

## **Suppression of shoot growth and improved putting green performance traits with use of plant growth regulators**

### **USGA ID#: 2015-20-535a**

This study evaluated extended growing degree day (GDD) models and sequential applications of plant growth regulators (PGRs) (Table 1) to 'Dominant' creeping bentgrass in Lubbock, TX. Growing degree day accumulation was determined by calculating the average daily temperature in Celsius ( $\text{min} + \text{max}/2$ ) with base temperature of 0°C. Modelling applications were made on 6-8 week intervals following the accumulation of 1,000+ GDD. Sequential applications were made every two weeks to simulate a calendar-based PGR strategy implemented by golf course superintendents.

The modelling applications effectively demonstrated the complete suppression and rebound phases expected from PGR applications (Fig. 1). Cutless (flurprimidol) provided the least amount of suppression (24% at 153 GDD), but the manufacturer suggested that multiple applications of the product may be required for the chemical to effectively suppress shoot growth. Primo Maxx (trinexapac-ethyl) provided greater suppression (32%), but reached peak suppression at only 125 GDD. Trimmit (paclobutrazol) and the combination product Legacy (trinexapac-ethyl and flurprimidol) both provided 33% maximum suppression at 162 and 170 GDD, respectively. Musketeer, containing all three chemistries, provided the greatest suppression (39%) peaking at 170 GDD. Evaluating the complete cycle of these PGR's can provide an approximate reapplication window for golf course superintendents using two thirds of the period to reach equal growth rates of untreated controls (Fig. 1). Based on these calculations, the following GDD accumulations could be used to determine appropriate reapplication windows: Cutless (230 GDD), Trimmit (250 GDD), Primo Maxx (260 GDD), Legacy (300 GDD), and Musketeer (340 GDD).

The ultimate goal of sequential PGR applications should be to maintain a consistent shoot growth rate lower than nontreated areas. Applying these PGR's every two weeks to the area did not manage consistent growth throughout the summer months. Initially, lower rates of PGR's were applied to minimize severe phytotoxicity that can occur with slower growth rates early in the summer. The lower rates did not sufficiently suppress shoot growth following the final two applications when growth rates began to increase (Fig. 2). Similarly, the sequential applications at moderate rates during peak growth periods resulted in large suppression and rebound swings (Fig. 3). This corresponds well with the application intervals suggested from modelling applications as peak growth periods accumulated over 300 GDD in the two weeks between applications. Our data suggest it takes 2-4 days to observed suppression following PGR application, so this may allow for greater rebound potential when using calendar-based sequential applications. Once a treatment rebounded, it was difficult to regain the level of suppression initially observed with the product unless growth rates were reduced allowing for greater suppression.

Trimmit and the combination products generally provided greater suppression than Primo Maxx and Cutless, but some of these products resulted in phytotoxicity that may reduce the visual quality of the putting green. Playability would not be affected unless serious canopy thinning occurred. The products containing paclobutrazol can cause severe phytotoxicity and thinning if applied when bentgrass is not growing quickly (Fig. 4). This can also lead to problems due to the slow recovery following application.

### **Summary bullet points:**

- Calendar-based PGR applications will likely result in high variations in shoot growth and a greater potential for rebound.

- Phytotoxicity and thinning of the turf canopy may be a concern with PGR’s containing paclobutrazol, especially if applied to creeping bentgrass in a slower growth period.
- Modelling applications indicated that reapplication of all PGRs would be required from 230 to 340 GDD
- During peak growth during summer months, GDD accumulation exceeded 300 GDD between 2-week sequential applications in this study

**Tables, Figures, and Images:**

Trade name	Active Ingredient	AI (%)	Low Rate lb/acre	Moderate Rate lb/acre
Untreated	N/A	N/A	N/A	N/A
Primo Maxx	Trinexapac-ethyl	11.30	6	6
Trimmit 2SC	Paclobutrazol	22.90	6	6
Cutless MEC	Flurprimidol	16.00	12	16
Legacy	Trinexapac-ethyl	5.00	6	10
	Flurprimidol	13.26		
Musketeer	Trinexapac-ethyl	1.40	12	18
	Paclobutrazol	5.60		
	Flurprimidol	5.60		

Table 1. Plant growth regulators applied to ‘Dominant’ creeping bentgrass putting greens in Lubbock, TX. Low rate was initially applied due to the slower growth rate to limit severe phytotoxicity and sustain growth. Moderate rates were applied rapid growth occurred during hotter summer months.

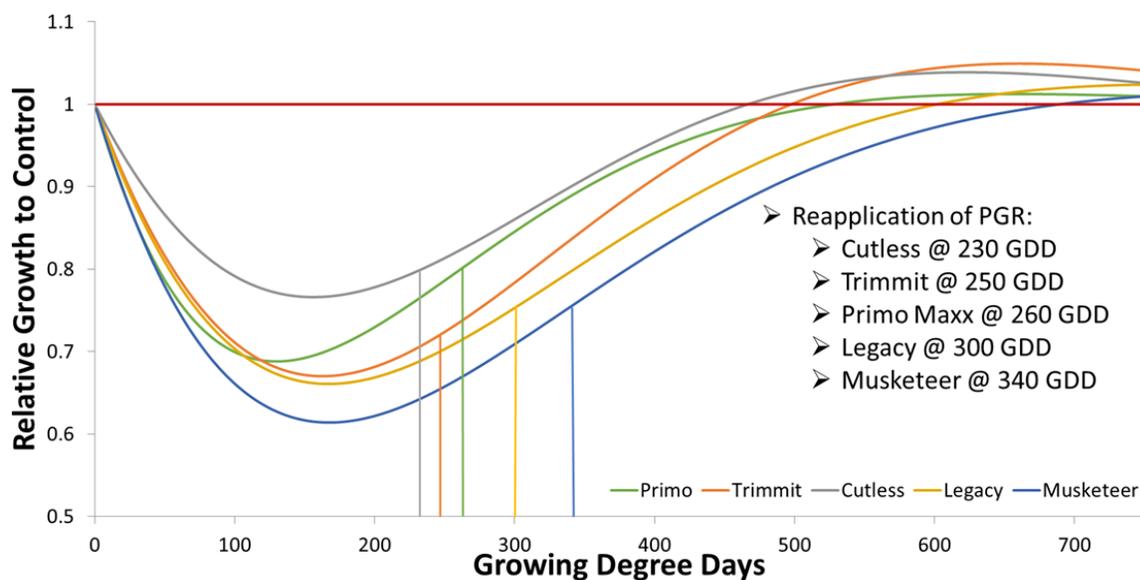


Figure 1. Modelling applications of all five plant growth regulators demonstrating the suppression phase, equilibrium point with untreated controls, and rebound phase. Two thirds of the equilibrium point can be an effective interval to maintain applications, and these values are indicated in the figure.

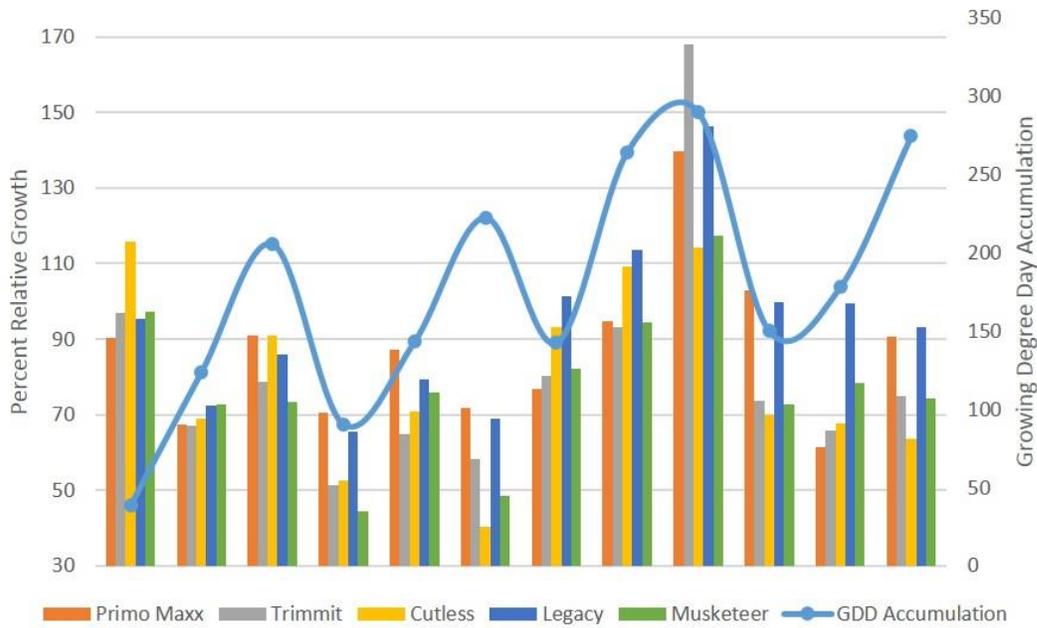


Figure 2. Sequential plant growth regulator applications from Rawls Golf Course applied every two weeks from 23 April to 15 June 2015. Each group of bars represents relative clipping yield compared to untreated control on a single clipping collection date. Growing degree day accumulations were calculated by determining the average temperature (°C) (min + max/2) using a base temperature of 0°C. At the lower rate, suppression is limited as the growth of creeping bentgrass is increasing.

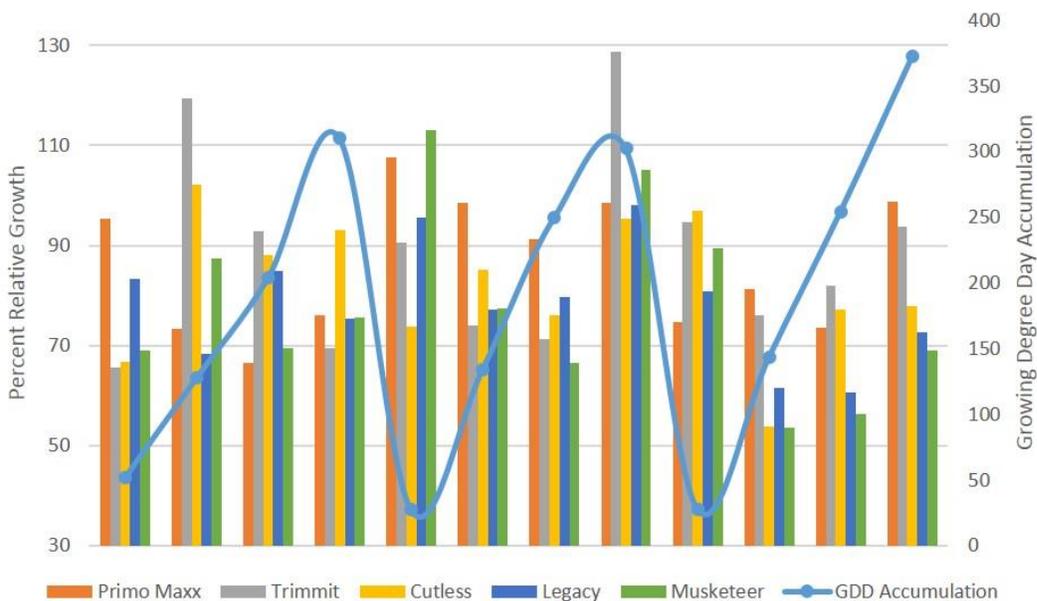


Figure 3. Sequential plant growth regulator applications from Rawls Golf Course applied every two weeks from 17 June to July 27 2015. Each group of bars represents relative clipping yield compared to untreated control on a single clipping collection date. Growing degree day accumulations were calculated by determining the average temperature (°C) (min + max/2) using a base temperature of 0°C.

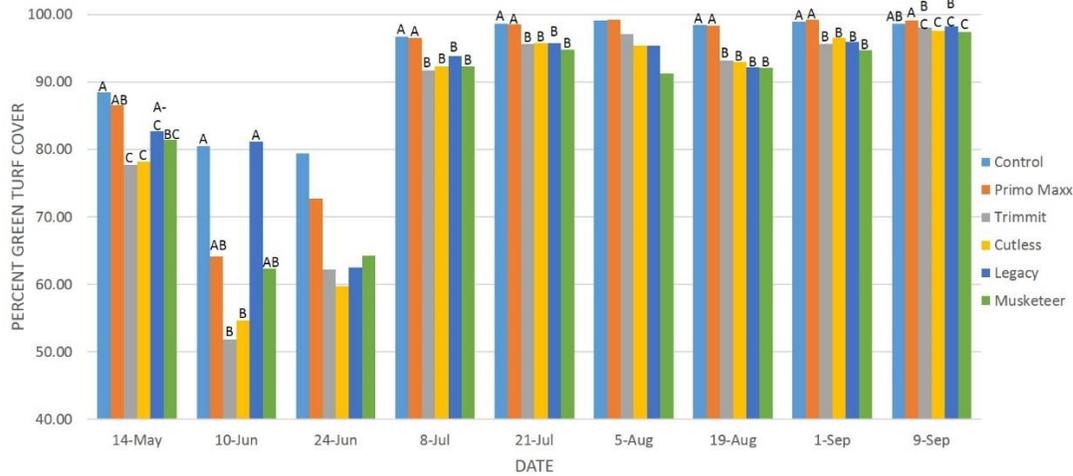


Figure 3. Percent green turf cover calculated from digital image analysis from the Rawls Course. Bars sharing the same letter are statistically similar at  $\alpha = 0.05$ . Plant growth regulators other than Primo Maxx result in phytotoxicity; however, the level of phytotoxicity is much greater early in the growing season prior to the increased growth rate of the creeping bentgrass.



Image 1. Plant growth regulator trial at Meadowbrook Golf Club illustrating darker green color observed with sequential applications at the conclusion of the trial on 8 September 2015. Treatment labels describe the product applied sequentially to the plot.