A Little Peace of Mind

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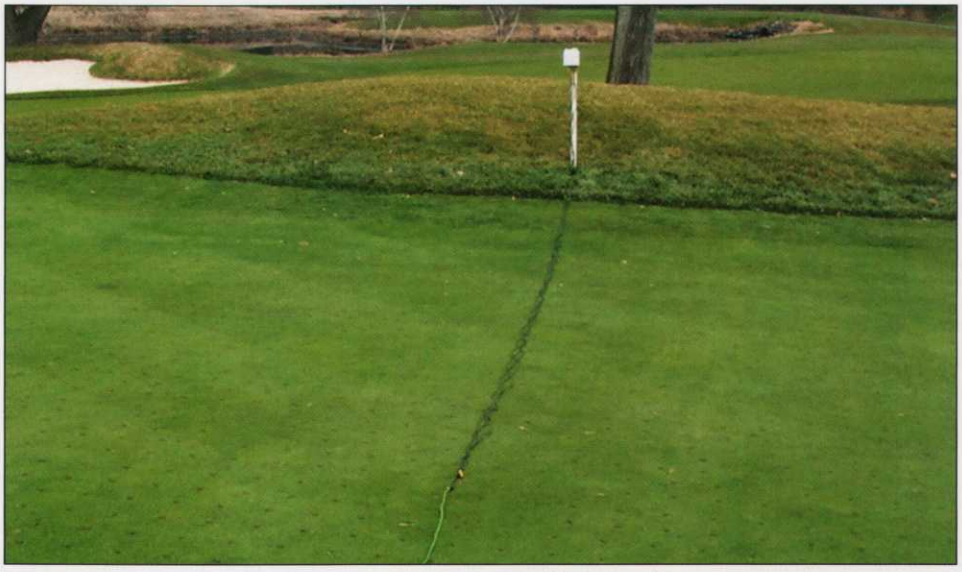
The spring of 2004 started out to be one, that many at The Minikahda Club would like to forget. Our unforgettable spring began the day our greens covers were removed. The greens were covered with the Stokote Greenjacket impermeable plastic covers, the same covers we had been using on an experimental basis the past three years. Seventeen greens were covered and 17 greens were damaged to one degree or another. Was it crown hydration, cold temperature kill or suffocation? All three forms of death were reasons for turf loss. We had incurred some minor damage in the past, but nothing to this degree. Nothing that indicated the need to revert to covers we had used in the past. The more we searched for answers, the less any of it made sense.

As we searched for answers we tried to correlate the similarities of turf loss from green to green. Did it only occur on north facing greens or was the damage worse on south facing greens. Was there a difference between shaded greens or greens in full sun? When did the damage occur? Was it in December during a warm up? Did the damage occur in January during an extremely cold period and the covers did not provide enough insulation from the cold? Or was the damage in the spring as temperatures rose and the ground thawed under the cover trapping moisture and causing crown hydration? Did the soil warm to a degree where the plant broke dormancy and a refreeze then killed the plants? As you can tell we asked ourselves many questions, and we came to one conclusion: the current system of covering greens did not work and we needed to change.



Data Logger at The Minikahda Club

Roger Kisch, Superintendent at Southview Country Club in St. Paul, had been working with 1/8" rolls of packing foam that he was placing under the Greenjacket cover. Roger was working closely with the manufacturer of the Greenjacket cover to develop a roll of foam that could be used in conjunction with the plastic cover in order to provide better insulation. The theory was that the added foam would protect the plants from swings in temperatures and the plastic would protect the greens from that nasty free water that can occur during the winter and spring. Roger had been having tremendous success with the foam. In fact, in the winter of 2004, greens that were covered with the foam at Southview emerged in perfect condition.

The Committee's Decision

After careful consideration our Grounds Committee concluded we would continue using the Greenjacket cover, provided that the foam was installed. The big question remained: Was this the protection and peace of mind we were looking for? Still thinking about the damage to the greens and wondering what really occurred under the cover last winter, I was bound to do a better job monitoring the condition of the greens throughout the winter. Since the greens would be covered with impermeable plastic it would be virtually impossible to look under the covers without tearing a hole in a cover, thus defeating the purpose of the impermeable plastic. My biggest question still remained: What was happening to the temperatures in the soil and under the covers during large swings in temperatures?

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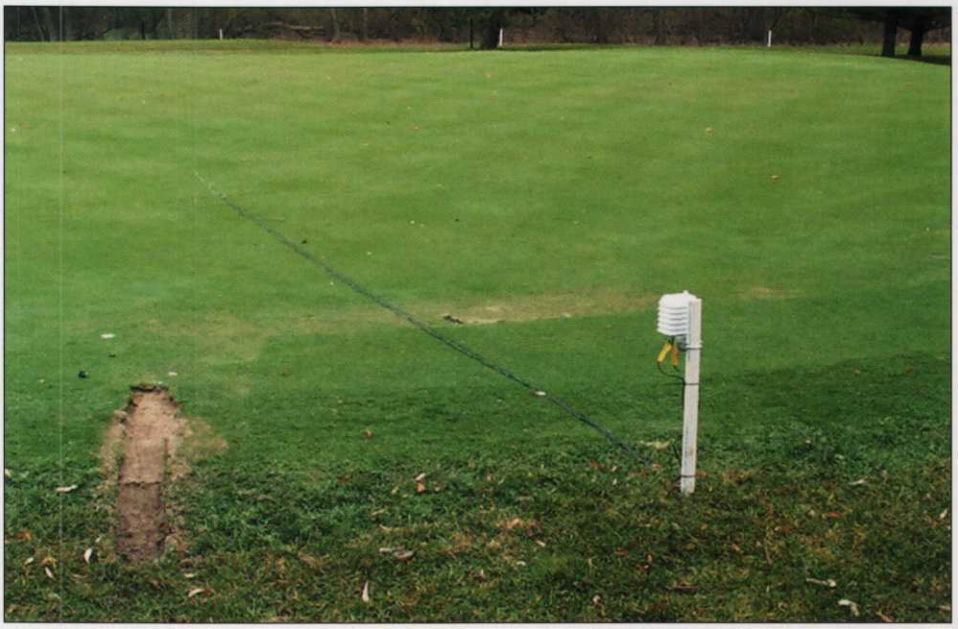
One day while paging through a Spectrum Technologies Catalog, I came across a Watch Dog Data Logger System. These systems were being marketed for recording temperatures and moisture in greenhouses as well as other applications related to that industry. This was exactly the type of system I was searching for to monitor our greens throughout the winter.

After calling the company to inquire about the versatility of the units, and to explain what we hoped to accomplish, I was assured that their product would meet our needs. My goal was to record daily ambient air temperatures, the temperature of the soil under the cover, the temperature at the green's surface (between the cover and the green), as well as soil moisture. I purchased one Watch Dog Data Logger model 425, along with a soil moisture sensor, one 20ft external soil temperature sensor that would be placed 2" into the greens surface and another 20ft probe to monitor the temperature between the green and the cover. The data logger itself would record the air temperature.

Normally, finding a way to consistently record data is always difficult. One has to be dedicated to record at the same time and location daily, but not with the Watch Dog System. Each unit can be programmed to record data as little as every 2 hours or as frequent as every minute. Having that capability was a big advantage of purchasing the unit. At an initial cost of $537 for the software, the data logger, a soil moisture sensor and two cables to monitor temperatures as well as a radiation shield to protect the unit from the elements, we were going to have the capability to monitor temperatures 24 hours a day, 7 days a week, all winter long. I felt the $537 was a minimal price to pay, knowing that the information gathered could be very valuable. In addition, we could purchase software, at a cost of $100, that would allow us to program the unit as well as download and record the data.

Initially my thought was to purchase one unit and do a little research on our own, without really disclosing our intentions. But, at a Grounds Committee Meeting in October I decided to mention my plan to our committee. Unsure of their reaction to our project, I was asked the cost of the unit. One gentleman said "Is that all, you better buy one more so you have something to compare your results too." So…. I purchased two more!



Data Logger at the Minikahda Club

Results of the Study

We decided to place the data loggers on a north facing green with partial shade, a south facing green in full sun and on our sixth green, which faces slightly north and is also shaded on the south side. This green had the most damage in the spring of 2004.

The data loggers were installed in greens 6, 7 and 12 before the covers were placed on the greens. The beauty of these units is that based on the parameters that are programmed, one can record continual data up to 360 days straight without reprogramming. We set up the units to record data every two hours. This gave us enough time to record swings in temperature and record highs and lows without inundating us with too much data.

In the beginning of the study we brought the data loggers in on a weekly basis, mostly to make sure the units were working properly and to get a feel of how the software worked. I did not want to make a mistake and lose the data. After we were comfortable with the process, I tried to leave the data loggers for about four weeks at a time. We found this to be very difficult. Our curiosity was so high that it was difficult to have patience.

Our initial theory regarding the foam was that once the greens froze, no matter the temperature, they would stay frozen until extended periods of warm weather would stick around. Meaning, the spring. Additionally we theorized that the foam would act as an insulator during extremely cold periods, even with a lack of snow cover. Would our theories hold up? There was only one way we were going to find out: check the data.

Early into the winter the results we were seeing looked very promising. Once the soil temperatures under the covers reached freezing in mid-December, the soil temperatures never again thawed until March. This was true for all three greens.

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The Data Logger results that are posted with this report give some interesting feedback. Note the swings in the Ambient Air temperatures from the highs to the lows. The average high and low differences varied from 12 to 20 degree swings. The seasonal low was -15.1 degrees on the 17th of January and the high was 57.3 degrees on the 12th of February. With swings in air temperature varying to this degree it's no wonder unprotected golf courses lost grass this past season.

The temperatures under the covers told a different story. Under the cover you will notice less of a variance between the average high and low. On average, this difference was only about 4-5 degrees in January and February, but as spring drew near the difference was quite dramatic. High temperatures under the covers reached 58.7 degrees on the 7th green on the 28th of March. Coincidentally, this was the same day the cover was removed. It did not seem to matter whether there was snow cover or not. As long as the soil temperature stayed below 32 degrees, the swings in temperature between the cover and the green did not vary that dramatically, nor did it have a detrimental effect on the poa. As predicted, once spring drew near, and the snow cover was gone and the air temperatures were on the rise, only then did we see a big difference in the temperatures between the cover and the green.

What I felt was the most interesting data laid within the first 2" of the soil profile. Once the soil froze, which was around the 20th of December, no matter how warm the air temperature or the temperature between the cover and the green got, soils did not reach a temperature above 32 degrees until the 25th of March. Just in time to remove the covers. The coldest any of the soil temperatures reached was 11.2 degrees on the 17th and 18th of January. At the same time air temperatures were almost 25 degrees colder, reaching a low of -15.1 degrees. As soil temperatures dipped into only the low teens, we were confident that we were not going to loose any poa annua to low temperature kill. It was just not possible.

The other assurance the data gave us was that we were not going to lose turf due to crown hydration. The soil temperatures were never above 32 degrees at any point. The plant had adequate time to harden off in the fall, and as long as the soil stayed below freezing the plants were never going to break dormancy. Also we knew the soil never thawed and refroze, so there was never any free water on the greens. Having this knowledge was having peace of mind.

Now that we have the data loggers, we will continue to use them on a yearly basis. We also had excellent success this past year with the Stokote Greenjacket cover with the foam under the plastic. Our greens came through the winter in excellent condition. The data loggers proved the foam was enough of an insulator to protect the plants from the erratic swings in temperature. If we ever have another difficult winter, and I know we will, we are hopeful the data loggers are going to provide us with some valuable information that may help us minimize the damage or help us to make adjustments so damage can be prevented in the future.

2004-05 Data Logger Results from The Minikahda Club

6 GREEN **Mostly Shady**

November 22 - 30	Ave. High	Ave. Low	Difference	Dates of High	Dates of Low
Ambient Air	36.1	23.6	12.5		
Between Cover/Green	35.1	27.9	7.9		
Soil @ 2"	33.6	32.5	1.1		
December 1 - 31	**Ave. High**	**Ave. Low**	**Difference**	**Dates of High**	**Dates of Low**
Ambient Air	28.6	14.8	13.8	30th @ 48.1	24th @ -13.4
Between Cover/Green	29.2	23.8	5.4	14th @ 35.4	24th @ 6.9
Soil @ 2"	29.6	28.3	1.3	12th @ 32.2	24th @ 16.3
January 1 - 31	**Ave. High**	**Ave. Low**	**Difference**	**Dates of High**	**Dates of Low**
Ambient Air	23	7.5	15.5	25th @ 46.7	14, 17th @ -15.1
Between Cover/Green	23.5	19.1	4.4	25, 30th @ 29.7	17th @ 5.7
Soil @ 2"	24.2	22.3	1.9	26, 31st @ 29.7	17th @ 12.3
February 1 - 28	**Ave. High**	**Ave. Low**	**Difference**	**Dates of High**	**Dates of Low**
Ambient Air	35.9	16.9	19	5th @ 54.5	22nd @ -2.9
Between Cover/Green	29.4	25.1	4.3	5,6,12,13,14,15 @ 31.4	18th @ 11.2
Soil @ 2"	30.1	27.1	3	6th @ 31.4	18th @ 17.3
March 1 - 28	**Ave. High**	**Ave. Low**	**Difference**	**Dates of High**	**Dates of Low**
Ambient Air	34.1	15.6	18.5	3rd @ -2.9	
Between Cover/Green	33.5	30.8	2.7	28th @ 67.7	9th @ 17.3
Soil @ 2"	30.8	25.5	5.3	28th @ 54.5	9th @ 22.0