Hole Notes

The Official Publication of the MGCSA

Winter Weather Nick You Up?

Recovery Will Happen

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Host Chris Aumock

May 20
South East Exposure at The Bridges
Host Kyle Kleinschmidt

June 3
Badgerland Exposure at Eau Claire G&CC
Host Nick Peinovich

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On the Cover
Injury/recovery at Giant's Ridge last year. Recovery will happen. Read a "Golden Oldie" by Dr. Don White on pages 30 - 31

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Presidential Perspective

by Matt Rostal, Superintendent Interlachen Country Club

April has arrived with a flurry of spring activity at everyone's golf courses and facilities. I can't believe how fast the snow has melted away in the last few weeks. Unfortunately, once again, many of us are facing recovery from winter damage! I have not been spared either this season as in past years. I have damage to some degree on all of my greens, but what I would consider significant damage only on a few greens.

As the snow melted over these last couple of weeks, I was able to get a glimpse of my greens under our traditional covers we use at Interlachen, the Greens Savers or commonly known as Excelsior Covers. I made it clear to my members that it is just a small sample size when you are looking under the covers. So, when my covers were removed on April 1st it exposed all three acres of my green surfaces. It was only then that I was able to determine the full extent of the winter kill.

I was very proactive with my members leading up to the removal of the covers, describing the three different stages of winter we experienced: a rain event which froze solid at the end of December, the polar vortex at the end of January with exposed turf and the record snow fall we received from February through the middle of March. I related how these three completely different winter conditions could contribute to winter kill and the potential spring conditions. Overall, my membership have been very understanding of the challenges we experienced this winter. Being proactive and educating my members and management team through timely communications kept the rumor mill from getting started.

For my membership I just cannot sit back and wait for the weather to warm up. I must take steps to assist recovery, knowing it is mostly dependent on the weather. But, I will be taking steps to introduce seed and warm the soil to promote recovery. As I take these steps I wish everyone the quickest recovery and if I can do anything to help, please reach out to me in this time of need.

The Board of Directors this past month received a proposal from the UMN to re-direct the member driven research funding to a four year winter research and recovery study. This study would be conducted in multi locations with other several Universities in the United States and Norway. Through much discussion at the BOD level, we decided to redirect all the member driven research funding for this study. Over the last couple of years, the ideas for member driven research has decreased dramatically, but yet one of the most frequent ideas has been a winter recovery study. Although the association has supported bentgrass seeding viability and late season applications of wetting solutions, the Board thought this was the proper time to support the UMN's proposal for a more complete study.

Now after the winter we experienced and the wide spread winter damage, we hope this study can provide valuable information to help us in the future!! However, we need your help with this study in getting it accepted in full by the USDA. One way to help is to donate your time collecting data at your golf course and this would help the $1 for $1 match in funding that the USDA requires. On April 5th, Eric Watkins emailed a request for help and I hope everyone steps up in support for this valuable research. Please take a moment to read through the request and fill out the 'Letter of Commitment'. This is just too important to not help.

I wish everyone a great spring and quick recovery if you have damage on your golf course!

Page 7

Reflections on Leadership:

Don't plow the field...

By Chris Tritabaugh, Superintendent at Hazeltine National Golf Club

There is a field near our house, it is a field I have driven by multiple times per day, nearly every day, for five seasons. Every spring, the field would be plowed, seemingly being prepared for a crop. "I wonder what they are going to plant?" I thought. The first year, after all the prep work nothing got planted, and the field became weeds.

Photo credit John Deere.com

The next spring, the field was again prepped for a crop. I had the same wonder as I drove by the field. A few weeks later, nothing but weeds.

The third spring arrived and the field was prepped once again. This time, rather than wonder what they were going to plant, cynicism kicked in. “Bet its just going to go to weeds again.”

Sure enough, weeds it was.

The same thing happened in year four. Finally, year five, after my cynical “bet its going to be weeds again”, a crop was planted.

Over the years, I've both witnessed and been a part of lots of plowing of the field, only to have the weeds take over. Do this enough, and your clientele begin to greet your plowing, not with wonder of what may happen, but with skepticism of anything happening at all.

Under promise and over deliver, is a phrase we're all likely familiar with. When it comes to making plans for the golf course, I have found over the years (often through less than enjoyable personal experience) it is always better to lay out your plans away from the harsh light of criticism and expectation.

We all make plans for improving our courses-it is, obviously, what we do. Next time you have a good idea, rather than run out and tell everyone what you are going to be doing, give yourself and your team a chance to digest the idea, plan for it and maybe implement it in a low-key manner.

Such patience brings one of two results; you surprise people with something new, or your plan is able to be perfected, or scrapped all together with little or no judgment. When all is said and done, you have more than likely over-delivered, rather than under-promised.

Unless you are entirely ready to plant your crop-don't plow the field.

Tough winter? You are not alone. Take heart in the words of the late Dr. Don White, "Grass grows in spite of what we do."

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Understand a Young Assistant: Before They are Extinct

An interview with Max Kelly (24)
Assistant Superintendent TPC Twin Cities 2019
AIT TPC Twin Cities 2018
AIT/Intern Hazeltine National 2017

Conducted by Matt Cavanaugh, Assistant Superintendent at Rush Creek Golf Club

What has been your school/job path to this point?

"I initially went to Winona State to play golf. I went to Winona, but I didn't know what I wanted to do. I stayed there for two years and decided it wasn't for me. I had a job at Menard's, but it was then I realized I didn't want to have a job inside. I thought back to my days in high school working at Forest Hills and I eventually enrolled in the turf program at Anoka Tech roughly one year after leaving Winona State. It's funny, when I was at Winona, I didn't know this was a career option."

Do you think the two-year program prepared you for your current job?

"Yes, I would do it again. Even though I've always done fine in school I've never really liked school, but I've always had the attitude that school comes first."

Do you think it is valuable to move around as an assistant, get a different view point?

Yes, absolutely. Now with my current situation, I have the ability with the TPC Network to go to different facilities with tournaments and see how other superintendents work without moving jobs. That is a huge opportunity for me. It's also a reason that we, as an industry, should allow the time for our assistants to volunteer."

Fill in the blank. I'll be a superintendent in______ years?

"Six years, I'll be 30 at that point. Four or five years ago I had told my Dad that by 30 I'd be a superintendent and I currently think that is reasonable."

Has anyone discussed goals with you?

"I like setting goals for myself, I always have. I do think discussing goals with a superior is absolutely a good thing. Is it done enough by a superior with a young assistants? Probably not, but part of that is also being comfortable talking about goals you have set for yourself with your superiors."

What skills so far have been the most challenging for you to get experience in?

"Crew management is the first thing that comes to mind. I've been around it and I see how it works. I still have lots of room to grow with this and I will gain that over time. It helps that I get along with Riley (assistant TPC) and Mark (superintendent TPC) and we are always communicating on how we want to get things done. I'm part of the meetings of putting the next day's jobs together, which is great. I'm not yet leading the crew, but I'll be gaining much more of that in 2019. For me, I learn the best through watching and being a part of the process. I don't necessarily need to have the reigns right now. Looking back though, as an intern/AIT, I do wish I would have had more of a chance to just see how a daily schedule is put together and how decisions are made on a day to day basis with the crew. Some interns/AIT's are not comfortable asking questions to be a part of the interworking of a management team and it is certainly a benefit for superiors to invite these interns/AIT's into this side of the business."

The elephant in the room for our industry is the salary of the assistant. Your thoughts?

"Everyone wants to get paid more. Do assistants get paid enough, I would say no. If you are looking to make a lot of money, it won't happen as an assistant superintendent. Hopefully, I'll make it to the superintendent role at some point. In a perfect world assistants would get paid more and, in my opinion, the industry is mostly losing assistants because of the


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pay. Although, I think many assistants try to move too fast. Most assistants want everything tomorrow, they want it too quickly. Me personally, I don't. For me it's about patience. I don't currently know where I want to end up and to me that is okay, because if I'm not there, then I'll potentially think I'm a failure and that is just not the case. I'm in no rush currently to leave the TPC or look for a superintendent job. It is key for me currently to stay where I'm and learn. I'm not ready for the superintendent job, but it certainly would be hard to turn a top job down if one came my way, though."

I'll be honest, I'm sick of all the "millennial this and millennial that talk". Has our industry focused too much on that from a young labor standpoint?

"I try to tune that stuff out. I certainly hear what many of the older generations say. It usually revolves around younger people always having a hand out wanting everything given to them. Yes that is out there, but there are plenty of people my age that want to work. If someone finds something they like to do, this age group will absolutely work for you. Too many people focus on the negatives of young employees; I'm certainly a different person now than even a few years ago. I think many of us forget what we were like in our late teens and early twenties. We all did dumb things"

What do you need to be better at?

"Honestly, I need to do a better job of knowing the different chemical names, not just the brand names. I can sometimes get lost in a conversation and I'll remember a chemical name and I'll then go back and look it up. However, more importantly, I need to have a better understanding of what these products are doing. How is a specific herbicide killing a plant, how is a specific fungicide impacting the fungus or how an insecticide is controlling the target pest. I still need to improve in this area."

Join Your Peers for the:

2019 MGCSA South-East Summer Exposure Golf Social

The Bridges Golf Club, Winona

Hosted by Superintendent Kyle Kleinschmidt

Monday, May 20, 2019

9:15 - 9:45	Registration with coffee and donuts
10:00	Event begins with shotgun or modified tee times. The format is a two-person scramble with braggers rights and proximity prizes based upon number of sponsoring affiliates.
12:00 noon	Lunch at "the turn"
2:30	Following the round, join your peers for a social opportunity. Cash bar.

Cost is $30 per person includes golf, carts and food

RSVP Requested by May 10 please

All area members and non-members are welcome

To Participate register on-line or Contact:

Jack MacKenzie, Executive Director, MGCSA jack@mgcsa.org

Variability in Creeping Bentgrass Cultivar Germinability as Influenced by Cold Temperatures

Garett C Heineck,* Sam Bauer, Matt Cavanaugh, Andrew Hollman, Eric Watkins, and Brian P. Horgan

Abstract

Re-establishing creeping bentgrass greens after winter damage can be a significant challenge in cold climates. Golf course superintendents require creeping bentgrass (*Agrostis stolonifera* L.) cultivars that are able to germinate under suboptimal temperatures to ensure early spring play. Little is known about cultivar differences for cold temperature germination; therefore, we assessed the germinability of 21 creeping bentgrass cultivars in a controlled environment. Temperature treatments represented a range of spring temperatures in Minnesota from 7 April to 25 May. Germination began occurring at the 19 April treatment. Top-performing cultivars included Proclamation, Declaration, and Pure Select while Independence and Memorial performed poorly. Overall, we found that temperatures below 45°F do not allow for sufficient creeping bentgrass germination regardless of cultivar. There were few relevant differences for the 25 May treatment. Golf course superintendents should carefully consider cultivar differences when seeding at suboptimal temperatures.

Golf course superintendents managing golf greens and fairways in cold climates often need to repair winter damage of poorly adapted species such as annual bluegrass (*Poa annua* L.). Creeping bentgrass (*Agrostis stolonifera* L.) provides a consistent golf-playing surface and is resistant to winter injury in northern climates, making it an excellent candidate for overseeding winter-damaged greens, tees, or fairways. However, annual bluegrass seed germinates under cool conditions and often fills damaged areas by late spring (Scherner et al., 2017). This leads to annual bluegrass dominating areas experiencing winterkill and limits introduction of creeping bentgrass (Gaussoin and Branham, 1989). Springtime repairs can sometimes delay course opening and are a significant burden on revenue. Thus, increasing understanding of how different cultivars of creeping bentgrass germinate under suboptimal conditions is beneficial to golf course maintenance.

Management practices aimed at hastening springtime germination and establishment of creeping bentgrass, including seed pre-treatment and the use of greens covers, have been met with varied success. For example, treating creeping bentgrass cultivar L-93 with glycinebetaine prior to seeding at both 9 and 18°F below

Applied Turfgrass Science

Core Ideas

- Golf course superintendents often overseed winter-damaged areas with creeping bentgrass in the early spring when temperatures are not ideal for rapid germination.
- Typical spring temperatures in the upper Midwest were used to define treatments in a controlled environment study to determine general germination response from early April to late May. Response was measured across 21 cultivars to find those with superior germinability under suboptimal conditions.
- The study found that creeping bentgrass does not germinate below 45°F. At temperatures typical to mid-April, the cultivars Proclamation, Declaration, and Pure Select had the best germinability.

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Abbreviations: AUGC98, area under the germination curve 98%; G_{max}, maximum germination; T_{50}, time to 50% germination; $T_{(90–10)}$, the difference between time to 90% germination and time to 10% germination.

Crop Forage Turfgrass Manage.
4:180054. doi:10.2134/cftm2018.07.0054

optimum temperatures had no significant effect on final germination percentage or germination rate (Zhang et al., 2014). Pre-germination treatment of cultivar T-1 with GA reduced time to germination by 1.7 days at 50°F compared with a non-primed control (DaCosta et al., 2015). Polyethylene covers over new spring establishments of creeping bentgrass following winterkill showed little to no improvement in the speed of germination and establishment (Frank et al., 2017).

Surprisingly, little research has examined creeping bentgrass cultivar performance for germination under cool soil temperatures. Turfgrass breeders have made tremendous progress improving a number of important creeping bentgrass traits including disease resistance (Bonos and Huff, 2013) and competitiveness with annual bluegrass (Brede, 2007). However, a review of cultivar registrations for creeping bentgrass in the United States suggests that plant breeders have given little attention to selecting germplasm with improved winter stress tolerance characteristics. For example, both 'Alpha' and 'T-1' were selected based on performance in the northern United States, but not in regions where cold temperatures might be limiting. Furthermore, no breeding or selection work on these cultivars was done on germination under suboptimal conditions (Brede, 2007).

Often, screening for germinability under suboptimal conditions is done in a controlled environment to better pinpoint critical temperatures for maximum germination and rate (Shen et al., 2008). Superior germinability can be described based on performance over several factors such as germination rate and mixed measures (Ranal and Santana, 2006; El-Kassaby et al., 2008). These characteristics can be easily described mathematically by many types of models such as log logistic, Weibull, and Hill functions (Ritz et al., 2013). To simplify the meaningful parameter estimates, authors often use mixed measures such as Timson's, Kotowski's, or Maguire's indices (Timson, 1965; Kotowski, 1927; Maguire, 1962). These measures have merit when there is need to quickly discriminate between large numbers of treatments or entries within a study; however, to fully describe a superior germinability, these indices should be coupled with other parameters such as maximum germination (Brown and Mayer, 1988). Larsen and Bibby (2005) developed a thermal time model based on typical soil temperatures at a depth of 0.5 inches to describe germination patterns of several cool-season turfgrasses.This had the potential to define the number of degree-days at any given time point required for germination. However, their research did not investigate diurnal temperature changes inherent to the open environment. Alteration of germination temperatures would better mimic natural diurnal differences in temperature (Shen et al., 2008).

The objectives of this study were to (1) determine temperature-specific guidelines for seeding creeping bentgrass based on realistic spring temperatures in the upper Midwest and (2) describe differences between 21 creeping bentgrass cultivars for their ability to germinate under suboptimal temperatures for cool-season turfgrass.

Germination Treatments

Twenty-one commercially available creeping bentgrass cultivars were included in this study (Table 1). All germination trials in this study were conducted on a double layer of steel blue germination blotter (CDB4.25, Anchor Paper Co., St. Paul, MN) within a sterile 3.9-inch polystyrene Petri dish (Fisher Scientific, Pittsburgh, PA) moistened with 0.6 oz of distilled water. To test for viability and lack of dormancy, initial germination was determined under optimal conditions by placing each Petri dish into a sealable plastic bag to maintain adequate moisture. Germination conditions were 72°F for a daytime temperature and 68°F for a nighttime temperature. Seeds were recorded as germinated at the appearance of the first leaf. All germination counts were made daily until germination events were no longer seen for three consecutive days.

To test the effect of different temperature treatments on germinability, controlled environment germination studies were conducted from fall 2015 to winter 2016. Trials were conducted in 86.9 ft^3 growth chambers (Environmental Growth Chambers, Chagrin Falls, OH) equipped with fluorescent and incandescent lights. Light intensity was 320 $\mu mol\ s^{-1}\ m^{-2}$ at 36 inches. Treatments corresponded to weather patterns for four potential creeping bentgrass seeding dates in the upper Midwest (Fig. 1). The four treatments included: 7 April (45/35°F; day/night), hereafter APR07; 19 April (55/35°F), APR19; 1 May (60/40°F), MAY01; and 25 May (70/50°F), MAY25 (Table 2). Temperatures for each of the treatments were based on 5-year historical daily high (day) and low (night) air and soil (2-inch depth under sod) averages from the University of Minnesota–St. Paul weather station (Fig. 1) (NOAA, 2018).

The study was designed as a randomized complete block design with 4 replicates and each block consisted of 100 seeds. After water was added, all replications and cultivars were placed into a single growth chamber for each of the temperature treatments. Seeds were counted as germinated and removed when the first leaf was visible. A single seed lot was used for each cultivar across all treatments and was stored under climate-controlled conditions of 40°F with relative humidity maintained at 40%.

Statistical Analysis

All statistical analyses were done using Program R (version 3.4.4) (R Core Team, 2018). Seed germination over time was estimated using a three-parameter log logistic model:

$$F = \frac{d}{1+\exp\left[b\left(\log\left(t\right)-\log\left(t_{50}\right)\right)\right]}$$

where d is the maximum germination proportion (between 0 and 1), b is the slope of the curve, t is time in days, t_{50} is the time needed to reach 50% of d, and F is the predicted germination proportion, which is 0 at $t = 0$ and increases to a maximum value denoted by d.

Table 1. Initial germination proportions, area under the germination curve 98% ($AUGC_{98}$), and maximum germination (G_{max}) values for 21 creeping bentgrass cultivars. The $AUGC_{98}$ is only meaningful within treatment, and those cultivars with larger values accumulated more germination units. Both $AUGC_{98}$ and G_{max} values are separated with 84% confidence intervals.

Cultivar	Germination† mean ‡	$AUGC_{98}$ APR07	$AUGC_{98}$ APR19	$AUGC_{98}$ MAY01	$AUGC_{98}$ MAY25	G_{max} APR07	G_{max} APR19	G_{max} MAY01	G_{max} MAY25
Independence	0.93 (0.04)	- §	2.5 ±0.3	3.3 ±0.2	2.3 ±0.2	0.0	65.4 ± 3.4	75.2 ± 3.1	94.4 ± 1.7
Memorial	0.95 (0.03)	–	2.7 ±0.3	5.1 ±0.3	3.7 ±0.2	0.3	38.1 ± 3.4	74.2 ± 3.2	94.2 ± 1.7
Tyee	0.95 (0.03)	–	4.2 ±0.4	4.6 ±0.3	4.4 ±0.2	0.5	51.8 ± 3.5	74.1 ± 3.2	93.6 ± 1.8
Luminary	0.95 (0.04)	–	4.2 ±0.4	3.7 ±0.2	4.1 ±0.2	1.6	52.8 ± 3.5	73.3 ± 3.2	92.6 ± 1.9
Mackenzie	0.97 (0.03)	–	4.3 ±0.4	5.7 ±0.3	4.4 ±0.2	0.0	47.2 ± 3.5	74.5 ± 3.1	96.3 ± 1.4
Penncross	0.97 (0.03)	–	4.5 ±0.4	5.2 ±0.3	4.2 ±0.2	0.0	50.0 ± 3.5	74.0 ± 3.1	93.7 ± 1.8
CY2	0.98 (0.02)	–	4.5 ±0.4	4.8 ±0.3	4.0 ±0.2	0.0	57.3 ± 3.5	73.6 ± 3.2	95.7 ± 1.5
T1	0.92 (0.05)	–	4.6 ±0.4	4.2 ±0.3	3.4 ±0.2	0.8	57.0 ± 3.5	71.9 ± 3.2	88.0 ± 2.4
L-93	0.95 (0.03)	–	4.8 ±0.4	4.8 ±0.2	4.2 ±0.2	0.0	56.0 ± 3.5	85.6 ± 2.5	94.5 ± 1.6
SR1150	0.92 (0.05)	–	4.9 ±0.4	5.5 ±0.3	4.0 ±0.2	0.5	52.7 ± 3.5	77.7 ± 3.0	90.8 ± 2.0
Cobra_2	0.98 (0.03)	–	5.1 ±0.4	3.6 ±0.2	3.8 ±0.2	0.8	70.8 ± 3.2	82.4 ± 3.2	95.5 ± 1.5
A1	0.98 (0.03)	–	5.3 ±0.4	4.4 ±0.3	4.5 ±0.2	0.0	57.0 ± 3.5	77.7 ± 3.1	94.0 ± 1.8
V8	0.96 (0.03)	–	5.3 ±0.4	4.6 ±0.3	4.0 ±0.2	0.3	62.2 ± 3.4	76.5 ± 3.1	90.7 ± 2.1
SR1119	0.99 (0.02)	–	5.6 ±0.4	5.4 ±0.3	3.6 ±0.2	0.0	62.5 ± 3.4	82.5 ± 3.5	89.1 ± 2.3
Focus	0.95 (0.04)	–	5.7 ±0.4	4.9 ±0.3	4.1 ±0.2	0.3	64.7 ± 3.4	81.4 ± 2.9	93.8 ± 1.7
Alpha	0.98 (0.03)	–	5.9 ±0.4	5.7 ±0.2	4.9 ±0.1	0.0	64.0 ± 3.4	87.0 ± 2.4	95.4 ± 1.5
OO7	0.95 (0.03)	–	6.0 ±0.4	6.3 ±0.2	4.3 ±0.1	0.0	66.3 ± 3.3	91.3 ± 2.0	97.4 ± 1.1
Pure Distinction	0.98 (0.02)	–	6.1 ±0.4	6.9 ±0.2	4.4 ±0.1	0.0	69.8 ± 3.2	94.4 ± 1.7	97.8 ± 1.0
Pure Select	0.93 (0.04)	–	7.0 ±0.4	8.2 ±0.2	4.4 ±0.1	0.5	78.8 ± 2.9	94.9 ± 1.6	98.2 ± 0.9
Declaration	0.98 (0.02)	–	7.4 ±0.3	5.9 ±0.3	4.6 ±0.1	1.5	83.5 ± 2.6	81.2 ± 2.8	96.5 ± 1.3
Proclamation	0.97 (0.03)	–	7.7 ±0.3	6.1 ±0.2	4.7 ±0.1	1.5	86.0 ± 2.4	97.8 ± 1.2	97.5 ± 1.1

† Initial germination proportion was determined under optimal conditions.

‡ Estimated marginal mean with standard error.

§ APR07 treatment did not germinate at a high enough percentage to calculate $AUGC_{98}$.

Parameter estimates for each germination curve were calculated using R package *drc* (Ritz et al., 2013). Parameters used to describe germination were slope, maximum germination (G_{max}), and time to 50% germination (T_{50}). Fitted germination curves were plotted using all three parameter estimates (Fig. 2). Slope of the regression was described using $T_{(90–10)}$, or the difference between time to 90% germination (T_{90}) and time to 10% germination (T_{10}). Cultivar estimates were separated using confidence intervals (CI); $\alpha = 0.16$ was chosen based on Payton et al. (2003), who showed dose response curves separated with 84% CI produced a more appropriate type II error rate when comparing treatments with similar standard errors.

Integration of area under the germination curve ($AUGC_{98}$), shown in Fig. 2, is a useful single value index that has a high potential for treatment discrimination as it takes into account the rate of germination as well as G_{max} (Timson, 1965; Joosen et al., 2010). Area under the germination curve has been used in conjunction with contemporary statistical software (El-Kassaby et al., 2008) and therefore was used in this analysis as a convenient way to discriminate between cultivars within a treatment (Baskin and Baskin, 2014). Differential rates of germination across temperature treatments can confound this value due to sporadic germination

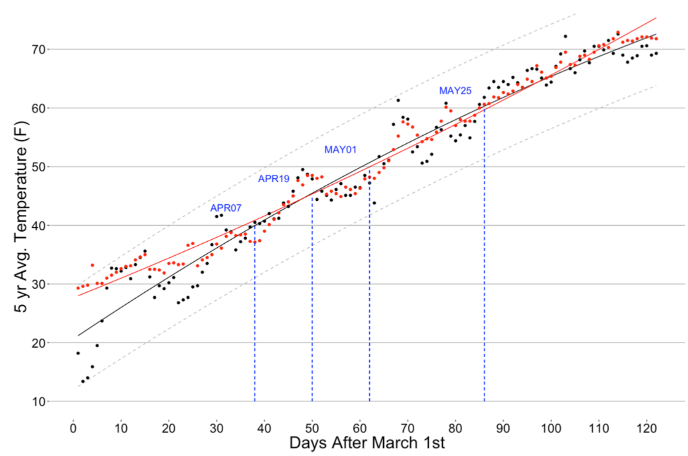

Fig. 1. Five-year average spring temperatures in St. Paul, MN. Black dots and solid line are average daily air temperatures. Red dots and solid line are average daily soil temperatures at 2 inches. Gray dashed lines represent maximum and minimum predicted air temperatures. Weather data taken from University of Minnesota–St. Paul weather station (coordinates 44.9846 N and −93.1772 W). Vertical blue dashed lines represent the calendar date of each treatment in relation to average field conditions.

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Table 2. Temperature treatments used for cultivar evaluation. Data for all cultivars were combined to display general trends for maximum germination (G_{max}), time to 50% germination (T_{50}), time to 98% germination (T_{98}), and $T_{(90–10)}$.

Treatment	Temperature range †	Length	G_{max}		T_{50}		T_{98}	$T_{(90–10)}$
	°F	d	*d* (θ%)	SE ‡	*e* (days)	SE	*e*	*e*- *e* ¶
APR07	45/35	26	00.4	- §	–	–	–	–
APR19	55/35	45	61.6	0.4	14.3	0.03	23	7.9
MAY01	60/40	36	81.6	0.3	9.4	0.02	16	5.7
MAY25	70/50	25	94.3	0.2	6.5	0.01	11	3.8

† Maximum (day) and minimum (night) temperatures for each treatment.

‡ Standard error surrounding parameter estimate.

§ Parameter estimates unavailable due to lack of germination.

¶ $T_{(90–10)}$ is the difference of days between T_{90} and T_{10}, which gives a description of slope.

events occurring as *F* approaches *d*; therefore, a cutoff of a cumulative 98% germination was used to standardize values within treatments (Brown and Mayer, 1988).

Temperature Effects

Golf course managers need to repair winter damage to their playing surfaces as quickly as possible to increase early season revenue. Establishment of creeping bentgrass in these areas is a better insurance against winterkill than the reintroduction of annual bluegrass. Typical weather patterns in the upper Midwest during early spring include a rapid increase in air and soil temperatures but do not typically reach optimal minimum and maximum temperatures (60 and 75°F) for creeping bentgrass germination until late May (Fig. 1) (AOSA, 2017). By this time, most golf courses would have been open for at least 1 month, and ideally, the greens would be established with growing seedlings by the opening date. The four temperature treatments in this study reflected soil and air temperatures during this critical time period (Fig. 1).

Prior to treatment initiation, cultivar germinability was assessed, under optimal conditions, to determine any possible dormancy and/or lack of viability that might inhibit germination under the various treatments. Germination tests showed that all seed lots germinated above 92% without any prior dormancy breaking treatment (Table 1). This test verified that none of the cultivars were under major physiological dormancy, which may be expected with fresh seed. Therefore, under suboptimal treatments, a G_{max} of 92%, with slowed rate of germination should be expected across all cultivars unless temperatures below the base germination temperature (T_b) caused imposed dormancy.

Initially, data were analyzed by combining all cultivars to describe general patterns across treatments (Table 2). As treatments simulated later calendar dates, from APR07 to MAY25, G_{max} increased from 0.04 to 94.3% and continued to increase across treatments. There is no T_b defined for creeping bentgrass; however, colonial bentgrass (*Agrostis capillaris* L.) has a T_b of 46°F, which is consistent with our results (Trudgill et al., 2000) (Table 2). Larsen and Bibby (2005) found that T_b for perennial ryegrass (*Lolium perenne* L.), slender creeping red fescue (*Festuca rubra* L. var. *littoralis*), and Kentucky bluegrass (*Poa pratensis* L.) was 37, 39, and 37°F, respectively. Interestingly, cultivars of these species performed similar to optimum conditions with respect to G_{max} when treated with suboptimal temperatures that were above T_b, but germination rate was indeed decreased (Larsen and Bibby, 2005; Trudgill et al., 2000). In our study, we found G_{max} was drastically reduced beyond the presupposed base temperature until the MAY25 treatment (60°F). However, similar to Larsen and Bibby (2005), T_{50} decreased by 7.8 days, and $T_{(90–10)}$ decreased by 4.1 days from APR019 to MAY25. It could be that under suboptimal conditions, secondary dormancy or differential base temperatures within cultivars may have been the cause of a lack of germinability (Zapiola and Mallory-Smith, 2010; Washitani and Takenaka, 1984).

Unraveling the biological meaning of these results is complex due to the length of time needed to reach G_{max} from APR07 to MAY25 in relation to the continuous increase in temperature that would be observed in the field. For example, the APR19 treatment maintained a consistent average temperature for 45 days. However, 45 days post 19 April, the average temperatures near the surface of the soil would have likely risen to greater than 60°F (Fig. 1). Typical germination studies only last for 7 to 14 days to limit any changes in dormancy that might impact results as well as provide a pragmatic interpretation to practitioners (Baskin and Baskin, 2014). Moreover, golf course managers would likely not wait more than 14 days for germination to occur. Therefore, T_{50} and the rate of germination surrounding that estimate ($T_{(90–10)}$) would be most insightful from a pragmatic standpoint.

Creeping Bentgrass Cultivar Germination Differences at Sub-Optimal Temperatures

Spring seeding prior to conditions similar to the APR19 (45°F) treatment is unacceptable due to lack of germination. The T_{50} at APR19 was 14.3 days, meaning that half of the seed would be germinated within approximately 2 weeks. However, compared with the MAY25 treatment, seeds remained in a dormant state far longer ($T_{(90-10)}$ 7.9 vs. 3.8 days, respectively) before germinating and had a lower overall G_{max} (61.6 vs. about 94.3%, respectively) (Table 2). Golf course managers could expect, in general, poor germinability around 19 April if temperatures remained constant, which is unlikely in a normal year. As temperatures increase, germination rate increases. Again, G_{max} for APR19 or MAY01 trial never reached 92%, meaning that in general, not all seed will germinate during this time period. The MAY25 treatment showed a very similar G_{max} as the initial germination test of 92% and had an impressive T_{50} and $T_{(90-10)}$ of 6.5 and 3.8 days, respectively. However, golf course managers desire earlier seeding than MAY25, so differences between cultivars at the APR19 treatment are the most insightful.

Area under the germination curve 98% ($AUGC_{98}$), based on Timson's index, is a useful single-value index that can easily discriminate between cultivars within a single treatment (Ranal and Santana, 2006; Brown and Mayer, 1988). 'Proclamation', 'Declaration', and 'Pure Select' performed well in the APR19 treatment, all accumulating at least 7.0 germination units, significantly higher than any other entry (Fig. 3). 'Independence' and 'Memorial' were clearly the worst-performing cultivars at APR19, accumulating only 2.5 and 2.7 germination units, respectively. The greatest contributing factor to superior $AUGC_{98}$ at the APR19 treatment was G_{max}, for which the three top performers were all statistically greater than other cultivars (Table 1). Time to 50% germination contributed very little to $AUGC_{98}$ with the exception of Independence, which had a T_{50} of nearly 20 days (Fig. 3). Golf course managers should be aware that there is very little variation for germination rate at APR19, meaning that nearly all cultivars will take approximately 14 days to reach 50% germination. However, fewer seeds are needed for Proclamation, Declaration, and Pure Select to fill in any given amount of space due to their high G_{max} (86.0, 83.5, and 75.9% respectively). In contrast, Memorial had a G_{max} of only 31.1%, less than half that of the three top performers.

As the treatments increased in temperature from APR19 to MAY01, differences between top performers began to change. Of the three outstanding performers at APR19, only Pure Select maintained clear dominance in $AUGC_{98}$, accumulating 8.2 germination units (Table 1). 'Pure Distinction' accumulated significantly more units than all cultivars except Pure Select. Cultivars 'Luminary', 'Cobra 2', and 'Independence' performed the worst accumulating significantly fewer germination units than any other cultivar at APR19 (3.7, 3.6, and 3.3 units, respectively) (Table 1). Mechanistic reasons for these rank changes are revealed in the T_{50} values at MAY01. Both Independence and Cobra 2 took more than 4 days longer to reach 50% germination compared with Pure Select (11.6 and 11.5 vs. 7.2 days, respectively). Proclamation, although it achieved the highest G_{max} at MAY01 (Table 1), had a relatively poor T_{50}. Eight cultivars did not achieve a G_{max} of 75% in cooler temperatures (Table 1). If utilized under suboptimal temperatures, these cultivars

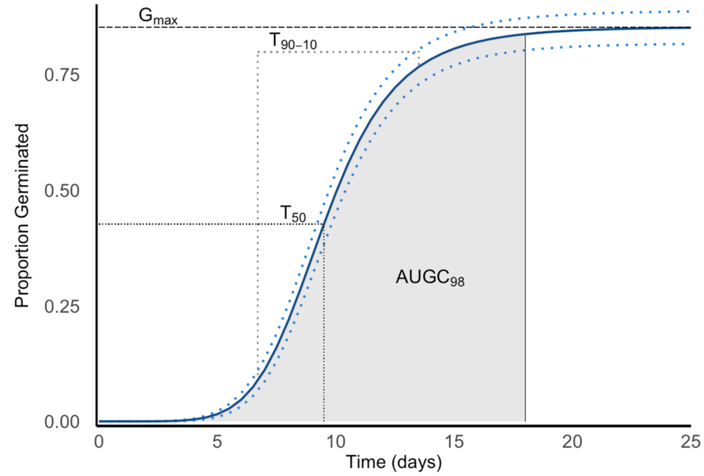

Fig. 2. Graphical demonstration of a predicted germination curve (solid blue line) using a three-parameter log logistic model. Dotted blue lines represent the upper and lower limit of the 84% confidence interval. Single-value germination values are plotted over the curve: G_{max} represents the upper limit of germination at 25 days (d = 0.85); T_{50} is the elapsed time at which 50% of the upper limit (d) was reached (9.5 days); $T_{(90-10)}$ is the difference between the T_{90} and T_{10} and describes slope (6.8 days); and $AUGC_{98}$ is the area under the germination curve restricted to T_{98}. Area under the germination curve is only valid when comparing cultivars within temperature treatments.

would require a seeding rate much higher than typically prescribed. Golf course managers seeking to quickly repair damaged greens in early spring in the upper Midwest would have the best results with Pure Select. Our study cannot determine the cause of decreased germinability at either APR19 or MAY01 though it could be that secondary dormancy was imposed by the cold temperatures, in which case the seeds may not germinate. Zapiola and Mallory-Smith (2010) found that creeping bentgrass seeds could go into a secondary dormancy after only 1 week at 40°F and were only again viable after 9 months of dry storage. Managers should be aware that seeding between 7 April and 1 May could cause secondary dormancy leading to lower G_{max}, as minimum temperatures often reach 40°F (Fig. 1).

The MAY25 treatment represented a late spring seeding and nearly mimicked optimum germination conditions. Variation for $AUGC_{98}$ was substantial although there was no clear outstanding cultivar. Alpha accumulated significantly more germination units than any other cultivar due to slightly faster T_{50} than Declaration, Proclamation, Pure Select, or Pure Distinction (5.8 vs. 6.1, 6.1, 6.3, and 6.4 days, respectively); however, there were no agronomically meaningful differences in rate of germination. All cultivars reached optimal G_{max} in the MAY25 treatment except T-1, 'SR1119', 'V8', and 'SR1150.' This date could be interpreted as being nearly optimal for germinability.

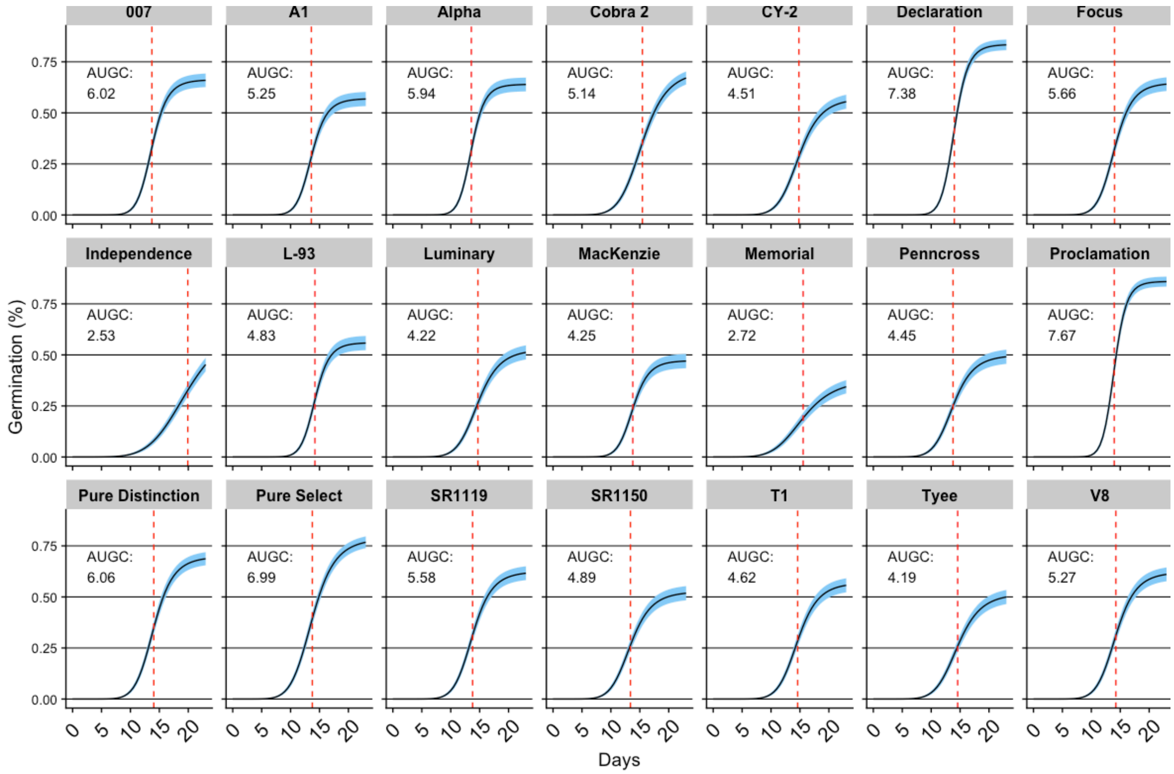

Fig. 3. Fitted germination curves for all 21 cultivars at the APR19 treatment (55/35°F). Area under the germination curve 98% is given for each cultivar. Red dashed line represents time to 50% germination (T_{50}). The predicted germination curve is based on a three parameter log logistic model surrounded with a 84% confidence interval.

Recommendations

Based on our results and past studies, it is likely that the base germination temperature for creeping bentgrass is around 45°F, and golf course managers should wait to seed until soils have reached this temperature to begin seeding. Premature seeding, especially near the surface of the soil increases the risk of secondary dormancy, loss in viability, and seed predation (Rampton and Ching, 1966). Several cultivars had reduced G_{max} at low temperatures, and these should be avoided as potential secondary dormancy could limit their performance later in the spring. Cultivars displaying superior low temperature performance were Proclamation, Declaration, and Pure Select. Independence and Memorial should be avoided under suboptimal temperature conditions. Managers should also be aware that overseeded cultivars might create localized changes in color over time, so future research should focus on the potential for reduced aesthetics from early-season cultivar introduction.

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2019 Legacy Scholarships Deadline for Application: June 1st, 2019

The Program: The Minnesota Golf Course Superintendents' Association offers a scholarship program designed to assist children and grandchildren of Class AA, A, B, C, D, EM, Associate and Affiliate members. The MGCSA provides scholarships to students attending college or vocational programs at any accredited post-secondary institution. The program is independently managed by Scholarship America, a national non-profit student aid service organization. Awards will be granted without regard to race, color, creed, religion, sex, disability, national origin or financial need.

The Joseph S. Garske Legacy award, named after the founder of Par Aide Products Company, Joe Garske, is committed to further the education of children and grandchildren of MGCSA members through financial contributions. This is the 22nd consecutive year for these awards. Par Aide is located in Lino Lakes, Minnesota and owned by Steve Garske, son of Joseph.

The late Mr. Garske, who died at the age of 76 in 1982, started Par Aide in 1954 with plans to make a "good" ball washer. A foundry man and avid golfer, he knew little about the golf business, tried to sell his ideas for design and tooling to two accessory companies, was turned down by both and so began Par Aide Products Company. Steve Garske started The Legacy Scholarship in his father's honor in 1996.

Selection of Recipients: Scholarship recipients are selected on the basis of academic record, potential to succeed, leadership and participation in school and community activities, honors, work experience, a statement of education and career goals and an outside appraisal. Selection of recipients is made by Scholarship Management Services. In no instance does any member of the MGCSA play a part in the selection. Applicants will be notified by the end of July whether they have been awarded or denied a scholarship.

Eligibility: Applicants for the MGCSA Legacy Scholarships must be: children/grandchildren of Class AA, A, B, C, D, EM, Associate or Affiliate members who have been members of the MGCSA at least five years; High school seniors or graduates who plan to enroll or students who are already enrolled in a full-time undergraduate course of study at an accredited two- or four-year college, university or vocational-technical school, and under 23 years of age.

Awards: Three awards will be given to children and grandchildren of Class AA, A, B and C members. One award of $1,500 in the name of Joseph S. Garske will be given to the highest evaluated applicant. That award will be renewable for one-year contingent upon full-time enrollment and satisfactory academic performance. One other $1,000 award will be given

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to other qualified applicants from this group. One $1,000 award will be available to children and grandchildren of Class D, EM, Associate and Affiliate members. These awards are not renewable. However, students may reapply to the program each year they meet eligibility requirements. Awards are for undergraduate study only.

Obligations: Recipients have no obligation to the MGCSA or its members. They are, however, required to supply Scholarship Management Services with current transcripts and to notify Scholarship Management Services of any changes of address, school enrollment or other relevant information. Except as described in this brochure, no obligation is assumed by the MGCSA.

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"Winter Kill" of Annual Bluegrass - 1976
or
Why Golf Course Superintendents Grow Old Before Their Time

1976 will go on record as one of those years that Poa annua didn't survive the winter. Minnesota golf course superintendents face problems like this on the average of once every four to ten years. So we shouldn't be completely disoriented with a spring like we're facing this year.

This year greens came out of the winter dead or maybe even looking normal for a few days only to go downhill rapidly. Everyone is disturbed and questions like "Are you sure you sprayed that green last fall?"; or "That blankety-blank Poa annua"; or "Those lousy blankety-blank greens" are heard every day. Fortunately, more constructive discussions such as "What caused the problem?" and "What can be done about it?" are heard more often than not.

That's the way to go! Find the cause and correct the situation.

In order to answer these questions, it is necessary first to have some kind of understanding about what "winter kill" really is. There are several types of winter kill that we face in Minnesota. One is desiccation. That's simply drying out of the grass over winter to the point where the grass does not survive. We find this usually associated with knobs on the greens or places where the wind is directed between buildings or between rows of trees and in open, exposed situations. Desiccation may be particularly bad in open winters. That wasn't the major problem last winter.

There are three other types of winter injury that are all related. These were the culprits last winter and spring. One is direct low temperature kill where plants are simply killed when subjected to low temperatures. This direct low temperature kill of plants is most often associated with compacted soils, poorly drained sites or low places. Some consider ice damage as a separate type of kill. However, ice damage can be associated with either the direct low temperature kill where the crowns are hydrated (when crowns take up water) and where grass has been subjected to low temperatures or to inhibition of gas exchange.

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To Participate register on-line or Contact:
Jack MacKenzie, Executive Director, MGCSA jack@mgcsa.org

Winter damage that is ordinarily associated with either ice or with free moisture on the surface of the soil is brought about by the inhibition of gas exchange in the soil and around the crowns of plants. The water and/or the ice seal the gases in the soil and the problem may be aggravated as the soil thaws and the ice melts inhibiting gas exchange. Under these conditions a buildup of toxic materials takes place resulting in direct kill of grass. It looks like this was a major factor in "winter kill" this spring with annual bluegrass as well as the direct low temperature kill of annual bluegrass in low or poorly drained places where the crowns became hydrated and frozen. On those locations on greens where samples smelled like sewer gas you may be fairly sure that a lot of the damage was associated with the gas exchange problem. Those areas on greens with substantial kill but a soil sample had no foul odor probably were killed by direct low temperature where the crown hydration-freezing situation prevailed.

Before proceeding further it would probably be useful to review some of the characteristics of annual bluegrass. First, annual bluegrass or Poa annua is not an annual. It's really a biennial. It flowers and seeds prolifically in the spring and fall. These seeds germinate in the spring and also in the fall. Seeds that germinate in the fall establish new plants that overwinter as new plants while the seeds that germinate in the spring establish plants that may overwinter the next year. In both cases, very young plants and the older more mature plants are susceptible to "winter damage".

One of the other characteristics of annual bluegrass is that if it is growing in free moisture the crowns become hydrated and in this condition become very susceptible to direct low temperature damage. The temperatures really don't have to be very low to kill the grass under those conditions. Also, as a comparison, annual bluegrass will not tolerate submersion nearly as well or as long as the bentgrasses.

To summarize then, it looks like our annual bluegrass was killed in two ways. First, in some situations, it was killed from direct, low temperature stress of hydrated crowns and in other situations from the inhibition of gas exchange and build-up of toxic chemicals and gases in the root zone and around the crown while the surface of the soil was wet during the spring thaw.

Why did it happen this year? It all started last year with a warm dry fall extending into late November. Just prior to freeze-up last fall it rained, moistening the surface soil. The rain was followed by subfreezing temperatures and wet snow accumulation so the grass went into the winter under very moist conditions. In fact, the soil did not freeze as deeply as usual because of mild temperatures. In January a check showed that in many places there was only two or three inches of frost under the snow. Then the thunderstorms in February accentuated the moist situation at the soil surface under the snow. Many superintendents found from one to several inches of ice on the greens at that time. Some removed the ice and others didn't but in any case the situation was set up for direct low temperature kill or for inhibition of gas exchange and poisoning of the plants.

What can we do about it? There are several alternatives. One of them might be to do nothing. If nothing is done the annual bluegrass will be back in June. By the end of July people will probably forget the problems they faced this spring. Another alternative might be to either convert the greens to bentgrass or to increase the bentgrass population on the greens. One procedure would be to simply spike the greens several times and overseed either with seed spread by means of a drop spreader or by hydroseeding. Another alternative would be to aerify a green, scarify the surface with a vertical mower (which would also break up the plugs) and then to overseed. Some people might find that they would have better success if they overseeded first and then used the aerifier and the scarifier. Another procedure might be to use the aerification-scarification-overseeding operation plus a top dressing. If top dressing is used you would have to be very careful that you didn't bury the seed too deeply.

It is important to note that aerification will be particularly important in situations where kill was caused by gas exchange problems. Aerification will allow the toxic materials to dissipate faster and for the soil situation to improve rapidly.

If you select Penncross as the bentgrass that you want to establish on your greens, an overseeding rate of 1/2 pound of seed per 1,000 square feet is suggested. If Seaside bentgrass or Emerald bentgrass is selected, you may want to use a pound or a pound and a half per 1,000 square feet. If the seed is to be applied dry, there is little problem when you apply it, either before or after the aerification, scarification or spiking. However, if you intend to apply the seed wet, that is through your sprayer, then it would be best applied after you've completed preparation operations. For those superintendents who have irrigation available at this time, it might be useful for them to consider soaking their seed overnight or until the seed is swelled. By doing this you may gain several days in the germination process. However, you must be very careful that once the seed starts to germinate that it has a continuous supply of moisture until it becomes fairly well established.

You may want to consider using a half a pound of actual nitrogen per 1,000 square feet in the form of a natural organic fertilizer or a non-burning type fertilizer after overseeding to insure an adequate nutrient supply for the new developing seedlings. Of course, you will want to keep people off these overseeded greens during rainy or wet periods.

It may be useful for you to let the membership of your club know what you're trying to do before taking on the task of converting greens to bentgrass at this time. It probably would be useful to let them know what to expect and that the greens will green up later in the spring.

I would like also to suggest that you take pictures or slides and keep records of what you do and how the treatments work out. It may even be useful then for some monthly meeting or to set aside some time at the annual meeting to exchange information, to show slides of before and after and to discuss the successes and failures of all your operations.

Good luck and best wishes for a good year. If I can help, don't hesitate to call. Thank you.

Things You Should Know

Want to know how much water is allocated to your course?

Go to:

https://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html

Scroll down and click on **"Water Use Data"**

Download the Excel file.

Use "Ctrl F" to find your course.

What to look for:

"permit_total_volume_mgy":

This is what your permit water allocation is.

Scroll to the right and compare that to your yearly water use.

Big difference isn't it?

We know it is, we looked and so can anyone else.

You may have the ability to lower this allocation amount is.

The benefit?

Show the regulatory agencies that we understand our water use.

In Bounds

by Jack MacKenzie, CGCS

Throughout my life, not many regrets have cast a heavy pall upon my mind. Of course I've missed opportunities because of poor planning, overlooked moments due to conflicts and simply failed to remember to make time for serendipitous encounters. Like sand in an hourglass, those events came and went without much impact, and fluidly, as my choices have always seemed to balance well with my lifestyle.

Late last fall I did schedule time for a growth experience with my, now adult, son Tyler. On an exceptional father/son adventure we laughed, became PADI Certified, watched brilliant sunsets, shared cigars, saw amazing underwater creatures and made mental photographs to keep each of us smiling well into our senior years. Together, we had a great time and I learned that my boy, now a man, is a pretty swell guy.

Currently I'm headed out on a father/daughter vacation, toward the equator with rod and reel, camping gear, a swimsuit, polarized shades and thoughts of delightful warmth sunshine and surf tantalizing my mind. Long talks, sharing new food, adventures, discoveries and wonderful memories are to be made. Our excursion will remain with each of us for the rest of our lives and hopefully conjure up smiles and renewed tales of outrageous delight. Although preoccupied with dreams of a strong bonding experience, in flight high above St. Louis, my thoughts wander.

Growing of age in the 1960's and 70's, I enjoyed many benefits of a two parent household. Dad left home early to work, returned home at 5:30, and we broke communal bread precisely at 6:00; typically an incredible meal made by my stay-at-home mom. When school was in session, homework and class activities kept me busy. In the summer, prior to employment first as a caddy and then on the grounds crew at the White Bear Yacht Club, family vacations dominated several weeks as anticipation eclipsed days, although the actual event lasted just about a week.

With adulthood came responsibilities. Work, dating, intense play, college, work, banking money, love, work, a house, career, wife, work, pets, a bigger house, Roth savings, work, kids, cars, happiness, a mini van, holidays, school functions, work, friends, divorce, heartache, sobriety, more work, mini-vacations, Wednesday nights and every other weekend, work, school sports, pets die, new pets, chaperone, an attempt to be the best Dad ever, new love, marriage, a do-over, bliss, trips, aging parents, work, savings, Mom passes, work, career change, graduations, marriages, downsize, grandkids, work, Dad's guardian, Dad dies, work, eyes upon retirement.

Following my father/son adventure and now upon my father/daughter, it comes as a great realization and complete disappointment that I never took an adult trip with either of my parents.

My final trek, and extended

time with Mom, was a central US tour to review colleges, and, despite acceptance at more than one, I landed at the University of Minnesota and quite close to home. To my chagrin, and hers I am sure, the pattern of child/parent discourse seemed delegated to using the free laundry services at home. Decades later, admittedly, Dad and I did make a cross country jaunt from Essex Connecticut in a twenty-three foot U-Haul box truck filled to half capacity with my deceased grandmother's household goods. Certainly a strange and impressionable adventure, but not full of enriching memories.

One could say it was an older age, a different blend of generations or the family budgets didn't warrant an outlay of money, as we were each pursuing different economies; mine raising a family and their's preserving retirement wealth. Sadly, and in quiet retrospect, I now believe each of us thought we didn't have the time or spare energy to invest in our adult relationships. Or, perhaps we were just ignorant. There were fleeting considerations of a fishing trip in Canada, a search for family roots in Scotland and extended time together on the north shore of Lake Superior. To my regret, each dissolved into wispy dreams, evaporating in the breezes of the moment. Should have, could have, would have.

What a bunch of BALONEY!

My responsibility as much as theirs, we, my parents and I, never made the chance to unite as adults. Limited to sporadic meals, the tenuous "happy" holiday and the infrequent request for a helping hand, we spoke of children, work issues, health and, of course, the weather. Substance? Not really, just passing time to move on with our lives.

Mom died suddenly in her mid '70s... Where did her time, our time, go? And, although my father's closest child in proximity, and thus his default "go-to" asset for household chores, medical crisis and chauffeur duties, my charge to him landed upon caregiving. Gone were the days of him being physically and mentally strong enough to develop an adult relationship. We had fallen into a consistent dependency with limited growth potential as he gradually declined.

Of course I cannot spin back the hands of time, but I can control the future. Having rerouted my priorities, and suddenly appreciated what had been lost, an adult relationship with my parents, a desire to create lasting memories with my children before I gentrify has become very important to me. My deep awakening comes at a time in their lives, filled with family, work and maturity. Hopefully, they will be interested in crafting mental album pages of special events with their Dad as we each realize the quick passage of time.

Seconds to minutes, hours to days, months to years and soon life passes us by. Today, even before the completion of a trek with my daughter, I pledge to plan more opportunities with family and close friends. As the saying goes, “If it ain’t on the calendar, it ain’t gonna happen”.

With just three more decades of good health and mental stability, I cannot afford to miss any opportunities.