Control of Winter Injury Caused by Ice Cover On Poa annua and Agrostis palustris

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A lab study compared the effect of ice cover and ice encasement with a control treatment (no ice) on Poa annua and Agrostis palustris plants. There were no significant differences between the ice cover and ice encasement treatments. Poa annua plants were dead after only 60 days covered with ice. In contrast, Agrostis palustris plants had LT50 values of -26° C after 90 days of ice cover and -16° C after 120 days of ice cover.

A related field study compared the effects of snow cover, snow removed in February, ice cover and ice removed in February for Poa annua and Agrostis palustris plants. Poa annua plants that had been ice-covered were mostly dead by late February, a period of about 40 days. Agrostis palustris plants in all treatments could tolerate temperatures below -20° C into April. However, plants from plots where the snow and ice were removed had reduced levels of cold hardiness.

The goal of this study was to determine under controlled and field conditions whether the problem with winter injury associated with ice cover, is due to:

+ prolonged ice cover

+ reduced cold hardiness associated with crown hydration

+ or rapid dehardening that can occur as a result of exposure to higher temperature when the ice cover is removed.

Materials and Methods

Lab Study Poa annua and Agrostis palustris plants were cold hardened and then tested to determine their baseline LT50 value. These plants were then stored in a freezer at -4° C for various periods of time: 60, 90, 120 and 150 days. Plants of each species were stored under three different conditions: control, ice cover and ice encasement. The control treatment plants were covered with snow to prevent desiccation, but were not covered with ice. Plants in the ice cover treatment were covered with 2.5 cm of ice. The ice was added gradually by misting. Plants in the ice encasement treatment were immersed in water and then frozen.

After the appropriate interval in the freezer, plants were subjected to a freeze test in a circulating bath. In the bath, the temperature was decreased by 20 C/hour and plants were removed at selected temperatures. Following the freeze test, plants were transferred to the greenhouse for 4 weeks. After 4 weeks, plant regrowth was rated for survival to establish LT50 values (i.e. lethal temperature for 50% of the plants). The experiment was performed using a split plot design with four successive freeze tests used as replicates. Main plots included the two species: Poa annua and Agrostis palustris. Subplots included: control, ice cover and ice encasement. When treatment effects were significant based on ANOVA, LSD's were used for mean separation.

Field Study Field plots were established in a split plot design with four replicates. Main plots were species: Poa annua and Agrostis palustris. Subplots included the following treatments:

+ snow cover maintained as long as possible

+ snow removed in February ice cover maintained as long as possible and

+ ice cover removed in February.

Plants were sampled on December 8, 1997 to determine baseline hardiness levels. It was not possible to establish ice on the plots until the week of January 5-9, 1998 due to the warm weather. Snow and ice were removed from the appropriate plots on February 22 and 23, 1998. LT50 values were determined at this time and also in late March and April. This roughly corresponded to 45, 60 and 90 day intervals.

Results to Date

There were dramatic differences between the two species (Table 1). Baseline LT50 values were -21° C for Poa annua and -38° C for Agrostis palustris. plants maintained reasonable cold hardiness levels for at least 120 days.

Agrostis palustris plants that were

Table 1. Effect of ice cover on LT50 value (°C) for Poa annua and Agrostis palustris plants stored under controlled conditions.

Species	baseline	60 days	◊90 days	120 days	150 days
Poa annua	-21	0a	0a	0a	0a
Agrostis palustris	-38	-37b	-26b	-16b	0a

1 Within a column, means followed by the same letter are not significantly different at p=0.05 (LSD).

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either covered or immersed in ice had reduced cold hardiness compared to the control treatment (Table 2). By 90 days, the differences were statistically significant and by 120 days the level of cold hardiness was greatly reduced compared to the control treatment.

Table 2. Effect of ice cover treatment on LT50 value (0C) of Agrostis palustris plants stored under controlled conditions.

Ice Cover Treatment	baseline	60 days ◊	90 days	120 days	150 days
Control	-38	-36a	-33a	-30a	-8a
Ice Cover	-	-37a	-26b	-16b	0b
Ice Encased	-	-32a	-24b	-18b	0b

1 Within a column, means followed by the same letter are not significantly different at p=0.05 (LSD).

Field Study

The first year of the field study was conducted this past winter. The weather conditions were less than ideal, as the weather was unusually mild particularly in the early part of the winter. Consequently, it was not possible to establish an ice cover until early January.

As in the controlled environment study, the Poa annua was much more susceptible to ice injury than the Agrostis palustris (Table 3). Poa annua plants evaluated on Feb. 23, 1998 that had been covered in ice for 45 days were dead. Consequently, there was no difference between the ice cover and ice removal treatments for Poa annua.

For the Agrostis palustris plants, there were no relevant treatment differences until April, 1998. By this time, all plants were starting to lose cold hardiness due to the warming temperatures. In the plots where a cover was maintained, whether snow or ice, better levels of cold hardiness were retained into the dehardening period.

Future Plans

The first goal of the research was to more precisely determine the period of time that Poa annua can tolerate under ice cover. A second goal is to confirm, under both lab and field conditions, that the period of time that Poa annua can withstand ice cover is really as short as it appears to be from last years research. For example, last year was an abnormal year weather wise, and other factors may have contributed to the early demise of the Poa annua plants.

(Editor's Note: This article was re-printed from the February/March 2000 issue of Turf Line News with permission from the Western Canada Turfgrass Association.)

Table 3. Effect of snow and ice cover treatment on LT50 values (0C) for Poa annua and Agrostis palustris plants grown in the field during the winter of 1997-98.

Treatment	Baseline	Feb. 1998◊	Mar. 1998	Apr. 1998
Poa annua	-19	-	-	-
snow cover	-	-13b	-10b	-7b
snow removed	-	-10b	-14b	-15c
ice cover	-	0a	0a	0a
ice removed	-	0a	-2a	0a

Treatment	Baseline	Feb. 1998◊	Mar. 1998	Apr. 1998
Agrostis palustris	-39	-	-	-
snow cover	-	-35cd	-39c	-32e
snow removed	-	-40d	-38c	-26d
ice cover	-	-34v	-39c	-31e
ice removed	-	-37d	-38c	-22d

1 Within a column, means followed by the same letter are not significantly different at p=0.05 (LSD).

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