

# Ethephon Potential for Spring Transition of Perennial Ryegrass Back to Common Bermudagrass

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## **Abstract**

*Spring transition of ryegrass back to the underlying bermudagrass has become problematic for turfgrass managers in the Southwest. This is in part do to increased heat tolerance and shoot densities of newer ryegrass cultivars which predominate the market place. The chemical ethephon (Proxy for turf) was evaluated for use as a plant growth regulator (PGR) to enhance transition from perennial ryegrass to bermudagrass. Proxy was applied at either 5 or 10 ounce rates/1000 square ft, either before, during or after soil moisture stress was imposed on the overseeded turf. On the dates of July 6, 21, 19 and August 9 the greatest visible difference occurred among treatments for percent bermudagrass. These responses were not statistically significant, however. The greatest transition response was achieved (in general) from Proxy applied at 10 the ounce rate, when applied "pre-stress". This treatment combination generally ranked highest for percent bermudagrass throughout the test. The second most beneficial treatment (in general) was that of Proxy at the 10 ounce rate when applied under "medium stress". From July 21 to August 9 this treatment essentially ranked second for the ryegrass to bermudagrass transition. The third most beneficial treatment (in general) was Proxy applied at the 10 ounce rate, applied "post stress". This treatment was applied the latest in the season ( June 16), which was 22 days after the entire test was fully irrigated (at the start of the test on May 23). Proxy applied "post stress" at the 10 ounce rate excelled in enhancing the ryegrass to bermudagrass transition from July 21 to July 29. When applied at either the 5 or 10 ounce product rates, the "low stress" application treatments had minimal affect for transition. These treatments ranked similar in response to that of the untreated - well watered controls. The "medium" stress plots receiving Proxy exhibited a greater affect on the ryegrass to bermuda transition, depending on the date of bermudagrass evaluation. Further testing should be conducted on lower mowed perennial ryegrass with a more aggressive underlying bermudagrass base, such as the popular Tifway 419.*

## **Introduction**

Each year in the Southern United States, bermudagrass turf (Cynodon spp.) is overseeded with cool season turf grasses in order to provide a year round green surface through late fall and into spring. During this period, the bermudagrass would otherwise be in a dormant condition. Overseeding is practiced on residential, commercial and sports turf surfaces. The most common overseed cool season grass used for overseeding is that of perennial ryegrass (Lolium perenne L.), hereafter referred to as PR.

With the advent and widespread use of improved turf-type perennial ryegrass, spring transition has become and

continues to be an extremely difficult cultural management problem. This is in part due to the improvement in heat tolerance, mowing tolerance (height of cut and frequency) and increased shoot density of PR for turf. Many of the standard cultural management practices which were employed in the past as field operations to enhance transition no longer produce anticipated or predictable transitions. Turf managers are often faced with either (1) prolonged transitions, (2) long term stands of PR turf, (3) sudden and abrupt loss of turf cover, and (4) poor regrowth of the bermudagrass into these areas.

A field test was devised and conducted to evaluate the use of ethephon (ethe) as a transition inducing agent. The biological premise is that the production of ethylene in ryegrass (triggered by ethephon) will cause an ethylene growth response, and thus result in a decreased ability for Proxy treated ryegrass compete with the desirable bermudagrass. Ethephon (trade name PROXY) should be more active on PR than bermudagrass at equivalent rates and therefore serve as a potential PGR for transition management.

## **Materials and Methods**

A five year old stand of "Arizona common" bermudagrass was overseeded for the fourth successive year in mid October, 1998 at the rate of 18 lbs. PLS/1000 ft<sup>2</sup>. The turf was mowed 2 times weekly with a rotary mower at a height of 1.5 inches. Clippings were removed by bagging. The turf received 4.6 lbs. of N, 1.0 lbs. of P, and 3.4 lbs. of K per thousand square feet from October to May 1999. Additional fertilizer was added as 3.75 lb N, 1.2 lbs P, and 2.6 lbs K from June 17 to August 25, 1999. (transition period). The turf was irrigated from emergence up until the beginning of the test to avoid stress. This was achieved by applying 90% of the modified Penman Reference Evaporative demand calculated from an on site weather station.

Proxy treatments were devised to evaluate the affects of application timing and rate for ryegrass to bermudagrass transition. Timing applications included a "pre-stress" sequence, two independent levels of stress ("light stress" and "moderate stress") and applications made "post stress." Rates included Proxy at 5 and 10 ounces of product/1000 ft<sup>2</sup>, applied at each "stress" level. Thus, a total of eight Proxy treatments were deployed.

Stress was imposed by first heavily watering the field to saturation for two days (May 23 and 24), followed by withholding subsequent irrigation. The two "low-stress treatments" and two "medium stress treatments" were applied during the dry down phase (in progressive levels of greater stress, depending on the desired stress level). Following this, the two "post stress treatments" were applied after the plots (1) showed visible signs of moderate stress and were (2) re-watered for 2-3 days. Plots were monitored for visual wilting using a progressive scale of 1-6 with 1 = none, 4 = moderate, and 6 = severe wilting. Plots were also monitored for soil moisture content in the first 10 days following the initial full irrigation using the TDR technique. After that, soil hardness prevented further use of the TDR unit.

Infra-red thermometry was used on several dates in an attempt to help quantify stress levels of PR. Data was recorded as the absolute canopy temperature and as the [canopy minus air temperature] of the turf. An Everest hand held IRT was used to record six measurements per plot, which were averaged for a plot mean.

Treatments applied during the "stress" (light or moderate) and "post stress" periods were monitored daily on an individual plot basis for stress level determination after treatments were applied. This insured that re-irrigation of the plots occurred at the proper stress level(s) and not before or after it occurred. Plots were irrigated with a hose to remove stress at the appropriate time and to return them to a well watered regime afterwards. Only until after the "post stress" treatments were applied, was the entire test area again irrigated entirely with the sprinkler system.

Plot size was 4' x 5'. Proxy was applied at either the 5 or 10 ounce product rate using a hand held Co<sub>2</sub> pressure boom equipped with three 8006 nozzles at 20" spacings. The final solution delivery was 95-97 gallons per acre (2.18 gallons/1000 ft<sup>2</sup>). Proxy dried on the leaves and was not watered in.

Percent bermudagrass, turfgrass color, and percent plot cover values were visually assessed and scored for each plot from June 22 to August 23, 1999. Stress (canopy and soil) measurements as described earlier were taken on applicable dates from June 6 to June 16, 1999. These measurements were made just prior to the "moderate" stress applications, and afterwards to quantify the stress levels after treatments were applied (treatments 3-4-5-6) and to initiate the proper level of stress before the "post stress" applications were made (for treatments 7-8). An untreated -

well watered control was also included for comparison of treatments (treatment 9). The control was hand watered throughout the test and evaluation period. *For complete details of field scheduling events see Table 1.*

All data was subjected to the analysis of variance technique using SAS software. LSD values were used as the mean separation statistic. Simple polynomial contrasts were used to test the significance of affect for pre-planned logical treatment comparisons. These contrasts are discussed in the text, where and when applicable. Simple correlation coefficients were used to investigate treatment relationships between plant and soil responses, and to possibly elucidate any relationships between these responses and the percent bermudagrass measured later on in the summer.

## Results and Discussion

The number of days from the respective Proxy application to the re-start of irrigation is provided in Table 1. Data demonstrates that applying Proxy “before stress” (incited by natural soil moisture depletion) prolonged the number of days required to reach a visible stress level which then mandated re-irrigation (alleviation of stress). Proxy applied “before stress” allowed ryegrass to sustain atmospheric and soil drought longer than the Proxy ryegrass treated 10 and 13 days later (“light stress” and “moderate stress” treatments, respectively) after the full initial irrigation (Table 1).

The fact that treatments 3-4 (“slight stress”) and 5-6 (“moderate stress”) were applied at 10 and 13 days into the non-irrigated period demonstrates the ability of perennial ryegrass (mowed at 1.5 inch) to sustain itself as an affective ground cover, before exhibiting a stressed turf condition. Soil volumetric contents (not shown) were low in all plots, (except the irrigated-only control). The TDR could not be inserted in plots after 16 days without irrigation. Thus, TDR measurements were discontinued.

Percent bermudagrass was evaluated on all plots on the dates of June 22, July 6, 21, 29, August 9 and 24. On all dates the overall treatment effect did not produce a significant F value (Table 2).

On June 22, mean percent bermudagrass ranged from 9% to 13%. The contrast of “5 ounces pre” versus “5 ounces post/moderate” was significant at  $P = 0.07$ . This contrast compared treatments 1 with 7, which had mean bermudagrass scores of 12% and 9%, respectively. This difference was not biologically significant for early transition (Table 2).

Percent plot bermudagrass on July 6 ranged from 22% to 36%. Proxy “pre-stress” turf treated at 10 ounces had the largest average amount of bermudagrass (36%), followed by Proxy “pre-stress” at 5 ounces (28%). All other treatments ranged from 22 to 26%. The control had 24% bermudagrass at this time (Table 2).

On July 6 the following contrasts were significant for the grouped comparisons of :

1. *5 pre vs. 10 pre* (trt 1 = 28% : trt 2 = 36%)
2. *5 pre vs. 5 post/medium* (trt 1 = 28% : trt 7 = 22%)
3. *All pre vs. all post* (trt 1, 2 = 32% : trt 7, 8 = 25%)
4. *All 5 vs. all 10* (trt 1,3,5 7 = 25% : trt 2,4,6,8 = 27%) Again, the “pre-stress” applied Proxy at 10 ounces provided the major response here, which merely ‘carried’ the contrast.

On July 21, there was a greater range in percent plot bermudagrass. Treatment means ranged from 24% to 49% bermudagrass cover. Proxy applied as a “pre-stress” treatment produced a 25% difference in bermudagrass transition between the 5 and 10 ounce application rates. When applied at the 5 ounce rate, only 24% bermudagrass cover was realized. The same application timing, when applied at the 10 ounce rate, produced 49% mean bermudagrass cover. No contrasts were significant for treatments on July 21. The untreated well watered control had 28% mean bermudagrass (Table 2, Figures 1 & 2).

On July 29, mean percent bermudagrass ranged from 51% to 74% cover bermudagrass (31% range within raw field data). Again, Proxy applied “pre-stress” at the 10 ounce rate had the greatest percent bermudagrass (74%), followed closely by the same 10 ounce rate applied in “post stress” sequence (72%). (Table 2, Figures 1&2).

The following contrasts for 29 July showed significance at  $P = 0.09$ :

1. *Light stress avg. vs. moderate stress avg.* (Trt 3, 4 = 64% : trt 5, 6 = 70%)

2. *All pre-stress vs. check (Trt 1, 2 = 67% : Trt 9 = 56%)*

On August 9, mean treatment values ranged from 91% to 97% bermudagrass. Although non-significant statistically, it is interesting that the “pre-stress” applications are opposed in rank for percent bermudagrass, according to rate (10 ounce pre = most bermuda = 5 ounce pre = essentially tied for the least amount of bermuda). Again the range was small and the treatment main affect was not statistically significant.

At the close of the test on August 24, 1999, all plots had 97% or greater bermudagrass. Values are listed in Table 2 for observational purposes. (Table 2, Figures 1 & 2).

General Trends:

On the dates of July 6, 21, 29 and August 9 the greatest visible difference occurred among treatments for percent bermudagrass. This again was not statistically significant, however.

The greatest transition response was achieved (in general) from Proxy at 10 ounce, applied “pre-stress” (Table 2). This treatment generally ranked first throughout the test for percent bermudagrass. Rankings in Table 2 are noted in (*parenthesis*), after the value for percent bermudagrass.

Proxy applied at 5 ounce, “pre-stress” had minimal affect.

The second most beneficial treatment (in general) was that of Proxy at 10 ounce applied “medium stress”. This treatment essentially ranked second in affect for bermudagrass transition.

The third most beneficial treatment (in general) was that of Proxy at 10 ounce, “post stress”. This treatment was applied the latest in the season (on June 16), which was 22 days from the full field irrigation at the start of the test on May 23. This treatment excelled in enhancing bermudagrass transition by 39% from July 21 to July 29, second only to the 10 ounce rate applied “low-stress” at a 40% increase in bermuda.

At either the 5 or 10 ounce product rates, the “low stress” application treatments had minimal affect, and they ranked very closely to that of the controls throughout the test period. The “medium” stress plots showed a greater affect on transition, depending on the date of bermudagrass evaluation.

Quantifying Stress

As previously described, canopy temperatures, soil moisture content using TDR, and visual wilt scores were taken throughout the period to assess the response of the turf both prior to and after Proxy applications for stress level assessment and re-irrigation purposes (relief of stress).

TDR sampled soil moisture values were related on only some dates to canopy temperatures and not on other dates. This could possibly be explained by mechanisms that cause elevated canopy temperatures at initial decreases in soil moisture content, which then remain high over a steadily decreasing range of lower soil moisture content values. This is a normal response, and would therefore require use of a specific crop water stress model (CWSI) or critical point model for turf. The University of Arizona has successfully developed and published a CWSI model for bermudagrass turf, but not for perennial ryegrass or a mixed sward of both grasses.

It would be desirable to account for the number of days after irrigation that treatments are applied (to adjust for stress), or of greater importance, to adjust treatment affects (for percent bermudagrass) based on the time interval between the Proxy application and the number of days until re-irrigation began. While this would not affect the overall outcome (percent bermudagrass transition) it would be of interest to elucidate the speed and type of response of ryegrass to Proxy.

On selected dates and treatment combinations, certain positive correlations existed for such variables as the number of days between treatment application, the number of days from treatment application until the re-wetting of the plots, and visual wilt scores. This data should be explored further, as it was not conclusive from this test. Likewise, a set of “stressed controls” would be desirable to include, but this would have required 12 more plots. This was not possible in 1999. A well watered control as a replicated treatment was included in this test.

Based on our initial results in 1999 using Proxy at 5 and 10 ounce rates (on 1.5 inch mowed perennial ryegrass/common bermudagrass turf), the 10 ounce rates produced greater transition. Combination treatments of

Proxy at 10 ounces, applied both “pre-stress” and “post stress”, should be tested against Proxy at 10 ounces applied at both the “medium stress” and “ post stress” levels. Both of these suggested treatments equal a 20 ounce total use rate.

Further testing should be conducted on lower mowed perennial ryegrass with a more aggressive underlying bermudagrass base, such as the popular Tifway 419.

## Conclusions

1. On the dates of July 6, 21, 29 and August 9 the greatest visible difference occurred among treatments for percent bermudagrass. This again was not statistically significant, however. The greatest transition response was achieved (in general) from Proxy as a 10 ounce, “pre-stress” application (Table 2, Figures 1 & 2). This treatment generally ranked first throughout the test for percent bermudagrass. Treatment rankings in the Table 2 are noted in parenthesis, after the value for percent bermudagrass.
2. The second most beneficial treatment (in general) was that of Proxy at 10 ounces - “medium stress”. From July 21 to August 9 it essentially ranked second in affect for the ryegrass to bermudagrass transition.
3. The third most beneficial treatment (in general) was that of Proxy at 10 ounce, “post stress”. This treatment was applied the latest in the season (on June 16), which was 22 days from the full field irrigation at the start of the test on May 23. This treatment excelled in enhancing bermudagrass transition from July 21 to July 29.
4. At either the 5 or 10 ounce product rates, the “low stress” application treatments had minimal affect, and they ranked very closely to that of the controls throughout the test period. The “medium” stress plots showed a greater affect on transition, depending on the date of bermudagrass evaluation.
5. Further testing should be conducted on lower mowed perennial ryegrass with a more aggressive underlying bermudagrass base, such as the popular Tifway 419.

Table 1. Activity dates for evaluating Proxy for spring transition of perennial ryegrass overseed back to perennial ryegrass. University of Arizona, 1999.

TRT	RATE <sup>1</sup> PROXY	TIMING <sup>2</sup>	APPLICATION DATE	PROXY APPLIED <sup>3</sup> # DAYS SINCE INT. FULL IRRIGATION	MEAN # DAYS <sup>4</sup> FROM PROXY TRT TO RE-IRRIGATION
1	5	Pre-Stress	25 May	1	18.2
2	10	Pre-Stress	25 May	1	18.7
3	5	Stress-Low	04 June	10	6.7
4	10	Stress-Low	04 June	10	7.2
5	5	Stress-Med	07 June	13	5.0
6	10	Stress-Med	07 June	13	4.7
7	5	Post-Stress	16 June	22	N.A.
8	10	Post-Stress	16 June	22	N.A.
9	--	Control	--	0	N.A.
LSD Value <sup>6</sup> for mean # days from Proxy Application to Re-Irrigation					2.0

<sup>1</sup>Proxy applied in ounces product per 1000 ft<sup>2</sup>.

<sup>2</sup>Application timing: Pre = no stress imposed, applied 2 days after full irrigation; Low = applied 10 days after full irrigation; Med = applied 13 days after full irrigation; Post = applied after stress imposed 24 days after full irrigation; Control = well watered continuously.

<sup>3</sup>Number of days respective treatments applied since entire area was fully irrigated on May 23, 1999.

<sup>4</sup>Mean number of days each treatment required at the respective stress - times level from treatment application date to re-irrigation. Post-Stress treatments applied after stress was employed, after re-irrigation.

<sup>5</sup>LSD value = mean separation statistic. Treatment means which differ by a numerical value greater than the LSD value are statistically different treatments from each other.

Table 2. Mean percent bermudagrass of overseeded turf following applications of Proxy. University of Arizona, 1999.

PERCENT BERMUDAGRASS<sup>3</sup> AND (NUMERICAL RANK)<sup>4</sup>

TRT	RATE <sup>1</sup> PROXY	TIMING <sup>2</sup>	APPLICATION DATE	22 JUNE	6 JULY	21 JULY	29 JULY	9 AUG	24 AUG
1	5	Pre-Stress	25 May	12 (2)	28 (2)	24 (8)	60 (5)	92 (6)	97 (3)
2	10	Pre-Stress	25 May	13 (1)	36 (1)	49 (1)	74 (1)	97 (1)	98 (2)
3	5	Stress-Low	04 June	12 (2)	26 (3)	36 (3)	60 (5)	91 (7)	98 (2)
4	10	Stress-Low	04 June	12 (2)	25 (5)	29 (6)	69 (4)	92 (6)	98 (2)
5	5	Stress-Med	07 June	12 (2)	22 (7)	35 (4)	69 (4)	93 (4)	99 (1)
6	10	Stress-Med	07 June	10 (3)	24 (6)	45 (2)	72 (3)	96 (2)	98 (2)
7	5	Post-Stress	16 June	9 (4)	26 (3)	29 (6)	51 (7)	92 (6)	98 (2)
8	10	Post-Stress	16 June	12 (2)	25 (4)	34 (5)	73 (2)	95 (3)	98 (2)
9	--	Control	--	12 (2)	24 (6)	28 (7)	56 (6)	93 (5)	98 (2)
TEST MEAN <sup>5</sup>				11	26	34	65	93	98
LSD VALUE <sup>6</sup>				N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

<sup>1</sup>Proxy applied in ounces product per 1000 ft<sup>2</sup>.

<sup>2</sup>Application timing: Pre = no stress imposed, applied 2 days after full irrigation; Low = applied 10 days after full irrigation; Med = applied 13 days after full irrigation; Post = applied after stress imposed, 24 days after full irrigation; Control = well watered continuously.

<sup>3</sup>Percent bermudagrass in plot (0-100%). Values are the mean of four replications.

<sup>4</sup>Numerical rank of % bermudagrass. Rank does not imply significance of response.

<sup>5</sup>Mean of all treated and control plots on that date.

<sup>6</sup>LSD value. Mean separation statistic. N.A. = not applicable if F value for treatments is non-significant, P = 0.05 or less.