any green plant has high enough concentrations of certain compounds that will influence the growth of another species. Still, there are well documented cases of allelopathy with rye cover cropping system studies conducted at Michigan State University. Interestingly, several years ago, turf researchers investigated the possibility that bentgrass could be allelopathic to annual bluegrass. Currently, there are reports of possible allelopathy of some fescues and ryegrasses on crabgrass infestations. As they say on the X-files, "the truth is out there".

Damping-off. Upon my arrival at Cornell, I began to interact with Dr. Eric Nelson, our Turfgrass Pathologist. In my opinion, most pathologists are in fact microbiologists and in our case in NY, Eric is considered a soil microbial ecologist. In other words, he studies the interaction of microbes and their environment, specifically in a turf system.

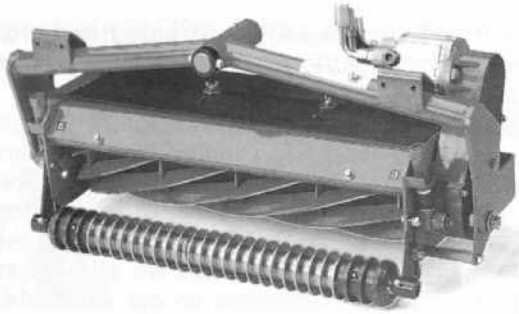
Eric has conducted research on seedling damping off problems with turf and other crops. His most recent work, funded by the USGA, discovered that when turfgrass seeds germinate, they take in water and release a sphere of concentrated linoleic acid. It turns out Pythium spp. that cause damping off can "sense" the seed and if they are in this sphere of linoleic acid, spore germination is stimulated and young seedlings are infected. Eric has gone further and identified a microorganism that uses the linoleic acid as a food source. Simply, when you add this microbe to a seedbed, it reduces the sphere of linoleic acid around the seed (called the spermosphere) and the amount of damping off at establishment is reduced.

This information was exciting for me because of the seeding rate research we had just completed at the Noer Facility. If you recall, we found higher damping off infestations associated with increased seeding rates. The seedbed literally becomes a "linoleic acid bath" and since pythium is just about everywhere in the soil, it is no surprise we had these problems. It has been shown that once a plant is infected with pythium, it remains infected and will show symptoms when the plant is stressed. The question follows then that if we keep pythium out at establishment, will we be able to keep our turf pythium-free? Of course, when we had fungicide (Apron) treated seed, we seemed to eliminate the damping off problems.

A few questions remain: 1. does the fungicide prevent pythium infection or just mask symptoms? 2. does the fungicide effect the spermosphere? 3. when we overseed into established turf are we stimulating pythium infections on our established plants? 4. can the micbial innoculant work in high seeding rate situations, not just up north but down south where intense overseeding occurs?

Final Thought. The previous pondering speaks to a guiding principle in my professional life; to try an understand the fundamental processes that occur in our turf systems, above-and below-ground. Next, we should communicate these processes in a way that integrates how we currently are managing the environment. From this should emerge a better appreciation for the impact of our management on the environment—positive or negative.

Once we incorporate this principle into our decision-making process, we are on our way to more sustainable and resource efficient turf management systems.



Finally, a quality lightweight with plenty of mowing muscle.

At less than 10 PSI ground pressure, the all-new Jacobsen LF-3810 treads lightly on the most delicate fairways. Yet its 5 heavy-duty 7″ diameter, 10-blade reels deliver the high torque to handle all kinds of grasses and conditions beautifully. Plus, 26″ balanced reels and our unique rear roller down pressure system produce tournament quality results at production mowing speeds, hugging undulations other machines would scalp.

Accessibility you'll flip over.

The entire operator platform and rear hood flip up, completely out of the way, for easy access to all key components. Also, the center cutting unit slides back, for quick, easy adjustments.

Comforting news for operators.

The LF-3810 is loaded with operator comfort features, including: full suspension seat with armrests; 5-position tilt, power steering; easier two-pedal hydrostatic drive; full instrumentation; even holders for their favorite soft drink and personal items.

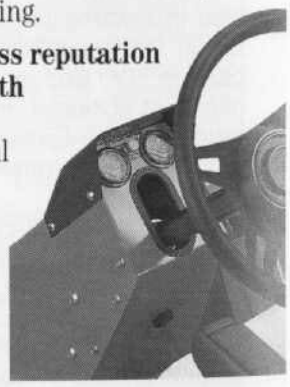
Transverse engine mounting helps you handle slopes with confidence.

This up-front automotive design produces surprising traction and excellent climbing ability in a 2-wheel drive unit.

Exclusive SynchroLift control—Cross cutting at its easiest & most productive.

A simple push or pull of the synchronized lift levers is all it takes with this system. The machine automatically raises the reels to turning height, then lowers them for nimble, flawless cross cutting.

Maintain a spotless reputation on the fairway with GreenSentry.™



Our advanced oil leak detection system is standard, to give you every advantage possible on the fairway.

The list goes on and on.

Variable-speed, power backlapping; 3, 4 or 5 gang operation; heavy-duty hydraulic system; a 38 hp, liquid-cooled Kubota diesel . . . the quality features just never seem to quit.

For a complete list of features and benefits, as well as a complete demonstration, contact your Jacobsen distributor today.

Shown with optional roll over protection structure

THE PROFESSIONAL'S CHOICE ON TURF.

JACOBSEN
TEXTRON
Jacobsen Division of Textron, Inc.

THE FIRST TRULY HEAVY-DUTY LIGHTWEIGHT.

WISCONSIN TURF EQUIPMENT CORP.

TWO LOCATIONS

1917 W. Court
JANESVILLE, WI 53545
608-752-8766

21520 W. Greenfield Ave.
NEW BERLIN, WI 53151
414-544-6421

Best Wishes For Another Year in Wisconsin Golf

By Monroe S. Miller

Christmas Eve in our town was altogether beautiful, much like you think it should be each year. The sky was clear, the landscape was white with fresh, newly fallen snow, and for the first time since 1950 there was a full moon on December 24th. It was dark when we went to church and we were filled with a peaceful and serene feeling.

The last few days before Christmas were warm. All of the snow had melted, and the only reason some of us felt glad about that was that the ice on our golf greens pretty much melted, too. We could start with a fresh slate. After all these years, I know there are a lot of causes of turf loss in winter, but none are as sure or deadly as ice accumulation in December.

Once the snow had melted, it rained. Then an Arctic blast of cold air swept into Wisconsin, causing some travel problems and coating trees with ice. But with cold came the snow — pure, white and beautiful for Christmas.

I took it all to be a good omen for the rest of the winter, even though most of the snow melted during the week between Christmas and New Year Day.

After all, we won't have another full moon on Christmas Eve until the year 2102.

•

Best post-election joke I've heard: now that the election is over and he won (with 49% of the popular vote), Slick Willie Clinton figures he can start dating again!

Best bumper sticker I've seen in the past few months since the Symposium: *Arborists are tree-mendous!*

•

A couple of publications caught my attention on the December newsstands. Who in Wisconsin wasn't proud to see Brett Favre on the *Sports Illustrated* cover in mid-December? And I'd like to meet the golf course superintendent who wasn't pleased by the subscriber opinion poll reported in the January 1997 issue of *Golf Digest*. The question and answers that brought smiles was: *Who is the most important person at your club or course?* The results were:

48% Golf course superintendent
25% Club pro
14% Club manager
11% Beverage cart or halfway house person
1% Handicap chairman
1% Club champion

No editorial comments are necessary, other than to say the results (to our way of thinking) reflect the truth in the popular Zontek saying, "golf is played on grass, not on a Polo sweater or a hamburger."

•

Except for a brief spell right before and right after Christmas, so far the *Farmers' Almanac* is off the mark in predicting another brutally cold and unsettled winter season.

The journal's chief weather forecaster expects it to be similar to last winter, maybe not quite as bad. Even Florida and other warm weather climes are included in the cold forecast.

At least as troubling is the summer forecast — to use their word, it will be a "scorcher".

•

There haven't been very many Symposiums I have missed since its beginning. The early ones were held while I was still in high school. Professor Love made sure his students were in the audience during the years I was a UW-Madison student; Uncle Sam's Army deprived me of two of them during the turbulent late sixties. Otherwise, I have been there, taking good notes and writing extensively about the meetings.

Those are the reasons I felt miserable about having to pass on the Symposium when it convened this fall. I had suggested Dr. Bruce Allison as a speaker and had made to invitation for him to speak, which only added to the frustration. But we had a fairly large project beginning on the exact day the Symposium started, and business must come first.

Unfortunately, it rained cats and dogs that day. By afternoon, nearly two inches of rain had fallen, it was still pouring and the project start up was put on hold. So I cleaned up and headed to Milwaukee with hopes of arriving in time for the WGCSA annual meeting and election.

The rain pounded all the way from Madison, the wind blew and the trip was close to risky. But if one is serious about being a good and dutiful member, sometimes you have to take a little risk, make an extra effort. After all, it is serious business we conduct at the annual meeting, and that was even more true this year when the terms of affiliation were to be discussed.

And what happened? Thirty minutes and out. For the second consecutive year.

I am amazed that such poor planning could happen again. I can accept it once — "their fault". But twice in a row? "Our fault". It appears more planning takes place for arrangements for a June or July or August golf meeting than does for our annual meeting and election.

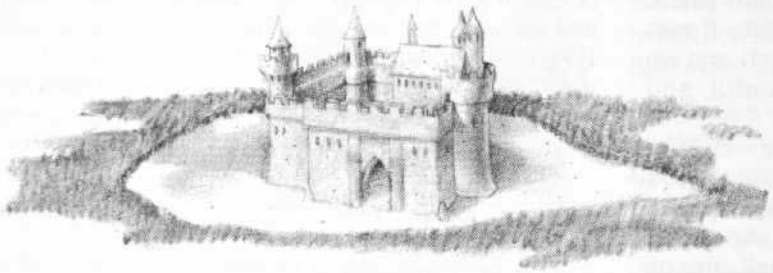
Why wasn't the meeting reconvened somewhere else — the hallway or a suite? Somewhere. Anywhere.

But instead, there was a shrugging of shoulders and adjournment for the hospitality room.

Funny thing (or is it a sad thing?): there is a room for beer and snacks and bull feathers, but not for elections and an annual meeting.

Will 1997 be better?

There Are A Few Things The Sand Pro Can't Do



What the Sand Pro 5000 can do is increase bunker playablility regardless of design or sand type. With the most attachments on the market, and adjustable down-pressure, it lets you really fine-tune your bunkers. Double air filtration and enclosed hydraulic drive keeps the grit out while separate fans for hydraulic and engine cooling prevent overheating.

And the 16 H. P. twin cylinder engine offers 3WD and optional on-demand 2WD.

For operator comfort and control Toro included a sound treatment package. And the rear mounted engine makes the operator feel like he's sitting on the machine, not straddling it.

Sand Pro® 5000

It all adds' up to better looking, better playing bunkers. No, the Sand Pro can't build castles, but it sure makes its home in the sand.

TORO®

Helping you put quality into play.™

Reinders
ELM GROVE APPLETON MADISON

TURF EQUIPMENT
13400 WATERTOWN PLANK ROAD, ELM GROVE WI 53122-0825
PHONES: LOCAL (414) 786-3301 800 782-3300
Branch Offices Appleton (414) 788-0200 Madison (608) 223-0200

Oh My Gosh! Did the couples have a great time in Oshkosh?

By Bruce Worzella

Now that the 1996 Holiday Season is history and everyone is worrying about paying taxes, getting ready for Las Vegas, or like me, reprogramming from over-eating and constant socializing, I would like to share a few highlights from the recent couples dinner dance.

The first weekend of October this year greeted us with exceptionally nice weather. Thirty-one couples with visions of being crowned "Mr & Mrs. Mow" this year teed up at beautiful Oshkosh Country Club. After all the divots were replaced and ball marks fixed, two teams were locked into a tie. Steve and Cheryl Schmidt, and Greg and Lynn Kallenburg had a chipping and putting contest on the ninth hole to determine the winner. It was proven that Steve needs to practice his short game; the victory went to the Kellenburgs.

Finally, after everyone rested and discussed their pitfalls of how to win this prestigious award, dinner and dancing polished off a terrific relaxing weekend.

Our great hosts.

Even the reps get a weekend off!

Again, I would like to thank Kris Pinkerton for allowing our group to play golf on a day I know members hate to see the course tied up. Also, thanks to John and Dina Jensen, hosts of the popular hospitality get-together room, and the contributors. Finally, we appreciated all of the attending couples and their efforts.

The calendar is already marked: October 4&5, 1997; Drugan's Castle Mound golf course, LaCrosse, Wisconsin. Be there or be square!

The Gerth's have not missed a one!

The playoff! Cheryl — "Thanks, Steve, next time I will do it myself."

Statistics and The Science of Turfgrass Research

By Tom Schwab, Superintendent
O.J. Noer Turfgrass Research and Education Facility

What comes to mind when you think of statistics? A most prevalent use of statistics is relating it to sports activities. A batting average, free throw percentage, use of handicaps, and a win/ loss record are all forms of statistics. Many of them are used to predict the outcome of a given event. My favorite statistic is the last time the Packers started out 8 and 1 they went on to win the title. The science of statistics is used to make unbiased inferences about outcomes in many walks-of-life such as sports, but also business, medicine, engineering, law, education, and turfgrass management.

The basic concept behind statistical inference is to observe a small part of a large group and from that small group make a prediction of the whole. Two simple terms need to be defined here, population and sample. The large group or real life situation which you are really interested in is considered the *population*. The small group or study from which you will be drawing inference to make a prediction on the population is called the *sample*. At the Noer Facility a *sample* might be to observe a bentgrass putting green that has three different mowing heights. We may be investigating whether the different mowing heights relate to having more or less disease incidence. The *population* of interest in this study would be all bentgrass putting greens.

A criticism that a study like this sometimes receives is that this putting green is not like the real world where a green may also have 60,000 rounds of golf played on it. That is true, but this study was not designed to study the whole real life situation. It was designed to investigate one aspect. Then you can take this one aspect and consider how it applies within your whole management scheme.

With careful planning and design of the experiment, using statistics, the researcher can quantify a claim that a certain input will have a chance of giving a certain effect. For example, they can state with a certain level of confidence (say 95%) that XYZ product will increase rooting on native soil bentgrass putting greens. Statistics uses calculations to give a numerical value of whether this difference is meaningful. Then you can judge whether with numerical value is enough for you to be confident in the claim.

Oftentimes we hear from advertisers about how well a new product works. Sometimes we are given testimonials as proof such as, "Joe at Bigwig Golf Links used schmuckum juice to speed germination and his members were playing the new green two week after planting." Because most of us value the scientific method over hearsay we can't be convinced of these claims unless we know more about the testimonial. You rarely hear any statistical techniques mentioned when you hear a testimonial. A testimonial could be believable if the following occurred: the same outcomes were repeated at many different sites, at each site individual treatments were replicated manipulations that you are observing in a study. For example in a fungicide study, each different product would be considered a separate treatment. Then you may be observing which treatment lasts the longest.) When analyzing statistical results: find out what tools of measurement were used in analyzing the data, and question whether the conclusions are biased by the people making the claims.

Many of the ideas behind statistical procedures seem like common-sense yet their importance in designing an investigation and producing factual analysis can not be underestimated. I can also tell you that taking a graduate level statistics course is significantly harder than most undergraduate courses I took 15+ years ago. For this novice, although many of the ideas seem obvious, their actual examination and calculation are very complex. There are many terms and procedures used in statistical science when analyzing data such as Null Hypothesis, Significance Testing, Confidence Interval, Power, Least Significant Difference, Sampling, and many others. I'll try to explain what some of these concepts mean.

Most statistical analysis starts out with a *null hypothesis*. That is an expectation that there is no distinction between the different treatments that you are observing. If there is an observed difference, statistics can be used to determine the probability that

this difference is a chance occurrence. If the probability, due to chance, is calculated to be very small than we conclude that the difference is due to the treatment. In actuality, what you most likely want to find is that there is difference between treatments. You would love to learn that one fungicide, for example, will last significantly longer than all the others, unless it costs an arm and a leg. In other words, you'd like to reject the null hypothesis which states that "the treatments are the same."

The statistical technique used to determine whether to reject or accept the null hypothesis is *significance testing.* Significance is a measure of probability that a certain difference is not due to chance. If the probability that these results could have occurred by chance is calculated to be extremely low, much less than 5%, then the null hypothesis (treatments are the same) should be rejected. If the null hypothesis can be determined not to be true, then you can be pretty sure that this observed treatment will be different from other treatments. Significance is just a way of telling you to what degree the treatment contributed to the difference. Then you can judge for yourself if the calculated significance value will make you believe that the particular treatment will make a difference.

Another similar approach to derive information from statistical inference is to calculate a *confidence interval.* A confidence interval is a plausible range for the true mean of the population. Say you wanted a type of turfgrass that could survive underwater for periods of time because you have some lowlands on your golf course that get flooded. You pay a researcher to investigate five different types of grasses that may be able to withstand submersion. They may find ABC grass can be underwater and survive for a period of one to seven days. The confidence interval in this case is one to seven days. (This is in contrast to significance testing discussed above which would tell you that ABC grass is distinctly better in it's flooding tolerance than the other four turfgrasses, but it would not tell you the upper and lower limit.) If that one to seven day interval is too broad and you absolutely need to know that a grass will last from three to five days underwater, that is over a narrower interval, the researcher could direct a study towards achieving this. This investigation would be more costly because the sample sizes would have to be much larger to achieve the same amount of confidence in the prediction. Thus more lab time would be needed and the possibility that no turfgrass can confidently be recommended to withstand that interval may be the conclusion. The confidence interval produces a plausible upper and lower limit where most of the data in the population will fall between. This confidence interval approach is related to significance testing because significance will also tell you to what degree the particular range predicts the population.

Power is the name of another statistical calculation. Power considers that the sample results may not be an exact prediction about the population. The power calculation theoretically asks, "If the true population is different from the null hypothesis, to what degree of probability can the test results be expressed?" Say that Organosmellystuff (OSS) fertilizer is expected, from previous knowledge, to keep Kentucky bluegrass growing vigorously for an average period of 40

(Continued on page 19)

TURF'S UP.

There's tough mowing ahead! City parks, back yards, baseball diamonds, municipal sites, golf courses–to name a few.

The whole nine yards!

Through it all, tough Magnum and Command engines keep clipping right along.

Kohler's high torque rise cuts jobs down to size in no time, flat.

For power that can cut it, at any angle, Kohler verticals are equipped with full pressure lubrication and full-flow oil filtration. And to protect your engine from low oil conditions, there's optional Oil Sentry.™

Kohler engines. Built for a hard day's work.

Plus, with genuine Kohler parts, a strong dealer network and a two year industrial strength warranty, Kohler engines keep your customers on the cutting edge of their field.

For more information about Kohler Magnum and Command engines write Kohler Co., Engine Division, Kohler, Wisconsin 53044. Or call 414-457-4441.

KOHLER engines

(Continued from page 17)
days. A study is planned to see if this expectation is realized. The study finds that OSS lasts for an average of 45 days. The researcher of the study may ask, "If the true population average longevity of OSS fertilizer would be 40 days, then with what probability can I make the statement that my expected longevity of 45 days is true?" Power is a measure of experimental sensitivity that determines how likely the sample results are correct based on previous knowledge about the true population. Power and some basic algebra can also be used to help you determine how large a sample size, or how many replications that you will need to achieve a certain level of probability in your results.

Least Significant Difference (LSD) is a very common statistics calculation used when analyzing data for a turfgrass research report. LSD is a calculated range which tells you that any treatments separated by this value or less are not to be considered different. Their difference is only a matter of experimental error that occurs by chance. For example, let's say you want to look at a National Turfgrass Evaluation Program to see which cultivar of fine fescue performed best. If you see a calculated LSD of 0.8 in the report, then a cultivar that is rated 6.6 is just as good as one rated 7.3. If two cultivars are rated with a difference of 0.9 or greater, then the higher rated one can be considered significantly better in this example.

Sampling is a process which explains that the larger the sample size the closer the study will approximate the true population distribution. This means that the more times a given treatment is replicated in a study the closer it will approximate the true population. If a study continues for a longer period it is also considered more accurate. This makes sense because if a study takes place over many years the climactic extremes that are experienced in the short term are balanced out. Longer studies are obviously more expensive so the cost/benefits have to be weighed with the degree of confidence that you are trying to achieve. Another example is if a researcher is trying to prove his conclusion to a very high degree to a very critical peer group then he would need to replicate the study many more times than if he was just setting up a demonstration for a group of non-professionals.

There is a difference between a demonstration and an experimental research design. Experimental research designs need consistent and controlled data collection and statistical analysis. In contrast, demonstrations often lack that sophistication, but they are still very important. An example of one of these demonstrations at the Noer Facility is our turfgrass variety plot. We planted 20 different types, mixtures, or blends of turfgrass that grow in our upper midwest climate for homeowners to observe. There is plenty of information already known about many of the characteristics of these turfs. To investigate a certain characteristic to yet a higher degree of confidence than is already available would take considerable amounts of time, effort, and money. Like most demonstration plots, this variety plot was inexpensive to install and yet it provides great information for non-professionals like homeowners. Non-professionals often just want more general information about what varieties to use. Demonstrations are also important in that they may, by chance, present a characteristic or input that should be investigated in much more detail in an experimental research design.

The Noer Facility has many demonstrations as well as experimental designs. An example of the latter is a study that has 15 different treatments with each treatment replicated 10 times. That study was designed by a department statistician. There is another study at the Noer Facility that will take place over ten years. Those are the kind of *samples* that will be able to make very accurate, statistically confident statements about the whole *population.*

There are many products that claim to positively effect turf health, such as decrease thatch, increase rooting, reduce pesticide applications, enhance winter hardiness, increase green speed, and on and on. To make those types of claims, a product needs to be evaluated using some statistical knowledge. If a salesperson or researcher can show you the statistical evaluation done in studying the product then you'll have more confidence in trying it. Every consumer needs some basic understanding of statistics in order to question and understand the claims that are made about a product or practice. Statistics, in spite of its complicated calculations, strengthens our understanding in many walks-of-life, from turfgrass management to sports. I just hope the original Packer outcome prediction holds true. The way that they're pounding the Bears today, as I write this, the prediction looks true with 100% confidence.

References:

Unpublished *Course Notes for Statistics/Forestry/Horticulture* Madison, Wisconsin Erik V. Nordheim & Murray K. Clayton

Statistical Methods for Food and Agriculture Filmore E Bender, Larry W. Douglass, Amihud Kramer

Statistical Methods in Agricultural Research Thomas M Little, F. Jackson Hill

WISCONSIN WINTERS

By Monroe S. Miller

I knew on November 9th last fall that winter had arrived. Cheryl and I had been to the first Badger basketball game the night before, and on the next afternoon we sat all bundled up in red to cheer the Wisconsin football team to a victory over Minnesota. But those were only meager clues of the season to come. The giveaway was the snow that fell that afternoon. The next morning, as we drove by the golf course on the way to church, the putting greens were white with snow. Winter.

The winter season in this part of the country is both welcomed and dreaded by golf course superintendents like me. On the one hand, there is relief that the golf season has finally, for the most part, come to an end. We are all tired and need "normal" work weeks. Some need to reconnect with their families. Others welcome the chance to see colleagues again. We look forward to Christmas, the Wisconsin Turfgrass Association EXPO, the GCSAA conference and any number of other opportunities to sharpen up for next year. Some (most?) have to use this time of the year to vacation.

On the other hand, winter is harsh. There isn't a golf course superintendent in the state who doesn't fret over and fear winter injury and winter kill. So much of our fate is, out of our control in the winter time. Way up north, the worry about snow molds takes an edge off the relief they normally feel. As one northern Wisconsin superintendent told me recently, "EVERY year is a snow mold year for me." Although the season should be a peaceful one, the worries are always there.

Some of the northern variety of golfers never want to give up, and they make for occasional unsettled days for some of us. Winter golf becomes a big thing for them, forcing decisions from us in early winter over course closing, play on greens, frost, frozen ground, leaf removal and all that. Some courses slam the door closed — those guys are lucky. They don't have to worry about opening or closing options. Others reverse play, with a flag and a stick on tees for the diehards. There are those who put flagstick and flag in a cupliner cut into the fairway for the hardy souls who want to play but cannot access greens because of snow fence or topdressing. There are a lot of us who wish winter golfers would go down south to play in the cold months. Or take up curling or bowling.

It was by chance that I discovered who may well have "invented" winter golf. I was reading some biographical material about one of literature's best known authors—Rudyard Kipling. He was born in India and spent time in London before coming to America to honeymoon and settle in 1892. His wife Caroline was from Vermont and they built a home near one of my favorite Vermont towns—Brattleboro. He loved the winters, despite not having experienced it prior to his move to southeast Vermont. He exulted in the deep snow and keen, sharp cold.

Kipling also loved golf, and the account of how he combined his love of the game and winter weather is fun reading for northern golf course superintendents. In her history of Brattleboro (1922), Mary Cabot quotes Kipling's winter golf partner, Reverend C.O. Day (pastor of the Congregational church while Kipling was in the town). It goes like this:

"We played golf over snow two feet deep, upon the crust, cutting holes into the soft snow, and naturally losing the balls until it occurred to him (Kipling) to ink them red. The first day we experimented with them, we dyed the plain like some football gridiron or Hohenlinden; then we had them dyed. The trouble with golfing on the crust was that as the meadow was upon a side hill with gradual slopes, a ball went on forever when once started unless headed off by some kindly stone wall. It was an easy matter to make drives of two miles. As spring came, little putting greens emerged like little oases in the snow, and then we had holes made of vegetable cans sunk in the moist soil, round which we would maneuver in rubber boots."