Evaluation of Winter Covers for Prevention of Freezing Injury on Putting Greens

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Summary

This trial was initiated to determine the insulating value of various winter covers and whether there was an effect on spring colour and plant hardiness levels.

Four golf green winter covers were compared against an uncovered control. The four covers were: Evergreen permeable cover, Typar® permeable cover, RPE® Type 4 impermeable cover and an impermeable insulated turf blanket. Covers of 12 foot by 24 foot dimensions were installed on greens at four golf courses throughout Alberta.

Temperatures were collected twice a month from November to the end of February and then three times per week in March and April to determine the effect of the covers on temperatures at the crown level of the plants. Colour rating and plants hardiness levels were also conducted in April.

The insulated turf blanket showed the least fluctuations in temperatures while the RPE® Type 4 cover showed the greatest heating. The insulated turf blanket and the RPE® Type 4 cover had the highest colour ratings.

There was the greatest retention of hardiness levels under the insulated turf blanket when measured on April 10. The RPE® Type 4 cover had the least amount of hardiness. Hardiness levels were measured for the Innisfail site only.

Introduction

Previous work conducted at the Prairie Turfgrass Research Centre attempted to determine the effects of temperature and crown moisture content on the hardening and dehardening of putting greens throughout winter.

Results of the trial showed that plants harden in the fall in response to a decline in temperature. Cool temperatures begin the hardening process while a period of freezing temperatures is necessary to completely harden the turfgrasses. As plants harden their crown moisture content decreases and their ability to resist freezing temperatures increases. In this trial hardiness levels were measured and were recorded as LT_{50} or the lethal temperature required to kill 50% of the plants.

Generally, the opposite effect occurs in the spring. As temperatures increase, plants begin to break dormancy and initiate growth. It is believed that one of the first plant responses to warmer temperatures is a re-hydrating of the plant tissues which causes an initial loss of hardiness. Further warm temperatures trigger a growth response in the plants and new growth and a noticeable greening takes place. The warmer the temperature and the greater the duration of warm temperature, the greater the loss in hardiness.

In the past, common thinking has been to warm turfgrasses in the spring so that new growth may be initiated. However, our studies revealed that plants that initiated growth were more susceptible to freezing injury because of their reduced hardiness levels (2).

The use of protective winter covers for golf greens have become quite common in northern climates of North America in the past decade. Generally, these covers are translucent in nature and cause considerable heating which, in turn, stimulates growth. As mentioned above, this stimulated growth causes a reduction in hardiness.

A recent study conducted at Univeriste de Laval (3) examined the effects of various winter covers on soil and crown level temperatures. It was found that snow cover acted as a very efficient insulator and that winter covers had no effect on soil temperatures when a thick snow covering existed. However, when snow cover was absent temperatures under the various winter covers varied considerably. Covers with good insulating properties reduced fluctuation in temperatures in cold and warm conditions. Plant hardiness levels were not measured under these covers.

This trial was initiated to determine the insulating value of various covers and whether there was an effect on spring colour and plant hardiness levels.

Methods and Materials

Four golf green winter covers were compared against an uncovered control. The four covers were: Evergreen permeable cover, Typar® permeable cover, RPE® Type 4 impermeable cover and an insulated turf blanket. The Evergreen and RPE® Type 4 are single layer translucent woven polyethylene materials. The Typar® is a single layer heat bonded polypropylene geotextile material which is grey in colour. The insulated turf blanket is a three layered cover where a 6mm closed-cell polyethylene foam is encapsulated between two white coloured impermeable woven polyethylene covers.

Covers of 12 foot by 24 foot dimensions were installed at four golf courses throughout Alberta. The four courses: Edmonton Country Club (Edmonton), Innisfail Golf Club (Innisfail), Red Deer Golf and Country Club (Red Deer) and River Bend Golf Club (Red Deer) installed the covers between November 10 and November 15, 1999. The four sites were considered to be replications in a Randomized Complete Block Design where individual covers were randomly placed at each of the sites. Covers were removed from all sites on or about April 10, 2000.

Temperatures were collected twice a month from November to the end of February and then three times per week in March and April. A Labcor Digi-sense Type T Thermometer (model P-91100-20) with Labcor Type T PVC epoxy tip thermocouples (model P-08466-06) were used to measure temperatures. Temperatures were collected each afternoon at between 1-2 PM.

Colour rating were conducted on April 6 at Edmonton Country Club and April 7 at the other three sites. Ratings were conducted based on the National Turfgrass Evaluation

program rating scale where 1=brown colour, 5=acceptable colour and 9=dark green colour.

Samples were collected on April 10 from the various treatments at Innisfail and subjected to a freeze test as described by Tompkins et al (1). Samples were collected for both creeping bentgrass and annual bluegrass and were subjected to various freezing temperatures. Following exposure to these temperatures plants were allowed to grow on in greenhouse so that relative hardiness levels could be determined.

Results

The insulated turf blanket showed the least fluctuations in temperatures while the RPE® Type 4 cover showed the greatest heating (table 1). Daytime highs were 11°C and 17°C for March 29 and April 3, respectively, at Innisfail. Temperatures under the RPE® Type 4 cover were 41.4°C and 37.1°C on those two dates, while temperatures under the insulated concrete blanket were 2.6°C and 5.0°C.

Table 1 - Types of cover and crown temperatures on various dates

Types of covers	Dec 6/99	Jan 12/00	Feb 9/00	Mar 8/00	Mar 29/00	April 3/00
Uncovered Control	-4.6 B[1]	-5.2 C	-2.3 A	0.1 B	17.1 B	19.1 B
Evergreen Permeable Cover	-4.7 B	-3.0 AB	-1.9 A	0.3 AB	23.3 AB	29.7 A
Typar® Permeable Cover	-4.5 A	-3.4 AB	-1.9 A	0.2 AB	20.8 AB	26.2 B
RPE® Type 4 Impermeable Cover	-3.4 A	-3.5 B	-1.9 A	0.6 AB	26.7 A	31.0 A
Insulated Turf Blanket	-2.8 A	-2.0 A	-1.7 A	0.7 A	4.6 C	6.2 C

[1]Within a column, numbers followed by the same letters are not significantly different at the p=0.05 level

The insulated turf blanket had the highest colour ratings although they were not significantly higher than the RPE® Type 4 cover (table 2).

Table 2 Colour ratings of turf under various winter covers

Types of Covers	Colour Rating
Uncovered Control	3.0 C
Evergreen Permeable Cover	4.3 B
Typar® Permeable Cover	4.5 B
RPE® Type 4 Impermeable Cover	6.0 A
Insulated Turf Blanket	6.3 A

[1]Within a column, numbers followed by the same letters are not significantly different at the p=0.05 level

There was the greatest retention of hardiness under the insulated turf blanket when measured on April 10 (table 3). The RPE® Type 4 cover had the least amount of hardiness. Hardiness levels were measured for the Innisfail site only, so the above mentioned observations may only be a trend and need to be verified in a future study.

Table 3 Hardiness levels of grasses under winter covers

Types of Covers	LT_{50} Values[1] Creeping Bentgrass	LT_{50} Values Annual Bluegrass
Uncovered Control	-18°C	Greater than –12°C
Evergreen Permeable Cover	-18°C	Greater than –12°C
Typar® Permeable Cover	-20°C	–12°C
RPE® Type 4 Impermeable Cover	-10°C	Less than –12°C
Insulated Turf Blanket	-26°C	–15°C

[1]LT_{50} Value is described as the temperature that is required to kill 50% of the plants.

Discussion

This trial showed that the insulated turf blanket had the best insulation values of the covering materials measured. The lowest recorded temperature under this cover was –6.3 and the highest recorded value was +6.9^{o}C.

The low value was much higher than the rated hardiness level of –15^{o}C on April 10. This would indicate that the insulated turf cover would sufficiently protect the turf from cold temperatures. In addition, plant hardiness levels are retained during the critical transition period from winter to spring. The high value of +6.9^{o}C did not cause the plants to lose hardiness.

As the measurement of hardiness levels was not replicated at the other trail sites this portion of the trial should be confirmed with a further study.

In addition, measurement of the effects of ice on top of the insulated turf cover should be examined. If the cover proved to be beneficial in prevention of ice damage scenarios there would be great value to it.

References

1. Tompkins, D.K., J.B. Ross and D.L. Moroz. 2000. Dehardening of annual bluegrass and creeping bentgrass during late winter and early spring. Agronomy Journal 92:5-9.

2. Tompkins, D. K., J.B. Ross, M.A. Batan and C.E. Miluch. 2000. Hardening of annual bluegrass and creeping bentgrass in fall and early winter. Trial in progress.

3. Dionne, J., Dube, P.A., Laganiere, M. and Y. Desjardins. 1999. Golf green soil and crown level temperatures under winter protective covers. Agronomy Journal 91-227-233.

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