Chapter 7

The effect of ice encasement and early snow removal on the survival of creeping bentgrass.

Abstract

Field studies conducted in 1992-1995 evaluated turf injury to creeping bentgrass following winter ice encasement. During the 1995 winter, ice encasement accompanied by early snow removal caused high stand mortality for two of five cultivars/lines, but ice encasement with snow cover had no effect. Our results suggest that dormancy of the cultivars affect bentgrass survival under ice encasement.

Key words: creeping bentgrass, ice encasement, snow removal, survival

Introduction

Creeping bentgrass (*Agrostis stolonifera* L.) is primarily used for golf putting green and fairway turfs in the temperate regions of North America. It has been shown to possess excellent cold temperature tolerance (Gusta *et al.* 1980) and ice-encasement tolerance of up to 60 days (Beard 1964). Newer cultivars of creeping bentgrass have been selected for survival under severe Manitoba conditions (Cattani 1987). The objective of this study was to compare bentgrass cultivar survival under winter-long ice encasement.

Methods and Materials

In August 1992 four cultivars "18th Green", "Cobra", "Penncross" and "Southshore" and one line "UM86-02" were seeded at 5 g m^{-2} over a base material of fine sand at Winnipeg, Manitoba. 18th Green and UM86-02 were derived from selections for survival in Manitoba (Cattani 1987) and exhibit an early onset of fall dormancy (Cattani and Smith 1996).

The experimental area was maintained as golf course putting green turf with a mowing height of 4.5 mm. Three separate areas were established to allow for natural snow (**NAT**), where undisturbed snow accumulated all winter, or ice encasement with snow (**ICE**), where snow accumulated after ice treatment, or ice encasement plus snow removal (**ICE-SR**) where snow was removed continuously after March 1. Within each of these treatments, three replications of the five cultivars/lines were established in a randomised complete block design. Plot size was 0.5 m^2. This arrangement of treatments did not allow for comparison of **NAT**, **ICE** and **ICE-SR**, however it facilitated the application of the ice treatments.

The **ICE** and **ICE-SR** areas were cleared of snow in early December and boards (5 cm x 15 cm) were placed 0.5 m outside the perimeter of the area resulting in an ice treated area of 36 m^{-2}. These areas were flooded several times during the following two weeks (5 times in 1992, 7 times in each of 1993 and 1994). Snow was removed until 21 December to facilitate flooding. Snow was allowed to accumulate on both areas from December 22 to March 1. All snow was removed manually with a snow scoop. The ice melted earlier on the **ICE-SR** area than the other areas. It melted on 16 March 1993, 3 March 1994, and 18 March 1995 on the **ICE-SR** area compared to 26 March 1993, 17 March 1994 and 2 April 1995 on **ICE** and **NAT** areas.

Two methods were used to determine winter survival. In1993 and 1995, visual recovery ratings were made 28 April and 5 May as growth began. In1994, turf plugs (6.25 cm diameter x 5 cm deep) were removed from each plot on 23 March and 07 April, held at 2 °C for three days and transplanted indoors into a greenhouse set at 20/15 °C temperatures and a 16/8 hr photoperiod. After 11 days in the greenhouse, visual ratings for growth (1= dead, 5= full regrowth) on a 5 point scale were assigned to each. There was little or no green growth visible in the field when the plugs were sampled.

Data analysis was carried out with SAS (SAS Institute, 1988). Since no valid comparisons of **NAT**, **ICE** and **ICE-SR** could be made, ANOVA was calculated for each area separately and Fisher's protected LSD (P = 0.05) was used for cultivar/line comparisons.

RESULTS AND DISCUSSION

In 1993, there were no differences among cultivars/line in any of the three treatment areas (data not shown).

In 1994, 18th Green and UM86-02 had significantly higher regrowth ratings than Cobra or Penncross (Table 7.1) for plugs removed from the **ICE** area on 7 April. There was no difference among cultivars/line for regrowth on plugs removed from the **NAT** or **ICE-SR** areas on either sampling date or from **ICE** area on 24 March (Table 7.1).

In 1995, 18th Green and UM86-02 had significantly higher regrowth ratings than

Table 7.1. Two week greenhouse regrowth ratings (measure of turf damage) for the natural snow cover, ice and snow cover and the ice and snow removed trials (1 - dead, 5 complete regrowth) for samples taken on March 24 and April 07, 1994.

	Natural Snow Cover (NAT)		Ice and Snow (ICE)		Ice and Snow Removal (ICE-SR)	
Cultivar	March 24	April 07	March 24	April 07	March 24	April 07
18th Green	4.0 a[z]	3.3 a	3.7 a	4.3 a	3.7 a	3.3 a
UM86-02	4.0 a	4.0 a	4.3 a	4.7 a	3.3 a	4.7 a
Southshore	3.7 a	3.3 a	2.7 a	4.0 ab	3.3 a	3.3 a
Cobra	3.7 a	2.3 a	2.7 a	2.0 c	2.7 a	3.0 a
Penncross	3.0 a	2.3 a	3.0 a	2.7 bc	2.7 a	3.0 a

[z] Means followed by the same letter within each column are not significantly different using Fisher's Protected LSD (P=0.05)

Table 7.2. 1995 percentage of plot showing active regrowth of creeping bentgrass cultivars for 28 April and 05 May, 1995.

	Natural Snow Cover (NAT)		Ice and Snow (ICE)		Ice and Snow Removal (ICE-SR)	
Cultivar	April 28	May 05	April 28	May 05	April 28	May 05
18th Green	73.3 a[z]	83.3 a	68.3 a	100.0 a	66.7 a	86.7 a
UM86-02	38.3 a	61.7 a	66.3 a	100.0 a	56.7 ab	81.7 a
Southshore	48.3 a	68.3 a	51.7 a	98.3 a	33.3 abc	50.0 ab
Cobra	78.3 a	83.3 a	41.7 a	96.7 a	18.3 bc	35.0 b
Penncross	51.7 a	71.7 a	36.7 a	96.7 a	10.0 c	25.0 b

[z] Means followed by the same letter within each column are not significantly different using Fisher's Protected LSD (P=0.05)

Penncross (Table 7.2) in the **ICE-SR** area. 18[th] Green also showed superior recovery to Southshore. Similar results were observed on 5 May for the **ICE-SR** area but no differences among the cultivars/line were observed on the **NAT** or **ICE** areas at either rating date in 1995 (Table 7.2). The differences observed in 1995 may be related to the 18 days of daytime temperatures above 0 °C which were followed by two consecutive night time temperatures of −15 °C on 2-4 April. Since the **ICE-SR** area was free of ice and snow on 18 March, it is possible that regrowth had begun prior to the frost. If low temperatures follow adequate growth conditions in the spring, then crown hydration injury may occur (Tompkins *et al.* 1996). This injury is caused by ice crystal formation and cell rupture producing tissue death. If snow removal is practised to enhance spring regrowth and earlier initiation of play on golf putting greens, then there will probably be a greater risk of crown hydration injury. The use of cultivars such as 18[th] Green will reduce this risk, however, play may be delayed to a later date.

While the Cobra and Penncross plots fully recovered in the **ICE** area in 1994, they did not recover to adequate levels from the damage in the **ICE-SR** area in 1995. Some snow mold injury (*Typhula* sp.) was observed on plots in the **NAT** area in 1995 but its occurrence was random and not related to cultivars/line.

These cultivars/line differ in fall dormancy ratings which is reflected in a decrease in relative turfgrass colour and quality ratings (Table 7.3). The expression of fall dormancy is dependent upon the environmental conditions being experienced, and therefore is not

Table 7.3. Cultivar or line, country of origin and fall visual colour ratings in 1985 and fall visual quality ratings in 1996 for selected cultivars and lines tested at the University of Manitoba Field Research Station.

		Visual Colour Ratings (9 - green, 1 – dormant)					
		1982 Creeping Bentgrass Trial[z]		1985 Creeping Bentgrass Trial[y]		1993 Creeping Bentgrass Trial[x]	
Cultivar	Origin	Sept. 23, 1985	Oct. 22, 1985	Sept. 23, 1985	Oct. 22, 1985	Sept. 30, 1996	Oct. 30, 1996
S4979	Canada	9.00	5.33				
Sobel	Sweden	8.33	5.00				
Manitoba	Canada	8.67	5.33				
Penncross	USA	8.33	8.67	7.00	6.88	5.67	4.67
UM67-10	Canada			9.00	7.00		
18th Green	Canada			8.63	6.63	8.33	3.00
UM85-01	Canada			8.13	7.13		
UM85-02	Canada			7.63	7.00		
Emerald	Sweden			6.13	5.25		
Southshore	USA					6.67	5.67

[z] 1985 University of Manitoba Turfgrass Research Report p. 5.
[y] 1985 University of Manitoba Turfgrass Research Report p. 6.
[x] 1996 University of Manitoba Turfgrass Research Report p. 5.

necessarily seen each year. However, this does not preclude the expression of later spring growth initiation.

Further research is presently underway to examine the relationship between fall dormancy and the different responses in this research. Early fall dormancy may be related to greater resistance to frost injury in the spring, such as that observed for 18th Green and UM86-02. However, if these physiological traits reduce end of season play, or delay the initiation of play in the spring, then golf superintendents must make a management decision based on these conflicting needs. Sampling and grow-out of turf plugs in early spring would be a useful management tool for superintendents to determining the status of their putting green turf.

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