

Evaluation of Proxy and Primo for Growth Reduction in Perennial Ryegrass

*D.M. Kopec, D. P. Jensen, S. B. Liddell, J.J. Gilbert, K.B. Marcum
University of Arizona*

Abstract

PROXY (ethephon) and PRIMO (trinexepac-ethyl) were applied to ryegrass (as overseeded turf) in winter and early spring of 1999. PGR effect was assessed as reduction in clipping weight between mowings on eleven harvest dates. From March to April, the greatest percentage reductions were realized from all PGR treatments. Over the entire test period (March 5 to May 15), clipping reduction was rate dependent for PROXY with the 10.0 ounce rate producing a greater PGR effect (less clippings than that of PROXY at the 5.0 ounce rate). PRIMO treated turf (at the highest label rate of 1.0 ounce/product/1000 ft) generally produced the greatest clipping reductions, but lost effect in the middle of May when suppression (broke) was released. PROXY at the 10.0 ounce rate was closer to that of PRIMO for PGR effect than was PROXY at the 5.0 rate. All treatments produced less clippings than that of the control on nine of the eleven harvest events. PRIMO produced on average a noticeably darker color turf than PROXY treated turfs and that of the control plots as well. PROXY treated turf at the 10.0 ounce rate generally had similar overall quality turf when compared to PRIMO treated turf throughout the test. This was due to a high degree of plant uniformity among PROXY treated turf, versus the darker color enhancement realized from PRIMO. No PGR affected the initial stages of spring transition from ryegrass to bermuda by late May 1999.

Introduction

Ethephon (Proxy) and trinexepac-ethyl (Primo) were applied to overseeded bermudagrass to assess plant growth regulator effects on perennial ryegrass (overseed) in the winter and spring of 1999. Growth response was measured as clipping production between mowing events.

Materials and Methods

A 3600 ft² common bermudagrass area was overseeded at the rate of 18 lbs./1000 ft in early October 1998. The turf was mowed twice weekly at 1.5 inches with a rotary mower and irrigated to prevent moisture stress. The treatments were applied on February 26 and again on the same plots on April 9, 1999 using a CO₂ pressure sprayer, with a delivery of 80 gallon per acre (8006 nozzles). Plot size was 5x8 feet. Spray applications were allowed to dry on the turf for a minimum of 15 hours before irrigation.

Ethephon (Proxy) was applied at the rates of 5.0 and 10.0 ounces/product/1000 ft². Trinexepac-ethyl (Primo) was applied at the maximum label rate of 1.0 ounce/product/1000 ft². Each treatment appeared four times in a RCB field design. Data consisted of quantitative growth reduction (by measuring clipping weight production) on eleven harvest dates, and visible responses of turfgrass color, quality, visual suppression and injury when applicable. Data was analyzed using the analysis of variance technique (ANOVA) on SAS software. Least significant difference (LSD)

values were calculated as the treatment mean separation statistic, which can be used for treatment comparison ONLY

when the P value for the main effect for “treatment” in the ANOVA is $P = 0.05$, or less.

Clippings were sampled by first double mowing each end of the plot (width-wise) and then harvesting clippings (from the mower bag) of one length-wise pass of the mower. The mower used was a 22" rotary 2 cycle TORO model. The area harvested was 8.0 square feet. Clippings were then dried in a hot air convection oven for four days at 135EF and weighed. Clippings were taken from three days growth on each of the eleven mowing sample dates. From October 1998 to May 1999 N, P, K fertilizations totaled 4.6, 1.0 and 3.4 lbs/1000 ft², respectively. Treatments were applied on February 26 and again on April 9, 1999.

Results and Discussion

Clipping Reduction

Dry clipping weights are listed in Table 1. Values are in grams dry weight per plot. Values in parenthesis indicate the percentage in clipping reduction of the PGR compared to the untreated controls. Six clipping dates (March 5 through April 9) were sampled to assess the response of the first application while five applications (April 16 through May 15) were sampled to assess response after the second (repeat) applications were made (Table 1).

For the first application series the “treatment effect” was significant at weeks four, five and six (March 26, April 2 and April 9). At weeks one, two and three (March 5, March 13, March 19) the “treatment” P values were 0.26, 0.18 and 0.13, respectively (non-significant treatment effect).

At week one (March 5), all dry clipping weight production was essentially similar, ranging from 3.22 gms/plot for PROXY and 5.0 ounces, to 2.98 gms/plot for PRIMO. The untreated controls produced 3.96 gms/plot. Both PROXY at 10.0 ounces and PRIMO at 1.0 ounce yielded essentially on average 25% yield reduction in clippings (Table 1).

At week two (March 13) dry clipping products ranged from 5.51 gms/plot, to 11.63 gms/plot among treated turfs. PRIMO at 1.0 ounce produced the greatest clipping production (5.51 gms/plot:38% reduction compared to control). For unexplained reasons both PROXY treatments produced greater amounts of clippings than the control at this time (Table 1).

At week three (March 19), PROXY at the 5.0 and 10.0 ounce rate provided 6% and 23% reduction of clippings (6.16 gms/plot and 5.10 gms/plot). The clipping reduction for PRIMO was 45% (3.61 gms/plot).

At four weeks after the first application (March 26), the percent clipping production was 21%, 36% and 53% for PROXY at 5 ounces, 10 ounces and PRIMO at 1.0 ounces, respectively. Clipping production was greatest at this time for the untreated controls. (11.02 gms/plot) (Table 1). This was the first date that the PGR treatment main effect was significant.

At week five (April 2), the average clippings production declined and clipping production ranged from 3.74 gms/plot (PRIMO), to 6.11 gms/plot for the control. PROXY at 10.0 ounces was similar to PRIMO at 1.0 ounces for clipping reduction. These treatments produced 3.84 gms/plot (37% reduction) and 3.74 gms/plot (39% reduction) respectively. PROXY at the 5.0 ounce rate produced 4.18 gms/plot (22% reduction) (Table 1).

At week six (April 9) dry clipping weights ranged from 2.88 gms/plot for PRIMO, to 4.98 gms/plot for the control. PROXY at 5.0 and 10.0 ounce applications produced 3.65 gms/plot (26% reduction) and 3.56 gms/plot (28% reduction) respectively. PRIMO produced a 42% clipping reduction on average (Table 1).

The second application (identical treatments over identical plots) was made on April 9.

At week one after the second application (April 16), dry weight clipping production ranged from 2.44 to 3.21 gms/plot among PGR treated turfs. The untreated control produced 4.39 gms/plot on average. PROXY at 5.0 and 10.0 ounce rates produced dry weight clipping production values of 3.21 gms/plot (27% reduction) and 2.58 gms/plot (41% reduction) respectively. From this point on, PROXY at the repeat 10.0 ounce treatment would be statistically identical to PRIMO at the 1.0 ounce repeat treatment for clipping reduction. This would be true until the last week of May 15 when PRIMO plots released PGR control and produced the largest amount of clippings over and beyond that of the controls.

At week two after the second application (April 23) clipping production ranged from 2.79 to 5.88 gms/plot. PROXY

at 5.0 ounces produced a 26% reduction in clippings. PROXY at 10.0 ounces produced dry weight clippings of 3.68 gms/plot (37% reduction). PRIMO plots yielded on average 2.79 gms/plot (53% clipping reduction).

At week three after the second application (April 27), mean dry clipping weights ranged from 3.40 to 4.43 gms/plot among all treated turfs. The control produced on average 6.86 gms/plot of dry matter as clippings. For PROXY 5.0 ounce, PROXY 10.0 ounce and PRIMO 1.0 ounce treated turfs, the percent clipping reduction was 35%, 37% and 50% respectively.

At week four after the second applications (May 7) all treated turfs yielded similar dry matter clipping production values. PROXY at 5.0 and 10.0 ounces, produced dry clipping values of 4.77 and 4.60 gms/plot respectively. This represents percent reductions in clippings of 20% and 23% respectively. PRIMO at the 1.0 ounce rate produced a 24% reduction in clippings, exhibiting an initial release in growth suppression.

On May 15, clippings were collected for the last time. Dry clipping weights removed from the treated turfs ranged from 6.63 gms/plot (PROXY 10.0 ounce) to 9.10 gms/plot for PRIMO which now produced more clippings than the untreated check plots. The untreated control plots had an average 7.23 gms/plot. At this time the PGR effect was minimal from the second application. Percent reduction in clippings were 2%, 8% and -26% for PROXY at 5.0, 10.0, and PRIMO at 1.0 ounce respectively.

From March to April, the greatest percentage reductions were realized from all PGR treatments. Over the entire test period (March 5 to May 15), clipping reduction was rate dependent for PROXY with the 10.0 ounce rate producing a greater PGR effect (less clippings than that of PROXY at the 5.0 ounce rate). PRIMO treated turf (at the highest label rate of 1.0 ounce/product/1000 ft) generally produced the greatest clipping reductions, but lost affect in the middle of May when suppression (broke) was released. PROXY at the 10.0 ounce rate was closer to that of PRIMO for PGR effect than was PROXY at the 5.0 rate.

Visible Turf Responses

Visual Suppression Scores were assigned to plots on four dates during the test. A scale of 1-6 was used with 1 = no suppression and 6 = severe suppression (as viewed by unmowed canopy height comparisons)(Table 2). On three of these dates (March 16, April 16, April 29) the suppression scores ranked similar to those of actual dry weight clipping production (Table 1 and 2). On May 15 the visual suppression scores of the plots were not related to the ranking for clipping production. This was probably due to “swelling” or “uneven” areas in the canopy which occurred in a gradient across the plots. This did not allow visually rating a uniform plot height. This response was probably due to PGR release which was just beginning at that date. The “treatment” effect in the ANOVA was significant for March 16 only (Table 2). Therefore clipping production is still needed to quantify PGR effect (Tables 1 and 2).

Turfgrass color was assigned to plots on six dates using the NTEP visual rating scale (Table 3). Basically all turf treated with PGR chemicals at the rates tested here produced fully acceptable turfgrass color. PRIMO treated plots did produce the darkest color turfs in general. The standard errors among the control plots and similar response among both PROXY treatments negated a significant treatment effect on all but one evaluation date (April 16). From April 16 to May 15, PGR treated turfs had better overall color (on average) than the untreated control turf. Again only on March 16 was the “PGR treatment” affect in the ANOVA significant (Table 3).

Overall quality scores were assigned to all plots on five dates (Table 4). Basically all PGR treated turfs produced acceptable quality turfs with treatment differences (including control plots) occurring on April 7, April 16 and on April 29. In March and early April, PRIMO plots produced high quality plots primarily due to color enhancement. PROXY treated at the 1.0 ounce rate had similar enhanced quality turf due to plot “evenness” and a high degree of uniformity over the entire plot. On April 16 PROXY plots had better overall quality plots than that of PRIMO due to the “even” looking appearance and high degree of uniformity of PROXY turf treated turfs. (Table 5).

Degree of injury and percent plot injury scores were assigned to plots on April 29 (Table 5). Injury was slightly evident as leaf yellowing among plots. Close inspection revealed tip damage from a dull mower blade. This injury was most noticeable on the PRIMO treated plots in degree of injury (2.3 mean score) and percent plot affected (9%). This was probably most evident from the contrast of leaf tip damage against the darker green background (Table 5).

Percent bermudagrass (0-100%) was assigned to plots on May 28, 1999. Mean percent plot bermuda ranged from 10%-12% among all plots and was not significant (data not shown).

Conclusion

1. As a PGR, assessed via clipping production of mowed perennial ryegrass turf, PROXY (ethephon) produced clipping reductions of 25%-41% compared to untreated control plots.
2. Clipping production (and percent clipping reductions) were greater for PROXY at 10.0 ounce/product/1000 ft. when compared to PROXY at the 5.0 ounce/product/1000 ft. rate.
3. PRIMO applied at the high label rate of 1.0 ounce/product/1000 ft. produced the greatest reduction in clippings for perennial ryegrass turf maintained at 1.5 inches (ranging from 25%-53% reduction in clippings).
4. Of eleven clipping harvest dates, the PGR main effect was significant (at the P = 0.05 level or less), on five of these dates.
5. All treatments produced less clippings than that of the control on nine of the eleven harvest events.
6. At the end of the test on May 15, 1999, PRIMO was producing more clippings than that of the control (upon PGR release).
7. PRIMO produced on average a noticeably darker color turf than PROXY treated turfs and that of the control.
8. PROXY treated turf at the 10.0 ounce rate generally had similar overall quality turf when compared to PRIMO treated turf throughout the test. This was due to a high degree of plant uniformity among PROXY treated turf, versus the darker color enhancement realized from PRIMO.
9. In early and late April 1999, PROXY at the low rate of 5.0 ounce/product/1000 ft² had excellent turfgrass quality due to increased uniformity and smoothness of the plot surface.
10. No PGR affected the initial stages of spring transition from ryegrass to bermuda by late May 1999.
11. All PGR's at timings and rates applied produced acceptable quality turf throughout the test.

Table 1. Mean clipping dry weights¹ of perennial ryegrass after treatment with PROXY and PRIMO plant growth regulators. Winter, spring, 1999. University of Arizona.

CLIPPING DRY WEIGHT ²												
TREATMENT	OZ PROD ³ 1000 FT ²	5 MAR ⁴ (7DAT/1)	13 MAR ⁴ (15DAT/1)	19 MAR ⁴ (21DAT/1)	26 MAR ⁴ (28DAT/1)	2 APR ⁴ (35DAT/1)	9 APR ⁵ (42DAT/2)	16 APR ⁵ (7DAT/2)	23 APR ⁵ (14DAT/2)	27 APR ⁵ (17DAT/2)	7 MAY ⁵ (27DAT/2)	15 MAY ⁵ (35DAT/2)
PROXY	5.0	3.22 (19)	11.63 (-30)	6.16 (6)	8.64 (21)	4.18 (32)	3.65 (26)	3.21 (27)	4.35 (26)	4.43 (35)	4.77 (20)	7.11 (2)
PROXY	10.0	3.02 (24)	9.57 (-7)	5.10 (23)	7.07 (36)	3.84 (37)	3.56 (28)	2.58 (41)	3.68 (37)	4.34 (37)	4.60 (23)	6.63 (8)
PRIMO	1.0	2.98 (25)	5.51 (38)	3.61 (45)	5.22 (53)	3.74 (39)	2.88 (42)	2.44 (44)	2.79 (53)	3.40 (50)	4.51 (24)	9.10 (-26)
CONTROL	---	3.96	8.92	6.58	11.02	6.11	4.98	4.39	5.88	6.86	5.93	7.23
TEST MEAN ⁶		3.29	8.91	5.36	7.98	4.46	3.76	3.15	4.17	4.76	4.93	7.52
LSD VALUE ⁷		1.2	5.7	2.7	3.6	1.6	1.0	1.7	1.0	1.3	3.2	3.1
P VALUE ⁸		P=0.26	P=0.18	P=0.13	P=0.02	P=0.02	P=0.006	P=0.10	P=0.006	P=0.001	P=0.69	P=0.57
P VALUE SIGNIFICANCE ⁹		NS	NS	NS	SIG	SIG	SIG	NS	SIG	SIG	NS	NS

¹Values are the mean of 4 replications, for 3 days growth.

²Values gms/dry weight for 8 square feet of clipping removal as a single linear pass per plot. Mow height of 1.5 inches. Values in parenthesis are percent reduction in clippings compared to untreated controls.

³Ounce of product applied per 1000 ft² of turf.

⁴Date of clipping harvest and number of days after first application date of February 26, 1999.

⁵Date of clipping harvest and number of days after second application date of April 9, 1999.

⁶Mean of all plots and all treatments, included controls.

⁷LSD value = Mean separation statistic. Treatments which differ in values greater than the LSD value are statistically different from each other. Note: Only use when P value is 0.05, or less.

⁸Probability statistic for ANOVA treatment main effect (MS trt/MS error).

⁹Significant main effect for treatments. NS = Nonsignificant. SIG = Significant at 0.05 level, or less.

Table 2. Mean¹ turfgrass visual suppression scores for perennial ryegrass after treatment with PROXY and PRIMO plant regulators. Winter, spring 1999. University of Arizona.

SUPPRESSION SCORES²

TREATMENT	OZ PROD ³ 1000 FT ²	16 MAR ⁴ (18DAT/1)	16 APR ⁵ (7DAT/2)	29 APR ⁵ (19DAT/2)	15 MAY ⁵ (35DAT/2)
PROXY	5.0	1.3	1.8	1.8	2.8
PROXY	10.0	1.8	2.0	2.5	1.5
PRIMO	1.0	3.8	2.8	2.5	2.0
CONTROL	-- --	1.0	1.0	2.0	2.3
TEST MEAN ⁶		2.0	2.1	2.2	2.1
LSD VALUE ⁷		1.9	1.3	1.5	1.0
P VALUE ⁸		P=0.05	P=0.29	P=0.63	P=0.11
P VALUE SIGNIFICANCE ⁹		SIG	NS	NS	NS

¹Values are the mean of 4 replications.

²Visual suppression scores 1-6. 1 = none, 4 = moderate, 6 = severe. Higher values indicate higher relative visual suppression.

³Ounce of product applied per 1000 ft² of turf.

⁴Date of clipping harvest and number of days after first application date of February 26, 1999.

⁵Date of clipping harvest and number of days after second application date of April 9, 1999.

⁶Mean of all plots and all treatments, included controls.

⁷LSD value = Mean separation statistic. Treatments which differ in values greater than the LSD value are statistically different from each other. Note: Only use when P value is 0.05, or less.

⁸Probability statistic for ANOVA treatment main affect (MS trt/MS error).

⁹Significant main affect for treatments. NS = Nonsignificant. SIG = Significant at 0.05 level, or less.

Table 3. Mean¹turfgrass color response of perennial ryegrass after treatment with PROXY and PRIMO plant growth regulators. Winter, spring 1999. University of Arizona.

COLOR SCORES²

TREATMENT	OZ PROD ³ 1000 FT ²	16 MAR ⁴ (18DAT/1)	31 MAR ⁴ (33DAT/1)	7 APR ⁴ (40DAT/1)	16 APR ⁵ (7DAT/2)	29 APR ⁵ (19DAT/2)	15 MAY ⁵ (35DAT/2)
PROXY	5.0	5.0	6.3	6.0	6.0	6.3	6.3
PROXY	10.0	6.0	6.5	6.0	7.0	6.0	7.0
PRIMO	1.0	6.8	7.3	7.3	7.5	7.5	7.5
CONTROL	-- --	6.3	6.0	6.8	5.3	6.3	5.8
TEST MEAN ⁶		6.0	6.5	6.5	6.4	6.5	6.6
LSD VALUE ⁷		1.3	2.0	2.1	1.5	1.8	1.5
P VALUE ⁸		P=0.07	P=0.54	P=0.49	P=0.02	P=0.31	P=0.11
P VALUE SIGNIFICANCE ⁹		NS	NS	NS	SIG	NS	NS

¹Values are the mean of 4 replications.

²Color scores 1-9. 1 = dead, 9 = dark green.

³Ounce of product applied per 1000 ft² of turf.

⁴Date of clipping harvest and number of days after first application date of February 26, 1999.

⁵Date of clipping harvest and number of days after second application date of April 9, 1999.

⁶Mean of all plots and all treatments, included controls.

⁷LSD value = Mean separation statistic. Treatments which differ in values greater than the LSD value are statistically different from each other. Note: Only use when P value is 0.05, or less.

⁸Probability statistic for ANOVA treatment main affect (MS trt/MS error).

⁹Significant main affect for treatments. NS = Nonsignificant. SIG = Significant at 0.05 level, or less.

Table 4. Mean¹turfgrass quality scores of perennial ryegrass after treatment with PROXY and PRIMO plant growth regulators. Winter, spring 1999. University of Arizona.

QUALITY SCORES ²						
TREATMENT	OZ PROD ³ 1000 FT ²	16 MAR ⁴ (18DAT/1)	7 APR ⁴ (40DAT/1)	16 APR ⁵ (7DAT/2)	29 APR ⁵ (19DAT/2)	15 MAY ⁵ (35DAT/2)
PROXY	5.0	6.5	6.5	7.5	7.8	6.5
PROXY	10.0	7.0	7.8	7.3	7.3	7.0
PRIMO	1.0	7.0	7.3	7.0	6.8	7.3
CONTROL	-- --	6.5	6.3	5.8	6.0	6.8
TEST MEAN ⁶		6.8	6.9	6.9	6.9	6.9
LSD VALUE ⁷		1.3	0.6	1.2	0.7	1.2
P VALUE ⁸		P=0.69	P=0.006	P=0.04	P=0.003	P=0.56
P VALUE SIGNIFICANCE ⁹		NS	SIG	SIG	SIG	NS

¹Values are the mean of 4 replications.

²Quality scores 1-9. 1 = dead, 9 = best possible.

³Ounce of product applied per 1000 ft² of turf.

⁴Date of clipping harvest and number of days after first application date of February 26, 1999.

⁵Date of clipping harvest and number of days after second application date of April 9, 1999.

⁶Mean of all plots and all treatments, included controls.

⁷LSD value = Mean separation statistic. Treatments which differ in values greater than the LSD value are statistically different from each other. Note: Only use when P value is 0.05, or less.

⁸Probability statistic for ANOVA treatment main affect (MS trt/MS error).

⁹Significant main affect for treatments. NS = Nonsignificant. SIG = Significant at 0.05 level, or less.

Table 5. Mean¹turfgrass response of uniformity, degree of injury, and percent injury on perennial ryegrass after treatment with PROXY and PRIMO plant growth regulators. Winter, spring 1999. University of Arizona.

TREATMENT	OZ PROD ³ 1000 FT ²	UNIFORMITY ³	DEGREE INJURY ⁴	PERCENT INJURY ⁵
		16 APR ⁶ (7DAT/2)	29 APR ⁶ (19DAT/2)	29 APR ⁶ (19DAT/2)
PROXY	5.0	7.3	1.3	1
PROXY	10.0	6.5	1.8	3
PRIMO	1.0	5.3	2.3	9
CONTROL	-- --	5.5	2.0	5
TEST MEAN ⁷		6.1	1.8	5
LSD VALUE ⁸		1.4	0.8	6
P VALUE ⁹		P=0.03	P=0.12	P=0.10
P VALUE SIGNIFICANCE ¹⁰		SIG	NS	NS

¹Values are the mean of 4 replications.

²Ounce of product applied per 1000 ft² of turf.

³Uniformity 1-9. 1 = dead, 6 = acceptable, 9 = best most uniform surface.

⁴Degree injury 1-6. 1 = none, 3 = slight/moderate, 4 = moderate, 6 = severe.

⁵Percent plot injury 0-100% of plot surface showing response.

⁶Date of evaluation and number of days after second application made on April 9, 1999.

⁷Mean of all plots, including controls.

⁸LSD value = Mean separation statistic. Treatments which differ in values greater than the LSD value are statistically different from each other. Note: Only use when P value is 0.05, or less.

⁹Probability statistic for ANOVA treatment main affect (MS trt/MS error).

¹⁰Significant main affect for treatments. NS = Nonsignificant. SIG = Significant at 0.05 level, or less.