as to why this particular winter has caused them to loose grass when it has not happened in the past. Our approach is to compare many scenarios for winter injury in a single year. This will help superintendents make strategic action about decisions they face such as ice removal, trucking water, covers, etc. Decisions on winter covers may be made early in the season with no ability to change strategy while others, like ice removal, may be made as the season develops and are based on the superintendents experience. In fact, we actually have no idea when the grass actually dies during the winter or spring. A unique part of our research strategy is to sample weekly during the winter to determine exactly when the grass dies. Our main goal is to make Golf Course Superintendents better prepared to explain local winter turf injury to their golfing and administrative clientele.

Rationale/description of problem:
Some level of winter injury occurs every year on putting greens and fairways in Iowa and other golf courses north of the transition zone. When turf loss is substantial, the golf course superintendent is faced with explaining why the grass died and in many cases why it died on their particular course and not on other courses near by. Many factors, such as direct low temperature, desiccation, ice cover, and soil heaving, are considered responsible for winter kill (Beard, 1973). These factors alone or in combination may be responsible for winter injury. Some research suggests that suffocation and toxic gas may be responsible for turf injury under ice (Freyman, 1967), and that ice removal is, therefore, beneficial. On the contrary, there are reports that no injuries to bentgrass were caused from ice cover for a period from 60 to 150 days (Beard, 1965). However, it is a very common practice to remove the ice from the green and fairway (Kind, 1999) even though there is no convincing research to justify this practice. Frost heaving (Kinbacher, 1956) and spring de-hardening under snow cover (Bilbrough et. al., 2000) have also been associated with winter damage to plants. In late winter and early spring, snow cover can lead to de-hardening of the creeping bentgrass and annual bluegrass, and, thus, expose the grass to low temperature injury at this period (Tompkins et. al., 2000). In 2001, Iowa experienced 90 days of continuous snow cover. Those superintendents who had applied snow mold treatments were anticipating minimal turf injury because of the protective blanket of snow. Instead, it was one of the worst years for injury to putting greens. Unfortunately, many research based explanations often contradict the obvious results that superintendents are experiencing. Consequently superintendents and experts are often left groping for an explanation of why a particular winter condition killed the grass. Most of the research to date evaluates a single type of winter injury and tries to determine if it is a contributing factor to the dead grass. Our approach is to evaluate the relative amount of injury that is associated with various scenarios for winter conditions; thus, providing the golf course superintendent with a reasonable idea of which type of winter condition has the greatest potential for turf loss and, in turn, if it is worth the expense or effort to try and minimize the injury by taking action.

Objectives:

1. To simulate and identify various types of winter conditions that result in turf injury under actual golf course conditions.
2. To determine the relative importance of winter injury on putting greens as it relates to snow cover, ice formation, desiccation, crown hydration, and freeze/thaw cycles.
3. To determine if superintendents should allow winter to take its natural course of events or should they actively manage to reduce winter injury by practices such as using protective covers and removing ice.

Materials/methods:

Ten possible winter scenarios: dry/open, wet, ice continuous, snow continuous, impermeable tarp + ice, ice removal, ice/melt freeze, snow removal/melt freeze, evergreen turf cover, and evergreen turf cover with snow removed, were created on two separate Iowa putting greens in 2004 (Table 1). One green was composed of 'Penncross' creeping bentgrass that was growing on a native soil at the Iowa State University Veenker Memorial Golf Course and the other was 85% annual bluegrass and 15% creeping bentgrass growing on a USGA-type green at the Iowa State University Horticulture Research Station. The Veenker Memorial Green was mowed at 3.54 mm (0.14 in) and the Horticulture Research Green was mowed at 6.35 mm (0.25 in). Two core samples per treatment, 3.5-in dia by 2-in deep, were taken each week with a hammer drill and recovered in a growth chamber to determine when grass died during the winter. After one month of recovery growth, the plugs were clipped at a 0.25 cm height and clippings were collected, dried, and weighed. Turf recovery in the greenhouse (dry weight yield) was used to indicate the amount of winter injury. Recovering core samples and field plots were visually evaluated for turf quality, 9=best, 1=worst, and 6= lowest acceptable quality. The percent of living turf cover was rated for core

samples and field plots. Soil temperature was measured at 0.5 inches below the soil/thatch interface using thermocouples and a data logger.

Snow and ice cover treatments began on January 6. Snow remained on the "continuous snow cover" treatments for 71 days after January 6. Treatments designated for "ice cover" also began on January 6 and lasted for 67 consecutive days. Treatments #6, 7 and 8 received "snow and ice removal" halfway through the season. Snow and ice were removed on February 23 giving these treatments 48 days of continuous snow or ice cover.
The experimental design is a randomized complete block with three replications and data will be analyzed using the Statistical Analysis System (SAS Institute Inc., 1996) and the Analysis of Variance (ANOVA) procedure

Table 1. List of 2004 Winter treatments.

Simulated winter conditions		Winter	Spring	Description - Target and actual ()
1.	**Dry/Open**	Dry	Dry	No cover, no ice, no snow - turf subject to desiccation
2.	**Wet**	Wet	Wet	Turf hydrated no surface ice
3.	**Ice continuous**	Ice	Ice	Extended ice cover for 90 (67) days
4.	**Snow continuous**	Snow	Snow	Extended snow cover 90 (71) days
5.	**Impermeable Cover + ice**	Ice	Ice remove	White impermeable cover designed to prevent plant hydration and ice encasement. 4 inches of ice over cover for 90 (67) days- ice started 1-6-04. Covers placed 12-1-03, removed 3-23-04.
6.	**Ice removal**	Ice	Ice remove	Ice removed 60 (48) days after ice formation.
7.	**Ice melt/freeze**	Ice	Melt/freeze	Natural melt/freeze cycle applied in the spring. Ice removed 60 (48) days after ice formation.
8.	**Snow removal**	Snow	Melt/freeze	Snow removed 60 (48) days after snow cover began.
9.	**Turfcover/Dry**	Dry	Dry	Evergreen turf cover - ice/snow removed 60 (48) days after snow cover began. Covers placed 12-1-03, removed 3-23-04.
10.	**Turfcover/Snow**	Snow	Snow	Evergreen turf cover - ice/snow present. Covers placed 12-1-03, removed 3-23-04.

Winter – January, February
Spring – March
Snow – 4 inches of snow cover
Ice – 4 inches of ice cover

Results 2004:

During the winter of 2004, Ames, IA had 42 inches of snow cover with approximately 70 days of continuous snow cover from January through early March. All snow occurred naturally in the research area and no ski resort snow was used in 2004. There were no reports of winter injury from Golf Course Superintendents and, in general, soil moisture was not considered to be excessive or deficient. The severe putting green desiccation that occurred during the winter of 2003 did not exist in 2004. Golf course superintendents in Minneapolis and South Dakota experienced up to 90% turf loss on some putting greens even when covers were used. The type of cover used could not be directly linked to turf injury. In Minnesota injury occurred on covered and non-covered greens with Poa annua receiving severe injury and creeping bentgrass only slightly injured. In South Dakota creeping bentgrass was even severely damaged by winter desiccation under covers.

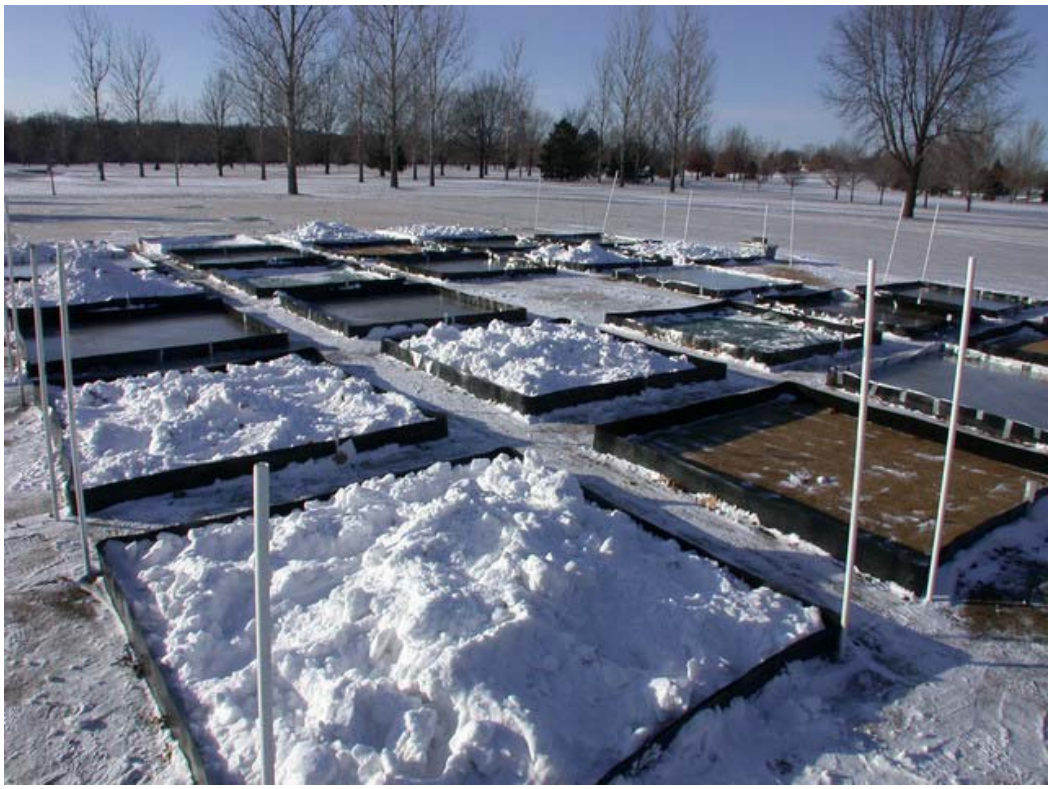
Table 2 shows the recovery of both study areas following the winter of 2004.

Creeping bentgrass green – Veenker Golf Course
The creeping bentgrass on the native soil green at Veenker Golf Course did not experience any turf kill and all plots retained 100% turf cover. However, coming out of winter turf color indicated that the dry desiccation treatment showed more winter injury than any of the other treatments. Any type of cover (snow, ice, synthetic) improved the green appearance of the turf. Removing snow or removing ice had little effect on winter recovery of the bentgrass. This is the first year that Green Jacket was used as an impermeable cover under the ice layer. Creeping bentgrass under the impermeable cover + ice (trt. 5) had substantially better appearance than the continuous ice treatment (trt. 6).

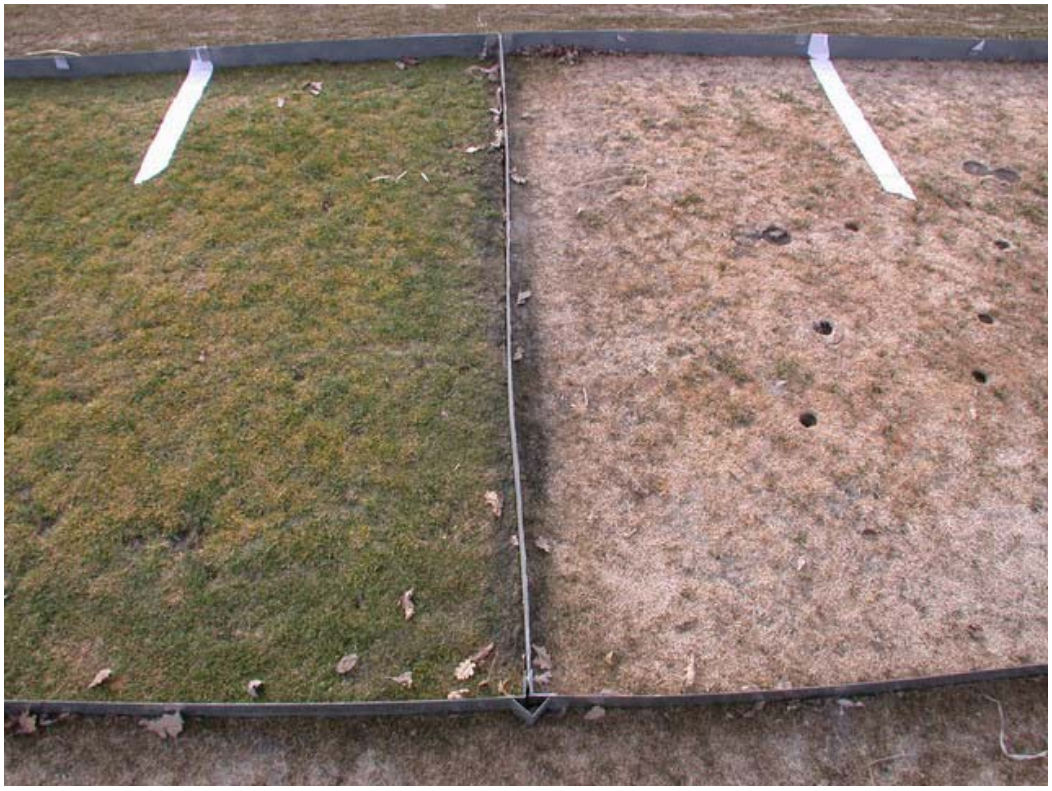
Poa annua green – ISU Research Station
The results for 2004 were similar to those found in 2003 related to *Poa annua* winter injury. Treatments related with ice cover (trts. 3,6,7) showed the most loss of turf color and turf cover. By April 5, the impermeable cover + ice (trt. 5) had twice as much surviving *Poa annua* (69%) compared with the continuous ice treatment (trt. 4) (35% cover). The Evergreen cover with or without snow removal (trts. 9 and 10) resulted in the most turf survival on the *Poa annua* green. In 2003, snow cover substantially improved Poa annua survival; however, the 2004 winter snow cover (trts. 4 and 8) had poor turf recovery. The natural snow cover in 2004 has some periods of melt and freeze that provide about an inch of ice under the snow that may have contributed to some of the Poa annua injury in the snow covered treatments.

Table 2. 2004 turf quality in field plots during spring green-up on a scale of 1-10, 10= completely green, 6=lowest acceptable quality, 1=bleached completely white. Poa annua survival rated as the percent of the plot area containing Poa annua cover.

		Creeping bentgrass Veenker Golf Course Turf color 1-9, 9=best		*Poa annua* ISU Research Station Turf color 1-9, 9=best		Percent turf cover	
Winter Treatments		**March 3**	**April 5**	**March 3**	**April 5**	**March 3**	**April 5**
1.	**Dry**	1.0	5.3	4.0	5.0	61.7	53.3
2.	**Wet**	4.3	6.7	5.0	6.7	69.4	65.0
3.	**Ice continuous**	4.0	6.7	1.0	2.0	65.0	35.6
4.	**Snow continuous**	5.3	6.7	4.7	4.3	65.6	36.7
5.	**Impermeable Cover + ice**	9.7	8.3	7.0	8.0	75.0	69.4
6.	**Ice removal**	4.3	6.3	1.0	2.0	66.1	35.6
7.	**Ice melt/freeze**	4.3	6.7	1.0	2.0	56.7	10.0
8.	**Snow removal**	6.0	7.0	5.3	5.3	73.3	46.1
9.	**Turfcover/Dry**	7.7	8.7	9.0	9.0	86.1	82.2
10.	**Turfcover/Snow**	8.3	8.3	7.7	7.3	93.3	92.2



Picture 1. 2004 Winter treatments on the creeping bentgrass trial at Veenker Golf Course.



Picture #2. Taken 3-19-2004. Poa annua study area showing survival on the left (trt#5 impermeable cover+ice) compared with winter kill from ice on the right (trt#3 continuous ice).

Picture #3. Taken 3-20-2004. Various differences during spring green up from the creeping bentrass winter trial at Veenker Golf Course.

Picture #4 Taken 4-8-2004. Winter desiccation on a bentgrass putting green in South Dakota even when a winter cover was used.

Picture # 5 Taken 4-12-2004. Unexplained winter injury from 2004 Minneapolis winter. Turf injury mainly on *the Poa annua*.

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