# What We Learned This Past Winter

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Besides the Glendale study, the second year of a study to look at the effects of ice and winter covers was completed at Olds College. Here are some of the findings of these two studies.

At Olds, we were trying to determine whether we could improve survival of annual bluegrass under ice cover with various winter covering systems. When we compared ice cover directly on the turf with ice cover on top of an impermeable white cover, direct ice cover completely killed the turf whereas the turf under the impermeable cover was alive, although with some reduced hardiness. This would indicate that an impermeable cover by itself can help to protect against ice damage.

**Figure 1.** Trial in Olds showing impermeable cover prior to ice development

For both years of this study, there was little or no gas buildup under impermeable covers, even when covers were maintained for 100 days. This was attributed to low temperatures (colder than -2$^{o}$C) under the covers. On one occasion, when temperatures rose above this threshold, oxygen depletion occurred. This would indicate that oxygen depletion will not occur when temperatures remain below -2$^{o}$C. However, we need more data to confirm this observation.

During the winter of 2006-07, considerable damage occurred at Glendale. A heavy wet snow cover accumulated on the impermeable covers when the turf was unfrozen. It was thought that oxygen depletion and carbon dioxide accumulation occurred under these conditions and was the cause of the injury.

This past winter, gases under the covers were monitored on a weekly basis at Glendale. Gas concentrations under the covers remained near those of the atmosphere (21% oxygen, 0.04% carbon dioxide) when there was no snow cover. However, as soon as snow accumulated on top of the covers, oxygen depletion and carbon dioxide buildup began to occur.

The gas monitoring system employed at Glendale was very effective in determining concentrations. A single tube was extended under the covers to the middle of the green and then on a weekly basis samples were taken with a Portable Multi-Gas Detector (RKI Instruments Inc. Model: Eagle 71-0028RK). It took approximately one half day to collect samples from each of 19 greens. This detector cost about $3000.


**Figure 2.** $O_2$ / $CO_2$ meter used at Glendale

Gas concentration changes were greatest on greens that had high organic matter content, which confirmed previous research findings from studies conducted in Quebec. The gas monitoring also pointed out that newer greens with a high sand content and low organic matter content did not have significant gas concentration changes. It seemed that the old 'push up' greens with high organic matter had the greatest changes. It has been theorized that this was attributed to greater microbial activity as they consume oxygen and produce carbon dioxide.

Although the gas monitoring system worked quite well, the system to ventilate greens at Glendale was not particularly effective. On one occasion, gases were monitored prior to actively ventilating the covering system and then again the following day. It seems that blowing air from the atmosphere did not significantly improve conditions under the covers. We are not sure whether gases were insufficiently expelled or whether buildup occurred within 24 hours.

The development of a more efficient passive ventilation system will be a goal of the research for 2009-10. Utilizing a roof turbine ventilation system may be one of the options that we will experiment with. In addition, extending a bubble tarp system out beyond the winter cover on the bottom side of the green may be another option to try. Close monitoring of the gases will tell us what the most effective system is.

One of the surprising findings was a lack of hardiness levels of the greens at Glendale when covers were removed in the spring. The study in Olds showed that hardiness levels were consistent over long periods of time under the covers and were maintained at -8 to -12$^{o}$C. However, hardiness levels were much poorer at Glendale and we do not have an explanation for this. We intend to closely monitor this next winter to determine when the hardiness levels are lost.

Our overall goal is to find a covering system that will be effective for all types of winter injury. A scenario similar to the 'Perfect Storm' of 2006-07 will be the real test. With a gas monitoring system in place, we will be able to determine what is happening in the 'eye of the storm' and whether the system in place can prevent injury.