Evaluation of Primo Rates and Application Timing Strategies for Improved Transition and Turf Quality on Common Bermudagrass Fairways

Principal Investigators: Wendy Gelernter, Ph.D. and Larry J. Stowell, Ph.D., CPAg

Cooperator: Mike Kocour, The Springs Club

Sponsors: Hi-Lo Desert Golf Course Superintendents Association and Novartis

Summary: A study was conducted on overseeded common bermudagrass fairways to determine the optimal rate, application timing and frequency of application of Primo to achieve improved Fall transition from common bermudagrass to ryegrass. A similar trial conducted in 1996/97 by the PACE Turfgrass Research Institute indicated that the highest quality overseeded turfgrass resulted when Primo applications (0.5 oz/1000 sq ft) were made at the time of the first ryegrass mowing. To confirm these results, a streamlined version of the study was repeated in 1997/98. Key results include:

- Overall, a single application of the 0.5 oz or 0.75 oz/1000 sq ft rate of Primo L provided the most consistent positive results when the product was applied to ryegrass, 1 - 9 days after the 1st mow. In contrast, applications made according to Primo L label instructions (1-5 days before overseeding) had no positive effects on turfgrass quality. Based on two years of data supporting this conclusion, a change in label application timing recommendations should be considered for the Low Desert, where the unique renovation and overseeding strategies that are practiced may dictate modifications in product use patterns.

- The turf quality improvements were observed 7-8 weeks after Primo applications were made, suggesting that the growth regulator effect of Primo on ryegrass, which typically lasts 4 weeks, only partly contributed to the results. Based on the data, it is likely that Primo applications made at the time of the first mowing caused significant and selective reductions in bermudagrass growth without a similar impact on ryegrass, allowing denser and more vigorous establishment of overseeded ryegrass in the treated plots.

- Primo L treatments (0.5 - 2.0 oz/1000 sq ft) made to bermudagrass, 1 - 14 days before overseeding, had no positive effects on turfgrass quality. Again this was similar to results observed in 1996/97. However, applications made to bermudagrass may be advisable as a green waste management tool.

- Double applications of Primo (an initial treatment of Primo prior to overseeding, followed by a second application after overseeding) did not appear to enhance the chances of improved ryegrass quality under the weather and overseeding conditions experienced in the Low Desert.

- None of the treatments tested caused any negative effect on the Spring transition from ryegrass to bermudagrass. This is in contrast to results seen in the previous year's study.

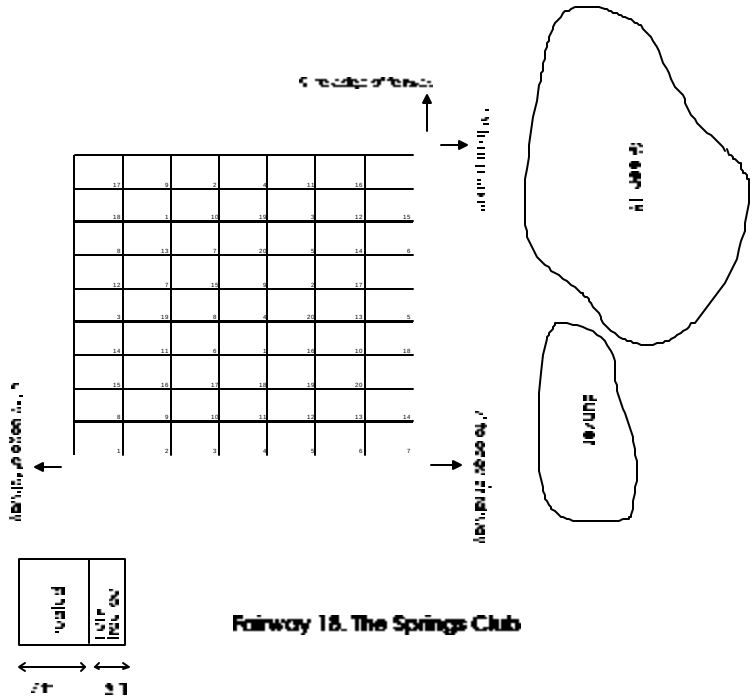
Materials and Methods:

Overseeding, Location and Design: Research plots were located at The Springs Club, Rancho Mirage, CA on Fairway 18, a common Bermudagrass fairway that was overseeded with perennial ryegrass at a rate of 750 lbs/A on October 8, 1997. All golf course fairways (including the test plot area) received two additional overseeding applications on 11/19/97 and 12/17/97, using 125 lb/A perennial ryegrass seed each time. The fairway was renovated via scalping and the use of a chain flail five days prior to overseeding, on October 3, 1997.

Plots measured 10 feet by 10 feet and were replicated three times in a randomized design. The treated area for each plot measured 7 feet by 10 feet, with an untreated strip measuring 3 feet by 10 feet that served as an internal check (Figure 1).

Application: Primo L (0.25 oz/1000 sq ft) was applied to all golf course fairways on September 1, 1997. Experimental Primo (12% trinexepac-ethyl) applications were made on the dates indicated in Table 1 and were applied with a bicycle sprayer equipped with 8008 vs flat fan nozzles and powered by CO_2 to deliver 28 psi at the boom and 1.76 gallons per 1000 sq ft. Calibration of each nozzle was confirmed prior to each application to be within 5% of the desired nozzle flow rate. The boom height was adjusted to 17 inches. The spray swath was 7.2 feet. Speed was monitored using a wheel driven speedometer at 2.0 mph (calibrated to be within 5% of the actual speed). Five gallon stainless steel beverage spray tanks were filled with water to the desired volume using a Great Plains Industries digital flow meter (Wichita, KS) calibrated to deliver volumes within 1% of the digital value displayed on the meter. Tanks were agitated by shaking twenty times prior to charging with compressed CO_2.

Figure 1. Plot plan.



Treatments: Twenty different treatments, selected to evaluate 5 rates of Primo Liquid (0.25, 0.5, 0.75, 1.0 and 2.0 oz/1000 sq ft), 4 different timing strategies (2 weeks before overseeding, one day before overseeding, 1 day and 9 days after the first ryegrass mowing) and single vs. double applications were tested (Table 2).

Evaluations and Statistical Analysis: On each of seven evaluation dates (see Table 1below), turf quality (color, density, uniformity and fineness of turf) was rated for each plot on the basis of a 0 - 7 scale, with 0 = dead turf and 7 = best possible turf quality. The treatments were compared against the non-treated check and against one another using analysis of variance, with treatment means separated using Fisher's LSD, where $P<0.05$ (Table 2).

The design of the trial allowed us to examine the data in greater depth, via factor analysis. Step-wise multiple linear regression analysis was conducted, with factors (rate, timing) added into the regression model if the probability that the partial correlation was due to chance was less than 0.05. A significant ($P<0.05$) positive correlation identified those treatments where rate and timing had a positive effect on turfgrass

quality, while a significant negative correlation indicated that rate and/or timing had a negative impact on turfgrass quality (Table 3).

Results and Discussion:

Overall turf conditions: Due to relatively warm winter temperatures during the course of the trial (Figure 2), Bermudagrass did not enter complete dormancy, and comprised 50% or more of the turf in all treatments throughout the trial.

Turf quality ratings (Tables 2 and 3): Several trends emerge from examination of this data including:

- When applications were timed to occur 1 day after the first ryegrass mowing, Primo applications made at 0.5 and 0.75 oz/1000 sq ft consistently resulted in significantly improved overseeded turfgrass quality. Because the observed turf quality improvements were observed 7 - 8 weeks after Primo applications were made, it is likely that the growth regulator effect of Primo on ryegrass, which typically lasts 4 weeks, only partly contributed to the results. Based on the data, it is probable that Primo applications made at the time of the first mowing caused significant reductions in bermudagrass cover without a similar impact on ryegrass, allowing denser and more vigorous growth of ryegrass in the treated plots.

- Several of the treatments timed 9 days after the first mow also resulted in significant ryegrass quality improvements. However, 1996/97 data indicated that Primo treatments made later in the season might negatively impact bermudagrass transition in the springtime, especially when Primo applications were made when cool temperatures were providing added stress to bermudagrass. Although this effect was not observed in this study, it seems advisable to recommend Primo applications as early in the season as possible, to avoid the chances of negatively affecting bermudagrass quality the following year. For this reason, Primo applications made as close as possible to the time of the first mowing appear to be optimal.

- Factor analysis of the data (Table 3) confirmed the results above, with Primo applications made either 1 day or 9 days after the first mowing the only treatments to demonstrate a positive correlation between rate and turfgrass quality.

- The positive results described above were the result of single applications of Primo made near the time of the first ryegrass mowing. Pre-treatment of the bermudagrass with Primo, either 14 days or 1 day before overseeding did not contribute significantly to improved turfgrass quality ratings. However, applications made to bermudagrass may be advisable as a green waste management tool.

- Single applications of Primo made according to label instructions (1 day before overseeding) produced no positive effects on turfgrass quality, unless they were followed by treatments made to ryegrass at the time of the first mowing, as described above.

- With two years of results indicating that the labeled recommendations for Primo application timing are not optimal under Low Desert conditions, it is worth considering why this may be. We believe that at least two factors are responsible. First, it seems likely that the drastic renovation procedures practiced in the Low Desert, which appear to be unique, even among other courses in the arid Southwest, play an important role in the observed effects. By removing as much bermudagrass biomass as possible prior to overseeding, it is likely that the majority of Primo applied to bermudagrass is actually carried off of the golf course, and therefore has little effect during ryegrass establishment. Secondly, the early overseeding dates (typically in late September and early October) and warm temperatures during ryegrass establishment tend to encourage dramatic re-growth of bermudagrass. In both years of this study, test plots contained at least 50% bermudagrass for the duration of the test. For this reason, Primo applications directed at bermudagrass as it re-grows and competes with ryegrass during the first few weeks of ryegrass establishment should have a significant and positive impact on the transition, as we did in fact observe.

- Turf quality ratings made after 12/19/97 (on 2/12, 4/14, 5/21 and 6/11/98) indicated that there were no differences among treatments.

- Primo applications may exert a negative effect on turf quality, in the form of a lighter, or more yellowed appearance, in the first 2 - 3 weeks after application. This negative effect is heightened as the rate of Primo is increased from 0.25 oz/1000 sq ft to 1.0 oz/1000 sq ft, as indicated by the significant negative correlation (Table 3) between turf quality and rate during and around the time period when Primo applications were being made (see also turf quality ratings in Table 2 for 10/31/97 and 11/15/97). This negative effect, which appears to be reversible, is not the direct effect of phytotoxicity. Instead, the normally senescing turf (especially the lower leaves) simply becomes more obvious in Primo treated turf, due to the desired slow-down in growth of new, green leaves in these plots.

- None of the treatments tested caused any negative effect on the Spring transition from ryegrass to bermudagrass. This is in contrast to results seen in the previous year's study, where applications made in late October, 1996 caused significantly decreased quality ratings of bermudagrass in June of the following year. Cooler air temperatures during late October and early November in the 1996 study (Figure 2) may have interacted with Primo applications made at this time to cause increased stress to bermudagrass which was reflected in a poorer transition the following year. In contrast, air temperatures during this same time period in 1997 were warmer, thus reducing stress on bermudagrass, and allowing a normal transition during the following year. In light of this possible interaction between cool temperatures and Primo applications, it seems advisable to recommend that Primo applications be made as close to the first mowing as possible.

Table 1. Treatment and evaluation schedule.

Date	Event
9/1/97	Primo (0.25 oz/1000 sq ft) applied to all golf course fairways prior to start of trial
9/24/97	Pre-overseeding application of Primo made to appropriate plots
10/3/97	Bermudagrass scalping
10/7/97	One day before overseeding Primo applications made to appropriate plots
10/8/97	Research plots overseeded with perennial ryegrass
10/22/97	First mowing of research plots
10/23/96	First post-mowing application of Primo made to appropriate plots
10/31/97	Second post-mowing application of Primo to appropriate plots; first evaluation date
11/15/97	Second evaluation date
12/19/97	Third evaluation date
2/12/98	Fourth evaluation date
4/14/98	Fifth evaluation date
5/21/987	Sixth evaluation date
6/11/98	Final evaluation date

Figure 2. Minimum and maximum air temperatures from CIMIS Station 50 (Thermal, CA) for October and November, 1996 and 1997. Note cooler temperatures 10/22-11/5/96 vs. the same time period during 1997.

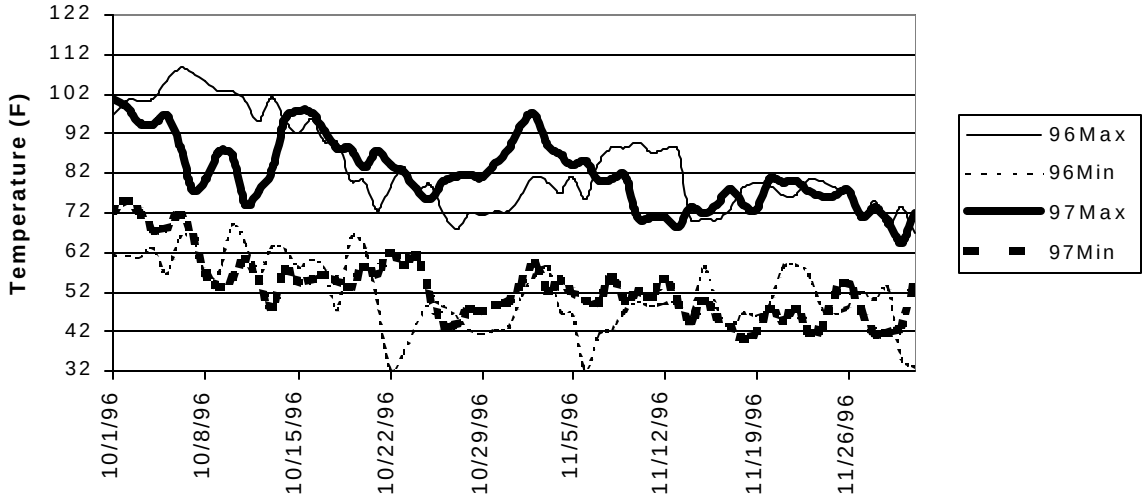


Table 2. Effect of Primo rates and timing strategies on turfgrass quality. Treatments significantly better than the check are highlighted in blue; treatments significantly worse than the check are highlighted in yellow (P<0.05). In evaluations made on 2/12, 4/14, 5/21 and 6/11/98 there were no significant differences among any of the treatments tested.

	Primo rate (oz/1000), 14 d before overseeding (9/24)					1d before overseeding (10/7)		1 d after 1st mow (10/23)				9 d after 1st mow (10/31)								
Trt #	**0.00**	**0.50**	**0.75**	**1.00**	**2.00**	**0.75**	**1.0**	**0.00**	**0.25**	**0.50**	**0.75**	**0.00**	**0.25**	**0.50**	**0.75**	**Mean Quality 10/31/97**		**Mean Quality 11/15/97**		**Mean Quality 12/19/97**	
1	X															6.0	f	6	bcd	6.0	a
2	X									X						5.0	cd	6.7	de	6.5	bcd
3	X													X		6.0	f	5.3	ab	6.2	ab
4		X								X						4.7	bc	7	e	6.7	cde
5		X									X					4.0	a	5.7	abc	6.7	cde
6		X												X		6.0	f	5	a	6.7	cde
7		X													X	6.0	f	5	a	6.8	de
8			X						X							5.7	ef	6.3	cde	6.8	de
9			X							X						5.0	cd	7	e	6.8	de
10			X								X					4.3	ab	7	e	6.8	de
11			X											X		6.0	f	5	a	6.8	de
12				X					X							5.3	de	6.7	de	6.8	de
13				X						X						4.7	bc	6	bcd	6.8	de
14				X							X					4.7	bc	5.7	abc	6.8	de
15				X										X		6.0	f	6.7	de	6.7	cde
16						X										6.0	f	6	bcd	6.3	abc
17						X								X		6.0	f	5.3	ab	7.0	e
18							X							X		6.0	f	6	bcd	6.2	ab
19							X								X	6.0	f	5	a	6.7	cde
20					X											6.0	f	6.3	cde	6.2	ab

Table 3. Significance of Primo rate and application timing for turfgrass quality using factor analysis. Step-wise multiple linear regression analysis was conducted, with factors (rate, timing) added into the regression model if the probability was less than 0.05 that the partial correlation was due to chance. Values in the table below represent the correlation coefficient (top number) and the probability due to chance (bottom number in parentheses) for each factor at each quality rating date. A probability of 0.05 or less indicates that the interaction was statistically significant. A positive correlation coefficient indicates a beneficial interaction among rate, timing, and turfgrass quality; statistically significant positive correlation coefficients are highlighted in green shaded boxes below. A negative correlation coefficient indicates that rate and/or timing had a negative impact on turfgrass quality; significant negative correlations are indicated below in pink shaded boxes.

APPLICATION DATE	APPLICATION TIMING	TURF QUALITY RATINGS		
		10/31/97	11/15/97	12/19/97
9/24//97	2 wks before overseeding (9 d before scalping)	0.019 (0.888)	0.151 (0.253)	0.205 (0.122)
10/7/97	1 day before overseeding	-0.005 (0.973)	-0.157 (0.234)	0.014 (0.918)
10/23/97	1 day after 1st mow (2 wks after overseeding)	-2.256 (0.000)	0.081 (0.542)	0.765 (0.000
10/31/97	9 days after 1st mow (3 wks after overseeding)	-0.0007 (0.956)	-1.757 (0.000)	0.668 (0.000)