Avoid the Rebound: Use of Growing Degree Days to Re-apply Growth Regulators

The most poorly understood products applied to turfgrass are plant growth regulators (PGRs) because 1) it is difficult tell when they are working and 2) their labels can be vague. This is especially true when PGRs are applied to golf course putting greens. Despite best efforts, it is nearly impossible to tell how well a PGR is suppressing putting green clipping yield. As a result, many golf course superintendents use vastly different application rates and frequencies for each PGR in their arsenal. This ambiguity leads to one of the most common questions superintendents tend to ask, "What rate should I use on my greens?"

Before we tackle that question let's get back to the basics. The most commonly applied PGRs used on putting greens are Primo Maxx (trinexapac-ethyl), Trimmit (paclobutrazol), and Cutless (flurprimidal). These products alter growth rate in two distinct phases. Following PGR application clipping yield becomes suppressed relative to non-treated turfgrass; the suppression phase. After a period of time the suppression phase ends and clipping yield increases to a level greater than nontreated turfgrass; the rebound phase. Researchers have found that the duration of the suppression phase is dependent upon air temperature (Lickfeldt et al. 2001; Beasley et al. 2007). As air temperatures increase into the summer the length of the suppression phase decreases. This occurs because turfgrass plants breakdown PGRs, such as Primo Maxx, faster as air temperatures increase (Beasley and Branham, 2005). This means that calendar based PGR re-application intervals are not efficient at maintaining yield suppression because the ideal re-application interval changes during the course of a growing season.

During my Masters degree with Dr. Soldat at the University of Wisconsin-Madison we studied how PGR re-application frequency and rate affected yield suppression on creeping bentgrass golf putting greens; primarily with Primo Maxx. Instead of evaluating inefficient calendar-based intervals (i.e. weekly or biweekly applications), we used a growing degree day (GDD) model to estimate the duration of the yield suppression phase and aid in scheduling Primo Maxx applications. The goal was to sustain yield season-long yield suppression and avoid the rebound. Growing degree day models are used extensively in traditional agriculture to estimate crop growth and development in relation to air temperature and recently have been used to estimate weed growth and development in turfgrass, i.e. *Poa annua* seed head formation (GDDTracker.net). To calculate GDD This means that calendar based PGR re-application intervals are not efficient at maintaining yield suppression...

the high and low air temperature are averaged together, subtracted from a base temperature where metabolism is minimal, and added to values from the previous days.

In a 2008 study, we measured daily relative clipping yield from a creeping bentgrass putting green treated with Primo Maxx every 100, 200, 400, and 800 GDD as well as every four weeks. The GDD was calculated in degrees Celsius with a base temperature of 0°C and began after the previous Primo Maxx application. After the GDD threshold had been surpassed (i.e. 200 GDD after Primo Maxx application), Primo was re-applied and the model was reset to zero. We realize that most American avoid using the Celsius scale, however, it is convenient in this case because there is no need to subtract a base temperature (the base is 0°C). Additionally, spreadsheet programs such as MS Excel can be used to track the progression of GDD after PGR application and convert temperatures to Celsius. Temperature °C=Temp °F-321.8

We found that the 400 GDD, 800 GDD, and four week re-application frequency did not maintain season-long yield suppression (Fig. 1). We plotted relative clipping yields at

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different GDDs after Primo Maxx application to create a Primo Maxx response model (Fig. 2). This model showed that the suppression phase occurs during the first 300 GDD; after 300 GDD the turfgrass entered the rebound phase of increased yield relative to non-treated turf. The maximum amounts of both yield suppression and rebound was 18% of the non-treated turf.

We found that the 100 and 200 GDD re-application frequencies maintained season-long yield suppression (Fig. 1). The 100 GDD re-application interval resulted in a greater level of yield suppression than the other treatments. The 200 GDD re-application interval is the furthest Primo Maxx re-application interval to maintain yield suppression because the yield begins to transition into the rebound phase after 200 GDD. For some perspective, 200 GDD occurs in 14 days during an average May in Madison, WI (average day temp. 57°F) and as frequently as every 9 days during an average July (72°F). During a heat wave with high temperatures of 100°F and lows around 75°F (average day temp. 89°F) 200 GDD occurs in 7 days or less (Fig. 3). This illustrates how Primo Maxx re-application interval needs to be



Figure 1.

The effect of Primo Maxx re-application frequency on the relative yield of a creeping bentgrass putting green. Stars indicate days clipping yield was less than the non-treated control (dashed line) and arrows indicated Primo Maxx applications. Primo Maxx was applied at the labeled rate for golf course putting greens of 0.125 fl oz/M. Values below the 1.0 reference line indicate yield suppression while values above the line indicate the rebound phase.



Figure 2.

Relative clipping yield of a creeping bentgrass golf putting green at various growing degree days after Primo Maxx application. Cumulative GDD was calculated in degrees Celsius with a base temperature of 0°C from the time the previous Primo Maxx application. Primo Maxx was applied at the labeled rate for golf course putting greens of 0.125 fl oz/M.Values below the 1.0 reference line indicate yield suppression while values above the line indicate the rebound phase.



Figure 3.

The influence of air temperature on the duration of the yield suppression and rebound phases in Madison, WI. Values below the 100% reference line indicate yield suppression while values above the line indicate the rebound phase.

adjusted depending upon air temperatures to avoid the rebound phase. As temperatures warm into the summer, Primo needs to be re-applied more frequently than it does in spring and fall to avoid the rebound.

In 2009 and 2010 we wanted to verify that the 200 GDD model worked on a different creeping bentgrass putting green and see how it was affected by Primo Maxx application rate. There were two application rates (0.125 and 0.25 fl oz/M) applied either every 200 GDD or every four weeks. In both years the 200 GDD re-application interval maintained season-long yield suppression regardless of the time of year. Surprisingly, we found that the 0.25 fl oz/M application rate did not increased either the level or duration of yield suppression. Application rate



Figure 4.

Relative clipping yield of a creeping bentgrass golf putting green at various growing degree days after Trimmit application. Cumulative GDD was calculated in degrees Celsius with a base temperature of 0°C from the time the previous Trimmit application. Trimmit was applied at the rate of 0.125 fl oz/M. Values below the 100% reference line indicate yield suppression while values above the line indicate the rebound phase.

did not matter. The only effective way to increase the amount of yield suppression is to re-apply more frequently than 200 GDD (i.e. 100 GDD). The only benefit of the high application rate is that the bentgrass visual quality was greater compared to the labeled application rate of 0.125 fl oz/M.

It needs to be very clear that 200 GDD re-application interval is only meant for Primo Maxx applications to creeping bentgrass golf putting greens. Bermuda grass greens and taller mowed turfgrass such as Kentucky bluegrass athletic fields are more sensitive to Primo Maxx and would have a different Primo GDD threshold. Some preliminary research on Poa annua putting greens found that the 200 GDD re-application interval is effective at maintaining yield suppression of Poa. We also have found that 200 GDD applications to mixed bent/Poa green decreased the *Poa annua* population from 23% to 16% of the surface. However, golf course superintendents visually estimated that there was more *Poa* invasion on those same plots. This occurred because the bentgrass and *Poa annua* populations began to segregate as the grass density increased with repeat Primo Maxx applications. This gave the illusion of more *Poa* invasion while the actual amount of was diminished (verified with a grid count).

We also wanted to determine the GDD threshold for Trimmit application to creeping bentgrass and Poa annua golf putting greens. We used the same methods described above to determine Primo Maxx GDD. Trimmit was applied at the rate of 0.25 fl oz/M (11 fl oz/A) and was lightly watered in after application. We found that 300 GDD re-applications (base °C) maintained yield suppression during the growing season for both grass species. After approximately 350 GDD the turf entered the rebound phase (Fig 4). A word of caution however, the 300 GDD Trimmit treatment contributed to the collapse of the Poa annua stand during 2010 and was described in more detail in Dr. Soldat's January/February 2011 Grass Roots article (http://www.lib.msu.edu/cgi-bin/flink.pl?recno=175732). In conclusion, the use a GDD model to estimate PGR metabolism and schedule re-applications increases application precision and removes some of the mystery and misconceptions involved with these PGRs. If you have any guestions or would like a copy of an Excel spreadsheet to track GDD accumulation please email me at wck38@cornell.edu. -OC

Increasing Primo Maxx application rate did not increase the level or duration of yield suppression, but the higher application rate resulted in greater visual quality enhancement.

Summary Points

- PGRs reduce clipping yield for a duration dependent upon air temperature. GDD systems can be used to estimate the duration of the suppression growth phase.
- Re-applying Primo Maxx to creeping bentgrass putting greens every 200 GDD (base 0°C) maintained season-long yield suppression regardless of season.
- The 200 GDD re-application interval is specific only to creeping bentgrass (and likely *Poa annua*) golf putting greens. Other turf species have different GDD thresholds which need to be determined experimentally.
- Increasing Primo Maxx application rate did not increase the level or duration of yield suppression, but the higher application rate resulted in greater visual quality enhancement.
- Re-application of Trimmit to creeping bentgrass and *Poa annua* putting greens every 300 GDD (base 0°C) maintained yield suppression. However, that application frequency was stressful on the *Poa annua* and contributed to collapse of the turfgrass stand in 2010.

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SUPER - N - SITE Nick Marfise, Park Ridge Country Club



Erwin McKone, CGCS and Dave Miloshoff -N- Briar Ridge Country Club

This year's 2011 ITF/ MAGCS Spring Golf Day will be hosted by Erwin Mckone, CGCS and Dave Miloshoff at Briar Ridge Country Club. The 27-hole golf course is located in Schererville, Indiana on the old Aaron Hart farm (48 minutes from I-88 and 355, measured just recently). Eighteen holes opened for play in the spring of 1980 and nine holes were added in 1989.

Erwin has been the Director of Grounds at Briar Ridge since 2004. During his tenure at Briar Ridge, he has implemented many changes to the golf course. Erwin notes, he could not have brought Briar Ridge to the point where it is today without his Superintendent, Dave Miloshoff. A common theme at Briar Ridge and the driving force behind the two's success, is their awareness of the impact that the golf course and their operations have on the environment. Both men not only work tirelessly to maintain a pristine course, but also to incorporate sustainable concepts whenever possible.

One of the green practices that they put into action is a visible vegetable and herb garden near the clubhouse.



Erwin (I) and Dave setting up their empty bee hives in early spring.

verting many full circle heads to part circle heads, in order to water more efficiently. Another water-saving trick that Dave and Erwin employ is using compressed air to clean equipment and mowers instead of water. As a result of their efforts. not only is a natural resource conserved, but the course saves money as well. Erwin and Dave also hope to initiate their own watershed program by planting native grasses and other plants to help filter nutrients near drains and runoff areas.

Dave and Erwin have recently built a greenhouse behind their shop. The heat for the house is generated by water filled hoses running through solar panels. The hoses run under the floor and radiate

Club members benefit from the visual aesthetics of the garden while also experiencing the results on their dinner plates. For a unique change of pace, Dave has even planted fruits and vegetables in some of the landscape beds by tee complexes. Tomatoes, eggplant, watermelon, pumpkins, and ornamental peppers have replaced more traditional annual plants. Dave has also converted once annual flowerbeds into native plantings using perennial plants. These expanded natural areas reduce labor and yearly costs, and allow more wildlife to move into the area. Erwin plans to add two beehives to the golf course later this year. The bees, as you all know, will help with pollination.

Dave and Erwin are also very conscious of their water usage at Briar Ridge. They have created different irrigation

heat for the greenhouse. The addition of the greenhouse allows the staff to store and preserve many of the previous year's plants and bulbs in for future use.

As gas and oil prices rise, the importance of finding alternative fuel sources continues. At the moment, Briar Ridge Country Club is adding electric carts into their operations. Erwin and Dave have their eyes set on bio diesel as an alternative energy source for their facility in the future.

The pair has also been doing some of their own turfgrass research. One of their studies includes replicating Dr. Derek Settle's experiments using bio-stimulants. They are studying dollar spot resistance through cultural practices. Cultivation methods such as verticutting, aerification, and seeding are (continued on page 17)



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part of the experiments, as well as applications of dyes and surfactants. They are proud of the CO_2 backpack sprayer they created to aid them in conducting their experiments. Made from an old backpack blower, the CO_2 sprayer gives them the ability to apply the necessary rates for their tests without the hassle of mixing large spray tanks.

Erwin and Dave's dedication to the environment and turfgrass research shows the importance of the Illinois Turfgrass Foundation. As the current president of the ITF, Erwin wants to continue to raise awareness of the ITF in hopes that everyone involved in this business understands the future importance of research to the game of golf. It seems the number of golfers is slowly declining for many different reasons. It is unknown how many people will continue to golf, or from where that next breed of golfer will come. As the economy continues to shift, and the money spent on large trade shows decreases, it will be up to us to continue to promote the importance to turfgrass research and find the funding for it.

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Briar Ridge's newly constructed greenhouse uses water heated by solar collectors to keep things on schedule for a spring planting. Below: The clubhouse is neatly landscaped with many perennial plants and welcomes any guest to its premises.







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The installation of the BigPar3 helps to create a new stream of funds for research. Not only does the event raise funds but it allows the golf course superintendent a platform to speak about present turf conditions and the importance of our profession. The great game of golf could not have come as far as it has today without research. It is through research that we have arrived at the knowledge that supports different components of the game, such as grass types, maintenance machines, cup cutters, pesticides, and constantly evolving irrigation and weather systems. As access to environmental resources become more limited in the future, it is important that golf course superintendents stay ahead of legislation by using scientific data to guide day to day operations. The end user needs to support this movement, and the BigPar3 is the conduit for this to happen.

As you continue to give your customer the best quality conditions possible, remember how important it really is to give back. The game itself relies on this. Here's to the ITF, Erwin, Dave and Briar Ridge and another 500 years of moving the little white thing forward. **-OC**

Superintendent Bios Erwin Mckone

- Erwin started at Briar Ridge in 2004, before Briar Ridge Erwin was the Assistant Superintendent at River Forest.
- He likes to play golf and the guitar, river fish, and shoot guns.
- Erwin Coaches his daughter's softball team.
- When he is not at work, Erwin is with his family; his wife Kristin, his daughter Molly and their dogs Ralph and Barney.

Dave Miloshoff

- Dave has been a resident of Indiana and grew up in the adjacent subdivision to Briar Ridge.
- Dave has had a passion for golf since he was a young kid.
- Dave began working at Briar Ridge through college. Dave attended Purdue University Calumet, and later got his Turf Degree from Penn State
- Dave is currently working towards certification; he is an active board member of the Michiana Superintendents chapter.
- Dave and his fiancé Stephanie will be married this September.

Left: Erwin the Apiarist is getting ready for his delivery of the bees in the coming days.

Below: One of the many areas at Briar Ridge designed to welcome bluebirds and other species of the animal kingdom.

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THE BULL SHEET John Gurke, CGCS, Associate Editor



May 2011

Welcome to the newest members of our association, who are: **Neal Skelly**, Class C, Chicago Highlands Club **Chad Walk**, Regular, Old Oak Country Club **Eric Blackert**, Assistant, Knollwood Club **Laurie McGhee**, Associate, Bailey Nurseries, Inc. **Aaron Reinhart**, Assistant, Aurora Country Club **Nathan Bolhous**, Briarwood Country Club **Matt Seibel**, Associate, Arysta LifeScience **Steve Olken**, Associate, Harris Golf Cars **Chad Hauth**, Associate, Harrell's Fertilizer, LLC **Kevin Fuchs**, Associate, Harrell's Fertilzier, LLC **Matt Baumgartner**, Associate, Nadler Golf Car Sales, Inc. **Scott Pavalko**, Regular, Cog Hill Golf & Country Club

the move recently include **Brad Anderson, CGCS**, who has come back to Illinois where he has taken the golf course superintendent's position at Bittersweet Golf Club in Gurnee.



Briar Ridge Country Club in Schererville, Indiana, Erwin McKone and David Miloshoff hosts. June 21 – MAGCS monthly meeting at Prairie Bluff Golf Club in Lockport, IL, Luke Strojny, CGCS host. July 5 – Nominations close for 2012 GCSAA Board of Directors July 13 or 20 – ITF/NWILGCA Summer Golf Day at Eagle Ridge Resort & Spa in Galena, IL, **Tom Tully, CGCS** host. July 18-23 – U.S. Girls Junior Championship at Olympia Fields Country Club, Sam MacKenzie, CGCS host. July 19 – Midwest Regional Turf Field Day at the Daniel Turf Center in West Lafayette, IN. Visit www.mrtf.org for info. July 30 – Deadline for submissions to TurfNet for its "2012 Superintendent's Best Friend Calendar."



Brad Anderson

Josh Therrien has joined the team at Arrowhead Golf Club, while Glen Flora Country Club has hired Justin Olmstead, a former assistant at Milwaukee CC as its new superintendent. And last but not least, Scott Pavalko is the new superintendent at Cog Hill Golf & Country Club in Lemont, IL. Congratulations to all of these guys.

Happy 20th Anniversary to the Audubon Cooperative Sanctuary Program! Seems like only yesterday that **Peter Leuzinger** and the late **Tod Hopphan** were blazing the trail for Chicagoland golf courses in this ground-breaking endeavor.

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