

Plant Growth Regulator (Re)search

July 30, 2019

We are approaching the 2019 Turfgrass Research Field Day. Sometimes I hear, “It’s just the same titles and topics. Why should I come this year?” The truths are i) many turf researcher are not very creative with titles (Dr. Gaussoin is much better than me), and ii) the topics may seem similar, but our understanding may have changed with each new experiment. It is common to design a study to help solve a problem or answer a question. Hopefully we find an answer or two, but are frequently left with a handful of new questions. I’ve been studying plant growth regulators (PGRs) for 13 years and I still have more questions than when I started. That is why we call it “Re”-search. Without your support of the NTA through membership dues and participation at field day and conference, we just couldn’t do turfgrass (re)search.

The first article I wrote about PGRs was published in the Wisconsin Turfgrass Association publication called the *Grass Roots*. It had the abysmal title, “Getting What You Want with Primo,” and it described a short study I conducted with Dr. Wayne Kusow during the fall of 2016 ([read it here](#)). The objective seemed simple. We wanted to know the best Primo MAXX (trinexapac-ethyl) application rate and interval for a creeping bentgrass putting green. At that point, Primo MAXX had been in the turf market for 13 years. Surely those answers were known. So it was confusing to hear of many different Primo Maxx programs.

To answer our question, we applied Primo Maxx at 0.05, 0.10, or 0.20 fl oz per 1000 ft² every one, two or three weeks from September 15 to October 13. It was a very short-lived study and the temperatures were quite cool. We measured clipping yield, turf quality, and color weekly and quantified root mass and leaf/tiller density at the end of the study. The article described several of our initial findings, but we were still left with questions. In the paragraphs below, I’ll describe some of those initial findings, explain how our understanding has changed, and end with current thoughts about PGR programs for putting greens.

Turfgrass (re)search is constantly evolving as we continue to refine best management practices and grow our understanding. This is why you should attend field days and turf conferences. They are the best place to get the latest answers to your turfgrass management problems and questions. Your attendance at these events, participation in the NTA Golf Tournament each fall, and NTA Sustaining membership directly support these efforts. [Click here to sign up for Summer Field Day on August 14](#). We cannot wait to show you the latest research and thank you for supporting turfgrass research this August.

Key Findings, changes, and lingering questions from *Getting What You Want with Primo* (2007)

- *Increased Primo MAXX application rate led to more clipping yield suppression.*
 - We continue to observe this result in all of our trials. Sometimes you would need to use illegal rates, however, to achieve noticeably more clipping yield suppression. For example, Primo MAXX applied at 0.2 compared to 0.1 fl oz/1000 ft² would only have a marginal impact on the amount of suppression *during* the growing season. Other PGRs like Trimmit 2SC have a wider rate range and higher application rates. This results in greater clipping yield suppression but also has an increased risk of phytotoxicity.

- *Lower application rates resulted in better turfgrass quality than higher application rates.*
 - The risk of phytotoxicity increases with higher PGR application rate. This is true across all the PGRs we’ve tested over the years. In this initial study, the low-weekly rate of Primo MAXX had the best turfgrass quality, but had no statistical clipping yield suppression. The higher application rate had very significant clipping yield suppression, but also had a blue-green appearance and evidence of root pruning and reduced leaf (tiller) density at the end of the study. This was

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surprising and it's important to note that this exact study design was never replicated. Dr. Yelverton has great images of Primo MAXX helping to sustain bentgrass root mass at higher temperature. Also, the research literature does not suggest that root pruning is common (Beasley and Branham, 2005b; Ervin and Xhang, 2008). Following this study, we found that same 0.2 fl oz/1000 ft² application rate had the best quality and density during summer conditions (Kreuser and Soldat, 2012).

Today, my message is to avoid too much clipping yield suppression because it can lead to problems. The high rates of Primo MAXX applied every week in that initial study resulted in over 70% clipping yield suppression. To make matters worse, the turf was barely growing because of the cool weather that fall. That level of suppression would be unheard of during the summer season using similar application rates and intervals. At the time, we didn't realize what we were doing to the plant.

- **Re-application intervals could not be intuitively understood in 2006**
 - All the re-application intervals sustained clipping yield at or below the clipping yield of non-treated turfgrass. The amount of suppression was fairly constant when the Primo MAXX was applied every three weeks. High rates had more than lower rates, but the amount of relative suppression at each rate didn't change with time.

When we applied Primo MAXX weekly or every two weeks, we noticed that the amount of suppression increased each week. This was odd. Why was it consistent at a three week re-application interval but increased with a more frequent re-application interval? It was our first evidence of PGR accumulation within the turfgrass plant. Primo Maxx was being applied faster than it was broken down or mowed off. This led to more suppression as the applications continued into the fall. From these findings, the ideal re-application interval would be every three weeks. Then why were so many superintendents applying Primo MAXX more frequently to sustain suppression during summer?

That winter, an interesting article was published by Dr. Jeff Beasley and Dr. Bruce Branham (2005a). It showed that PGR breakdown (metabolism) was directly related to air temperature. As air temperature increases, the rate of breakdown also increased. From this research, it became clear that temperature needs to be accounted for when determining when to re-apply PGRs. We also know grass species and mowing height/frequency impact PGR duration, but those factors don't change like air temperature.

Growing degree day (GDDs) models proved to be good predictors of PGR performance because they track temperature accumulation (Kreuser and Soldat, 2011; Kreuser et al., 2018). As the average air temperature increases, the GDDs accumulate faster and the PGRs need to be re-applied more frequently. For Primo MAXX on cool-season putting greens, we found the ideal re-application interval is 200 GDD (base 0°C). Making Primo Maxx applications every 200 GDD led to consistent clipping yield suppression (~25%), improved turf density, reduced nitrogen requirements, and greater turf color; even at the higher application rate of 0.2 fl oz/1000 ft² (Kreuser and Soldat, 2012).

When we re-calculated the GDDs from the 2006 study, we concluded that Primo Maxx was being applied every 70-150 GDD at the weekly and biweekly interval. This led to rapid accumulation of PGR within the plant and intensified clipping yield suppression. Dr. Frank Rossi called this “PGR stacking” because PGR from the prior apps were stacked on top of the latest PGR application. This is likely what caused phytotoxicity in 2006, nearly stopped all growth, and may have caused the reduction in root mass and density.

- **Lessons and questions going forward**

- This concept of PGR stacking is a very real problem in the golf turf management industry. It occurs most frequently when summer re-application intervals are used during cool weather in the spring and fall. It is even more prevalent with golf course collars. We know the ideal Primo Maxx re-application interval for golf collars is 350-380 GDD. Yet PGRs are being applied at 200 GDD for the greens. This means that over-spray onto collars can cause the same stacking effect and phytotoxicity that we observed in 2006. This is an area of active research that you can read here: <https://turf.unl.edu/turfinfo/6-1-Preventing-Collar-Degradation.pdf>. You can also see it for yourself at field day. Our current research aims to understand how mixing PGRs and DMI fungicide impact performance. Our lab also wants to determine how much growth rate is ideal for different turfgrass areas. The plan is to build this PGR stacking model into <https://GreenKeeperApp.com> this coming winter.

When it comes to managing PGRs, I believe it is best to have some idea of your ideal growth rate and try to manage PGR and nitrogen application rates to hit those growth rate goals (as long as other issues like compaction are the cause). PGR application rate doesn't have a significant impact on PGR duration, so vary the PGRs without concern for changing the duration of suppression. My goal would be to have uniform clipping yield and I would use different rates of soluble nitrogen sources and PGRs to strive for those goals. This will maximize PGR performance and help you hit your turfgrass performance goals.

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