

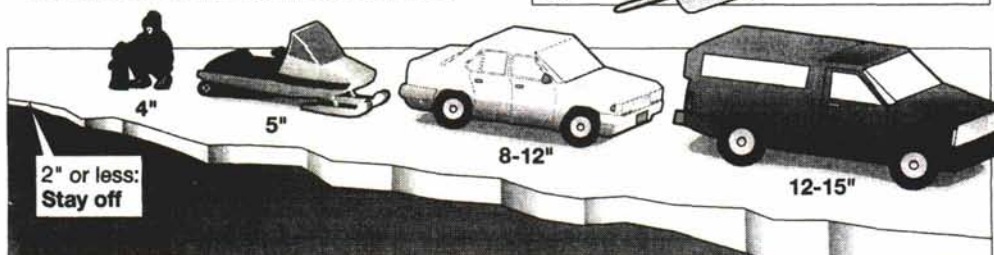
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- 3** If you're walking on the ice and fall through, try to return to where you fell in. The ice near there is more likely to be able to support you if you can get out of the water.
- 4** Ice near open water is very slippery and hard to grasp. To get out of the water, try kicking as hard as possible with your legs to push yourself up and onto the ice.

• Recommended minimum ice thickness



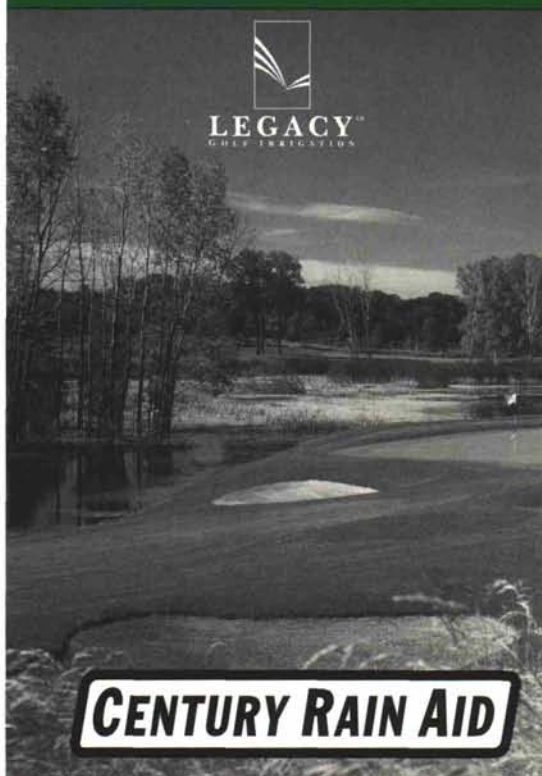
Source: Minnesota Department of Natural Resources; Ramsey County Sheriff's Department

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The Influence of Plant Growth Regulators on Golf Course Turf

Frank Rossi
Extension Turfgrass Specialist
Cornell University

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 gibberillic acid (GA). Each PGR affects the synthesis differently.

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.

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 fifty or so GA's 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 fifty or so GA's are produced but before the important GA¹, can trigger elongation. In essence, Primo is less physiologically disruptive.

(continued on page 14)

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

Treatment	Rate (lbs. ai/A)	Appl. Interval	Weekly % Divot Recovery*				Average Weekly % Vertical Leaf Extension**							Mean Vert Leaf Extension
			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	
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.

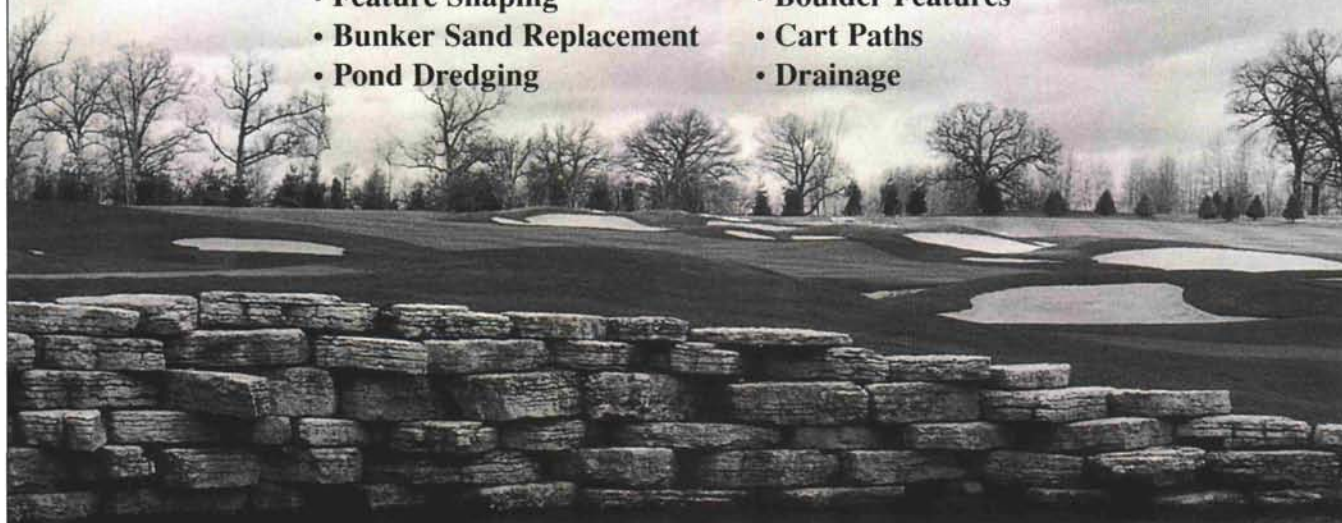
** Leaf extension measured daily with the Turf-Chek apparatus and measurements expressed as percent increase in height/week.

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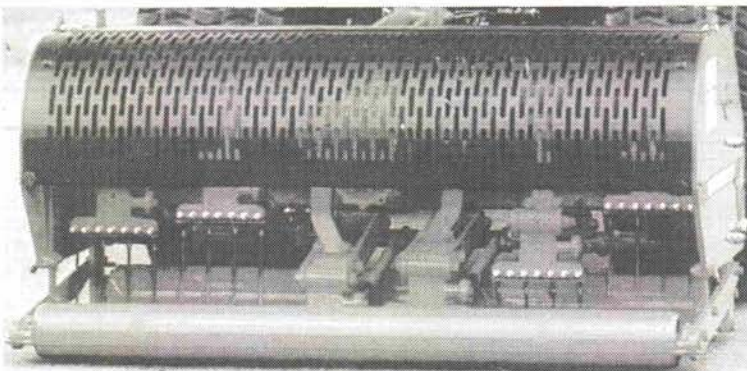
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PGRs for mowing management could extend the mowing intervals and allow for increased flexibility with staff time. Also, it could reduce wear and tear on mowers, energy consumption and clipping problems. This study is in the third year. The first two 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 TurfChek
Prism for seven
weeks after the initial
application date.*

Vertical leaf extension was measured daily with a TurfChek Prism for seven 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

(continued on page 16)

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

Treatment	Rate (lbs. ai/A)	Appl. Interval	Visual Quality				1995 Quality Mean	Typhula Snow Mold*	Thatch Levels**		
			June	July	Aug.	Sept.			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.

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The Influence of Plant Growth Regulators
(continued from page 14)

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 and 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

*Untreated plots
from week 3 through
week 7 increased leaf
height by at least 50%.*

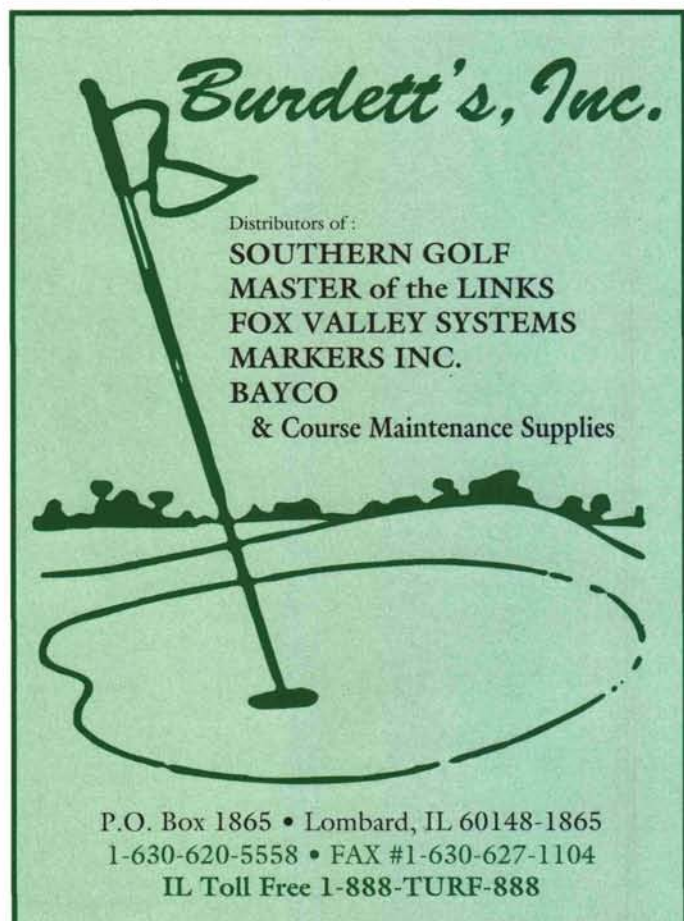
*This means that
if you mowed once
per week, you'd
remove half of
the foliage with
each mowing.*

several researchers. The lack of significant differences between treatments 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 mowing per week.

There are significant differences among the treatments; however, only a few Primo and

(continued on page 20)



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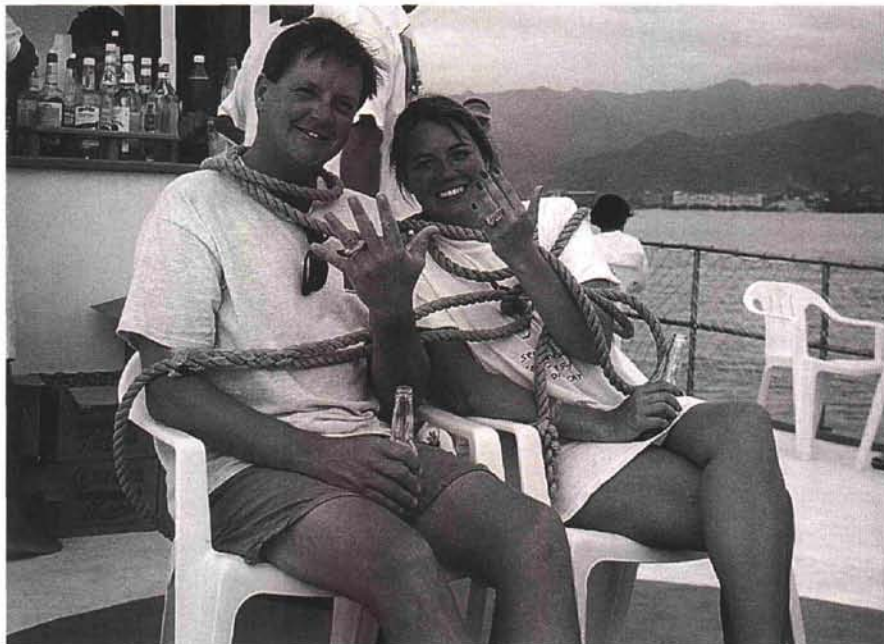
The Sky Has Fallen (And That's a Good Thing)

John Gurke, CGCS
Aurora C.C.

Dateline: November 7, 1997, Puerto Vallarta. Today, in the city of Puerto Vallarta, the state of Jalisco, and the country of Mexico, the sky has fallen. It has snowed in July. The Cubs have won the World Series. The Bears have won a game. And most unexpectedly, Dave Blomquist has taken the vows of marriage. The MAGCS has lost one of its most renowned bachelors since Mike Bavier to wedlock.

Now, perhaps I am not the most qualified individual to make an unbiased observation on this institution, but in Dave's and his new wife Michelle's case, I can. I have had the pleasure of knowing Dave forever and Mrs. Blomquist (wow!) for slightly less; and I can honestly say, "Cool." In the coming years, when you've had the opportunity to meet Dave's betrothed, you'll learn what those of us who already know her have learned: the perfect mate for everyone IS out there . . . even for Dave.

In attendance for the unique and wonderful event were several of our MAGCS colleagues, including Dave Nadler, Tim Davis, Tim Anderson, Dan Sterr, Joel Purpur, Brian Winkel, Jose Herrera, and myself (along with assorted wives, significant others, and companions). Rounding out the group were friends and family of the bride and groom, making for an intimate and fairly raucous occasion.



Dave and Michelle have tied the knot

The ceremony itself was held on Friday evening on the beach in front of our hotel. Weddings in Mexico are not much different from those in the States, with the few noted exceptions such as the fingerprinting at the altar and the added presence of a translator. Wedding receptions in Mexico . . . well, I can't comment much on that, although photographic evidence indicates that I was, in fact, there. I can say that one advantage is that fragile objects such as bottles and cameras, when inadvertently dropped, do not break on sand floors.

So, when you are reading this, tip your coffee cup and toast this lucky couple. Yes, the sky has fallen; and yes, it has snowed in July; and yes, the Cubs have won the World Series; and yes, Dave Blomquist is a happily married and very fortunate man. As for the Bears? The sky might need to fall a bit further. ■



A cold day in July? No, just some wedding-goers who didn't understand the Weather Channel in Spanish. L to R: John Gurke, Tim Davis, Joel Purpur, Dave Blomquist, Brian Winkel, Tim Betts, and Dan Sterr. (Nadler wanted nothing to do with this group.)

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The Influence of Plant Growth Regulators

(continued from page 16)

Cutless treatments at four-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 and 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 plot variability. As a result, thatch level changes were significant and indicated 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.

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 temperatures 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. ■

Credit: Cornell University
Turfgrass Times



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