The Influence of Plant Growth Regulators on Golf Course Turf

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Courtesy of Cornell University Turfgrass Times

Plant growth regulator (PGR) technology is poorly understood by a majority of golf turf managers. PGRs are touted as tools for reducing mowing, controlling annual bluegrass and increasing green speed. PGRs recommended for use on high quality (or Class A type) turf generally inhibit cell elongation for a period of time (weeks).

The process of regulating cell elongation includes the synthesis of giberillic acid (GA). Each PGR affects the synthesis differently. For example, studies have shown that paclobutrazol (Turf Enhancer) and flurprimidol (Cutless) block GA synthesis early in the pathway. This early blockage prevents the creation of the 50 or so GAs necessary for growth. This indiscriminate blockage can result in severe injury under stressful conditions. Also, this explains the morphological effects of Turf Enhancer with regard to widening the blades of bentgrass under regulation. Trinexepac (Primo) blocks the pathway at the very end after the 50 or so GAs are produced but before the important GA[1], can trigger elongation. In essence, Primo is less physiologically disruptive.

PGRs for mowing management could extend the mowing intervals and allow for increased flexibility with staff time. Also, it could reduce wear and tear on mowers, energy consumption and clipping problems. This study is in the third year. The first two seasons investigated clipping reduction and visual quality. Data from these years indicate that regulation greater than 40% significantly reduces turf quality below an acceptable level. Assuming this information, the next two years of research will address morphological and functional parameters such as vertical leaf extension and ability to recover from divot injury.

Experimental Methods

Plant growth regulator treatments were applied for the third consecutive year to a Penncross creeping bentgrass fairway turf growing on a Batavia silt loam pH 7.4. Applications were made at various intervals from July through September. Fertilizer applications are made to supply 2.5 to 3.5#N/M/year. Plots are irrigated to prevent stress.

Vertical leaf extension was measured daily with a Turf-Chek Prism for 7 weeks after the initial application date. Plots were mowed one time per week for the first four weeks then because of severe mowing quality reductions, schedules expanded to three times per week. The MSU/UW Divot Extraction System was used to create uniform divots in each plot coinciding with the scheduled four week treatments. This resulted in three sets of divots per month of the season. Divot recovery was measured weekly with the point quadrant method recording a hit when the vegetation was encroaching the divot. Visual quality ratings were recorded monthly from 1 to 9 where 1=poor turf; 6=minimum acceptable turf; 9=excellent turf.

Results

After the second full year of PGR treatments, no snow mold fungicide applications were made. The turf had continued to become thatchy and the spring of 1995 brought a severe *Typhula* spp. snowmold infestation. The plot area required two months from the damage, therefore delayed treatment initiation until early July. One could speculate that ability to recover might be evident in the June quality ratings, where the soil active material treated plots, TGR, Turf Enhancer and Cutless, had less than acceptable quality.

The influence of PGRs on turf density has been reported by several researchers. The lack of significant differences between treatements and the untreated plot for divot recovery could be interpreted as being consistent with the idea that active lateral growth or tillering continues.

Vertical leaf extension was substantial across the entire turf facility. Environmental conditions were conducive to active top growth if moisture was not limiting. Untreated plots from week 3 through week 7 increased leaf height by at least 50% This means that if you mowed once per week you'd remove half of the foliage with each mowing. And as is expected, close-cut bentgrass often requires several mowings per week.

There are significant differences among the treatments; however, only a few Primo and Cutless treatments at 4 week intervals provided acceptable regulation and maintained quality. In both cases it was immediately following the second four-week application. Primo at 0.02 lbs. a.i./acre applied every two weeks did provide excellent regulation, acceptable visual quality with slight, but insignificant increase in thatch.

In the second year of measuring thatch, every effort was made to increase the individual plot sampling to account for within plot variability. As a result, thatch level changes were significant and indicate that three years of regular Cutless use could lead to significant increases in thatch level. No other PGR approached the same level of changes in thatch. *(Continued on Page 19)*

Plant Growth Regulators—

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Summary

Plant growth regulators for mowing management are viable options; however, a growing season that is conducive to excessive top growth will neutralize the regulation to a great extent. Therefore, the light frequent applications of low rates of Primo gave excellent regulation (about 35%), maintained acceptable quality (6.9) and did not significantly reduce divot recovery. However, increased Primo rates to 0.04 demonstrated substantial release of regulation (rebound) that may have a physiological consequence predisposing the plant to low-temperature stress.

TGR + fertilizer plots exhibited significant phytotoxicity from applications made under high temperature when the bentgrass may have been stressed. However, the same rate of PGR in Turf Enhancer provided excellent quality and steady regulation throughout the season. Cutless treatments resulted in darker green turf that had a rather non uniform appearance. Regulation with Cutless was adequate; however, increased rates compromise quality and result in thatch accumulation greater than the untreated.

Table 1. Data from the 1995 Bentgrass Fairway Mowing Management Trial showing divot recovery and vertical leaf extension.

			Weekly % Divot Recovery*				Average Weekly % Vertical Leaf Extension**							
Treatment	Rate (lbs. ai/A)	Appl. Interval	Divots Taken in July	Divots Taken in Aug.	Divots Taken in Sept.	Mean Wkly Divot Recovery	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Mean Vert Leaf Extension
Untreated			9.8	22.6	34.2	22.2	25.7	42.0	58.3	52.5	49.9	57.4	79.0	52.1
Primo 1EC	0.02	1wk	8.9	20.0	36.8	21.9	17.2	40.6	56.1	58.4	42.3	38.3	50.2	43.3
Primo 1EC	0.02	2wk	11.9	20.4	36.8	23.0	13.4	37.9	57.0	50.2	33.4	27.7	33.4	36.1
Primo 1EC	0.04	2wk	8.3	22.6	34.3	21.8	19.2	48.5	46.4	52.7	55.1	71.9	136.0	61.4
Primo 1EC	0.04	4wk	8.6	24.3	35.3	22.7	14.5	52.2	52.7	56.5	56.0	69.3	124.5	60.8
Primo 1EC	0.08	2wk	8.6	17.4	35.0	20.3	10.0	41.9	53.8	55.9	43.6	42.5	60.0	44.0
Primo 1EC	0.08	4wk	7.5	18.9	40.6	22.3	0.0	46.3	53.0	48.5	42.4	46.2	73.0	44.2
Primo 1EC	0.17	4wk	8.1	22.5	36.5	22.4	12.1	39.0	54.6	52.5	37.4	33.4	43.2	38.9
Untreated			10.1	21.0	35.1	22.1	14.8	42.5	63.7	55.5	37.0	30.9	37.3	40.2
Untreated			8.8	19.4	37.5	21.9	3.4	41.9	58.2	58.7	42.4	38.2	49.9	41.8
Cutless 50WP	0.125	2wk	7.5	19.9	37.9	21.7	13.2	48.1	55.6	54.7	47.3	51.1	80.1	50.0
Cutless 50WP	0.25	4wk	8.8	18.8	36.2	21.2	5.8	43.8	57.0	55.9	43.0	41.3	57.6	43.5
Cutless 50WP	0.5	4wk	7.8	20.0	37.4	21.7	1.3	37.9	63.4	55.1	32.9	24.6	26.6	34.5
Cutless 50WP	0.75	4wk	7.1	22.1	37.1	22.1	15.5	45.3	55.3	48.3	39.6	40.6	60.3	43.5
Cutless 50WP	1	4wk	8.2	21.9	35.9	22.0	6.6	38.4	64.0	48.4	29.1	21.8	23.7	33.1
Turf Enhancer	0.125	4wk	8.8	21.1	36.5	22.1	14.3	55.4	63.5	56.9	49.7	54.2	85.7	54.2
Turf Enhancer	0.25/0.125	4wk	9.8	21.1	33.9	21.6	4.7	43.6	68.7	52.1	33.1	26.3	30.3	37.0
Turf Enhancer	0.25/0.25	4wk	12.8	21.3	38.1	24.0	0.0	46.8	72.6	54.9	35.4	28.6	33.4	38.8
TGR+Fert.	0.25	4wk	9.1	20.9	41.3	23.8	0.0	41.2	65.1	71.1	45.0	35.6	40.8	42.7
TGR+Fert.	0.5	4wk	10.3	21.5	42.3	24.7	1.8	46.1	64.6	68.5	48.8	43.5	56.2	47.1
	LSD (0.05)		NS	NS	NS	NS	12.2	4.7	6.3	5.9	13.5	28.6	42.4	12.9

* Divot recovery measured using the point quadrat method and recovery expressed as percent divot fill/week.
** Leaf extension measured daily with the Turf-Chek apparatus and measurements expressed as percent increase in height/week.

Table 2. Data from the 1995 Bentgrass Fairway Mowing Management Trial showing visual quality and thatch levels.

			Visual Quality						Thatch Levels**		
Treatment	Rate (lbs. ai/A)	Appl. Interval	June	July	Aug.	Sept.	1995 Quality Mean	Typhula Snow Mold*	Initial (mm)	Final (mm)	% Change
Untreated			7.1	6.8	6.0	7.0	6.7	5.0	7.0	6.9	-1.1
Primo 1EC	0.02	1wk	6.8	6.7	6.4	7.3	6.8	4.2	6.5	7.0	7.7
Primo 1EC	0.02	2wk	7.1	7.2	6.2	7.1	6.9	5.0	6.6	7.1	7.0
Primo 1EC	0.04	2wk	7.0	6.7	6.3	7.3	6.8	4.5	7.0	6.3	-10.5
Primo 1EC	0.04	4wk	7.2	7.1	6.5	6.7	6.9	4.5	6.7	6.1	-8.6
Primo 1EC	0.08	2wk	6.5	6.6	6.9	8.0	7.0	5.0	7.2	6.6	-7.3
Primo 1EC	0.08	4wk	7.1	6.8	6.8	7.8	7.1	4.2	7.2	6.4	-10.6
Primo 1EC	0.17	4wk	6.8	6.7	6.1	7.0	6.7	4.8	7.2	7.4	3.1
Untreated			6.5	6.6	5.9	6.8	6.5	5.2	6.3	6.6	5.2
Untreated			6.7	6.3	6.6	7.6	6.8	3.5	6.5	6.1	-5.8
Cutless 50WP	0.125	2wk	7.1	7.0	6.5	7.5	7.1	4.0	5.8	7.1	21.8
Cutless 50WP	0.25	4wk	6.0	6.1	6.5	7.5	6.5	4.0	6.5	6.8	4.8
Cutless 50WP	0.5	4wk	6.8	6.5	6.8	7.8	7.0	4.0	6.2	7.1	14.9
Cutless 50WP	0.75	4wk	5.7	5.6	6.8	7.8	6.5	4.5	4.9	6.3	28.8
Cutless 50WP	1	4wk	5.6	5.7	6.5	7.4	6.3	4.5	4.9	6.6	35.2
Turf Enhancer	0.125	4wk	6.9	6.6	6.2	7.1	6.7	4.0	6.3	6.8	6.3
Turf Enhancer	0.25/0.125	4wk	6.1	6.0	6.4	7.3	6.5	5.0	6.5	6.3	-3.6
Turf Enhancer	0.25/0.25	4wk	5.9	6.0	7.0	8.0	6.7	5.2	7.0	6.6	-6.9
TGR+Fert.	0.25	4wk	6.3	6.0	4.3	4.9	5.4	4.8	5.2	6.8	28.6
TGR+Fert.	0.5	4wk	5.9	5.8	4.8	5.5	5.5	4.5	6.8	6.8	-0.5
	LSD (0.05)		0.5	0.6	0.5	0.7	0.3	NS	5.3	0.3	13.9

* Typhula Snow Mold incidence rated from 0 to 9; where 0=no disease, 9=severe disease.
** Thatch levels determined by the press-method.