Precision Growth Regulation for Athletic Fields

Doug Soldat, Ph.D., Nick Bero MSc.

Dept. of Soil Science University of Wisconsin-Madison

djsoldat@wisc.edu

**Objective:** The objective of this study was to evaluate the turfgrass growth and visual quality of a Kentucky bluegrass athletic field treated with a variety of precision growth regulators (PGRs) and placed under intense simulated traffic.

**Materials and Methods:** This study was conducted at the O.J. Noer Turfgrass Facility in Madison. A randomized complete block design was used with nine treatments (listed in Table 1) and three replications. Plots were split into two traffic regimes, no traffic and traffic. Individual plots measured 4 x 4 feet. The study site was on Kentucky bluegrass (2.25 inch mowing height). PGR treatments were applied using a CO2-powered backpack sprayer calibrated to deliver 86 gallons per acre. Applications were begun on 1 June 2020 and reapplications were made based on growing degree day models from the GreenKeeper App. Products were watered in (or not) according to the label instructions.

Turfgrass visual quality was assessed using the NTEP standard 1-9 scale where 1 is dead or completely brown turf, 6 represents minimal acceptability, and 9 is associated with highest possible turfgrass quality. Turfgrass reflectance and color (NDRE) was assessed by a Holland Scientific CS-45 color reflectance meter. Clippings were collected approximately every two weeks, dried, and massed to determine the degree of growth regulation. Traffic was applied by a Brinkman traffic simulator which simulated three NFL games a week. Treatment means were separated using Fisher’s Least Significant Difference at alpha = 0.05.

**Table 1**. Treatments and application rates for the products used in the trial.

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment Description** | **Application Rate** | **Reapplication Interval** | **Applications Made** |
|  | oz per 1000 sq. ft. | GDD base 0 ℃ |  |
| Primo Low | 0.25 | 280 | 9 |
| Primo High | 0.75 | 353 | 8 |
| Trimmit 2SC Low | 0.5 | 300 | 9 |
| Trimmit 2SC High | 0.75 | 300 | 9 |
| Cutless Low | 0.55 | 300 | 9 |
| Cutless High | 1.1 | 300 | 9 |
| Aneuw Low | 0.3 (g) | 294 | 9 |
| Aneuw High | 0.6 (g) | 333 | 8 |
| Control | n/a | n/a | n/a |

**Results:** Table 2 summarizes the season-long averages of turfgrass quality, color, clipping yield, density, and crabgrass as affected by traffic and PGR treatment. Interestingly, for the non-treated control, we noticed higher turfgrass quality under traffic, than with no traffic. This can be partly attributed to the effect of traffic on reducing crabgrass. The greatest turfgrass quality was associated with the non-treated control and the Anuew treatment at the high label rate. These two treatments, along with Primo Maxx at the low label rate had the greatest color over the season as well. However, we found that the Anuew (high) and Primo Maxx (low) treatments produced over three times less clippings per mowing than the non-treated control (20 g/plot vs ~ 6 g/plot). This observation suggests that these two products can be used to maintain high quality turfgrass with substantially fewer clippings under intense traffic. The high rates of Anuew and Primo Maxx resulted in significantly greater tiller density at the end of the study. The low label rates for these two products had statistically similar density as the control treatment.

*Turfgrass Quality:* Upon inspection of Figure 1, the PGR treatments under traffic fell into three distinct groups for turfgrass quality. The previously mentioned top group included the control, Primo (low), and Anuew. The middle group (worse quality than the control) included Primo (high) and Cutless (low), and the bottom group for turfgrass quality included Trimmit and Cutless (high). These results suggest that Trimmit and Cutless and high rates of Primo Maxx may result in a significant decline in visual turfgrass quality when applied at the frequencies used in this study under traffic. Similar trends held for the non-trafficked plots, although the distinctions between the groupings was less clear (Figure 1). Data for turfgrass visual quality for each individual rating date is reported in Table 3.

*Turfgrass Color (NDRE):* Turfgrass NDRE is approximated by color, but is also an indication of healthy vegetation. Typically, turfgrass quality and NDRE results track together and that was case for this study as well. Figure 2 shows the NDRE trends over the season. For the trafficked plots, the top NDRE scores came from plots treated with Anuew, Primo Maxx, and the non-treated control. The Trimmit and Cutless treatments grouped together with the high rate of Trimmit producing very low NDRE, indicating that the turf was unhealthy. Individual scores and statistics are shown in Table 4.

Clipping Yield: PGRs are tools for reducing clipping yield and potentially mowing requirements. Figure 3 shows that all of the PGRs performed well for this criteria. It is interesting to note how much more growth reduction was achieved when the plots were under traffic. This suggests that one must be careful not to over-regulate the turf when heavy traffic is occurring. The Primo, Anuew, and low rate of Cutless reduced growth the least in the non-traffic plots, but still ranged between 50-75% reduction. The Trimmit and high rate of Cutless treatments reduced growth by a factor of about 6 in the no traffic scenario. However, under traffic, the Trimmit, Cutless, and Primo (high) treatments reduced growth by closer to 90%. The Anuew and Primo (low) treatments showed very strong reductions in yield, but were the least aggressive. It is not a conincidence that these three treatments resulted in the healthiest grass. When using PGRs, it is important to non over-regulate the turf, and this research has shown that the amount of growth regulation is related to the traffic level. Yield data and statistics from individual collection dates are shown in Table 5.

*Conclusion:* For Kentucky bluegrass athletic fields under traffic, using Anuew at any rate or Primo Maxx at the low label rate can maintain or increase visual turfgrass quality and color while substantially reducing clipping production. Use of Trimmit or Cutless or the high rate of Primo Maxx resulted in excessive yield reduction and decreases in turfgrass quality and color. For non-trafficked areas these same trends held, but Primo Maxx and Cutless at the low label rate also appeared to be effective tools.

**Table 2.** Average Quality, Color, and clipping mass through the study period. Different letters indicate statistically significant differences (p = 0.05).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Quality** | **Color (NDRE)** | **Clipping Mass** | **Density** | **Crabgrass** |
|  | 1-9, 9 is best | 0-1, 1 is greenest | g/plot | Tillers/3 in2 | % |
| **No Traffic** |  |  |  |  |  |
| Primo Low | 5.94 cd | 0.388 ab | 16.6 bc | No data | 14.7 ab |
| Primo High | 4.61 e | 0.358 defg | 9.0 def | No data | 26.7 a |
| Trimmit 2SC Low | 4.30 ef | 0.340 fgh | 10.4 cdef | No data | 4.0 b |
| Trimmit 2SC High | 3.89 f | 0.334 h | 9.4 cde | No data | 2.3 b |
| Cutless Low | 5.50 d | 0.364 cde | 12.6 def | No data | 8.3 ab |
| Cutless High | 4.61 e | 0.346 efgh | 8.1 bc | No data | 2.0 b |
| Aneuw Low | 5.75 d | 0.381 abc | 17.1 cd | No data | 13.3 ab |
| Aneuw High | 5.86 cd | 0.375 bcd | 12.8 a | No data | 2.7 b |
| Control | 5.94 cd | 0.375 bcd | 33.0 def | No data | 25.0 a |
| **Traffic** |  |  |  |  |  |
| Primo Low | 6.50 bc | 0.401 a | 6.3 f | 52 bc | 4.0 b |
| Primo High | 5.56 d | 0.372 bcd | 4.3 def | 66 ab | 1.3 b |
| Trimmit 2SC Low | 4.25 ef | 0.360 cdef | 6.3 def | 73 ab | 0 b |
| Trimmit 2SC High | 3.92 f | 0.336 gh | 5.8 def | 76 ab | 0.3 b |
| Cutless Low | 5.47 d | 0.360 cdef | 5.0 f | 51 bc | 1.0 b |
| Cutless High | 4.72 e | 0.355 defgh | 5.6 ef | 80 a | 0 b |
| Aneuw Low | 6.67 b | 0.391 ab | 5.9 def | 53 bc | 1.3 b |
| Aneuw High | 6.72 ab | 0.401 a | 5.7 ef | 66 ab | 0 b |
| Control | 7.36 a | 0.403 a | 20.2 b | 37 c | 0 b |

**Table 3.** Visual estimate of turfgrass quality at each rating date during the study. Different letters indicate statistically significant differences (p = 0.05) \* - initial application date

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **6/1\*** | **6/15** | **6/28** | **7/14** | **7/28** | **8/10** |
|  | ------------------------ 1-9, 1 is death 9 is best ------------------------ |
| **No Traffic** |  |  |  |  |  |  |
| Primo Low | 7.7 a | 7.0 ab | 5.7 cd | 4.7 cde | 6.3 ab | 5.7 bcd |
| Primo High | 7.7 a | 6.7 abc | 5.0 de | 3.0 f | 3.0 f | 4.3 def |
| Trimmit 2SC Low | 7.3 a | 7.0 ab | 5.7 cd | 3.7 ef | 3.7 ef | 3.7 ef |
| Trimmit 2SC High | 7.3 a | 7.3 a | 5.7 cd | 3.7 ef | 3.0 f | 3.0 f |
| Cutless Low | 7.3 a | 7.0 ab | 6.7 ab | 5.0 bcd | 5.0 cd | 5.3 bcd |
| Cutless High | 7.3 a | 7.0 ab | 5.7 cd | 3.7 ef | 3.7 ef | 3.7 ef |
| Aneuw Low | 7.3 a | 7.0 ab | 6.0 bc | 5.3 abc | 6.0 bc | 5.7 bcd |
| Aneuw High | 7.7 a | 6.0 c | 4.7 ef | 3.3 f | 5.7 bcd | 5.3 bcd |
| **Traffic** |  |  |  |  |  |  |
| Control | 7.3 a | 6.7 abc | 7.0 a | 6.3 a | 6.3 ab | 4.7 cde |
| Primo Low | 7.7 a | 6.0 c | 4.3 ef | 3.7 ef | 6.3 ab | 6.3 ab |
| Primo High | 7.7 a | 6.7 abc | 4.0 ef | 3.0 f | 5.0 cd | 6.0 abc |
| Trimmit 2SC Low | 7.3 a | 6.3 bc | 4.7 ef | 3.0 f | 3.3 f | 3.7 ef |
| Trimmit 2SC High | 7.3 a | 6.7 abc | 4.7 ef | 3.0 f | 3.3 f | 3.3 ef |
| Cutless Low | 7.3 a | 6.0 c | 5.0 de | 4.0 def | 5.7 bcd | 5.7 bcd |
| Cutless High | 7.3 a  | 6.3 bc | 4.3 ef | 3.7 ef | 4.7 de | 5.3 bcd |
| Aneuw Low | 7.3 a | 6.3 bc | 4.7 ef | 5.0 bcd | 6.7 ab | 7.3 a |
| Aneuw High | 7.7 a | 6.0 c | 4.0 f | 3.7 ef | 7.3 a | 6.7 ab |
| Control | 7.3 a | 7.3 a | 6.3 a | 6.0 ab | 7.3 a | 7.3 a |

**Table 3 (cont.)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **8/24** | **9/2** | **9/14** | **9/29** | **10/6** | **10/29** |
|  | ------------------------ 1-9, 1 is death 9 is best ------------------------ |
| **No Traffic** |  |  |  |  |  |  |
| Primo Low | 4.7 cde | 5.0 cd | 5.3 cde | 6.3 bcd | 6.0 abcd | 7.0 abc |
| Primo High | 3.7 ef | 3.7 def | 4.3 de | 5.3 def | 4.3 def | 4.3 fgh |
| Trimmit 2SC Low | 3.3 ef | 3.7 def | 4.0 de | 3.3 g | 3.7 ef | 2.7 i |
| Trimmit 2SC High | 2.7 f | 2.0 f | 3.3 e | 3.0 g | 2.7 f | 3.0 hi |
| Cutless Low | 5.0 bcde | 4.7 cde | 4.7 de | 6.3 bcd | 5.0 cde | 4.0 ghi |
| Cutless High | 4.0 def | 4.7 cde | 4.3 de | 4.7 defg | 3.7 ef | 3.0 hi |
| Aneuw Low | 5.0 bcde | 5.0 cd | 5.0 de | 5.7 cde | 5.7 bcd | 5.3 defg |
| Aneuw High | 5.7 bcd | 6.0 abc | 5.7 bcd | 7.3 abc | 7.0 ab | 6.0 bcde |
| Control | 4.7 cde | 5.3 bcd | 5.3 cde | 6.3 bcd | 5.7bcd | 5.7 cdef |
| **Traffic** |  |  |  |  |  |  |
| Primo Low | 7.0 ab | 6.3 abc | 7.7 ab | 7.7 ab | 7.3 ab | 7.7 a |
| Primo High | 6.7 ab | 5.3 bcd | 6.0 abcd | 6.3 bcd | 5.0 cde | 5.0 efg |
| Trimmit 2SC Low | 4.3 def | 3.7 def | 4.7 de | 3.7 fg | 3.3 ef | 3.0 hi |
| Trimmit 2SC High | 3.3 ef | 2.7 ef | 4.0 de | 3.3 g | 2.7 f | 2.7i |
| Cutless Low | 6.3 abc | 5.0 cd | 5.7 bcd | 6.0 bcd | 4.7 de | 4.3 fgh |
| Cutless High | 5.7 bcd | 3.7 def | 5.0 de | 4.0 efg | 3.3 ef | 3.3 hi |
| Aneuw Low | 7.7 a | 7.3 ab | 7.3 abc | 7.7 ab | 6.7 abc | 6.0 bcde |
| Aneuw High | 8.0 a | 7.7 a | 7.7 ab | 7.7 ab | 7.0 ab | 7.3 ab |
| Control | 8.0 a | 8.0 a | 8.0 a | 8.3 a | 7.7 a | 6.7 abcd |



**Figure 1**. Visual estimate of turfgrass quality during the study period.

**Table 4.** Turfgrass color (NDRE) at each rating date during the study. Different letters indicate statistically significant differences (p = 0.05) \* - initial application date

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **6/1\*** | **6/15** | **6/28** | **7/14** | **7/28** | **8/10** |
|  | ----------------------------------------- 0-1, 1 is greenest ----------------------------------------- |
| **No Traffic** |  |  |  |  |  |  |
| Primo Low | 0.397 ab | 0.360 abc | 0.318 bcde | 0.295 abcd | 0.399 ab | 0.413 ab |
| Primo High | 0.398 ab | 0.342 abcd | 0.295 ef | 0.271 cd | 0.330 def | 0.370 bcdef |
| Trimmit 2SC Low | 0.390 abc | 0.351 abcd | 0.312 abc | 0.290 bcd | 0.338 cde | 0.328 fg |
| Trimmit 2SC High | 0.387 abc | 0.369 a | 0.337 ab | 0.294 abcd | 0.313 ef | 0.307 g |
| Cutless Low | 0.376 c | 0.349 abc | 0.327 abcd | 0.302 abcd | 0.381 abc | 0.398 abcd |
| Cutless High | 0.396 abc | 0.349 abc | 0.329 abcd | 0.293 bcd | 0.323 def | 0.357 def |
| Aneuw Low | 0.378 bc | 0.336 cd | 0.330 abcd | 0.326 ab | 0.414 a | 0.423 a |
| Aneuw High | 0.383 abc | 0.333 cd | 0.290 ef | 0.281 bcd | 0.386 ab | 0.423 a |
| Control | 0.386 abc | 0.366 ab | 0.356 a | 0.340 a | 0.406 a | 0.404 abcd |
| **Traffic** |  |  |  |  |  |  |
| Primo Low | 0.399 a | 0.352 abcd | 0.293 ef | 0.287 bcd | 0.387 ab | 0.398 abcd |
| Primo High | 0.399 a | 0.344 abcd | 0.275 f | 0.257 d | 0.327 def | 0.385 abcde |
| Trimmit 2SC Low | 0.395 abc | 0.349 abcd | 0.312 bcde | 0.284 bcd | 0.320 def | 0.343 efg |
| Trimmit 2SC High | 0.386 abc | 0.355 abcd | 0.300 cdef | 0.266 cd | 0.288 f | 0.298 g |
| Cutless Low | 0.388 abc | 0.354 abcd | 0.300 cdef | 0.285 bcd | 0.361 bcd | 0.362 cdef |
| Cutless High | 0.389 abc | 0.361 abc | 0.294 ef | 0.264 cd | 0.314 ef | 0.337 efg |
| Aneuw Low | 0.386 abc | 0.328 d | 0.399 def | 0.309 abc | 0.403 ab | 0.418 ab |
| Aneuw High | 0.394 abc | 0.337 bcd | 0.280 f | 0.277 cd | 0.403 ab | 0.408 abc |
| Control | 0.383 abc | 0.366 ab | 0.331 abc | 0.327 ab | 0.419 a | 0.404 abcd |

**Table 4 (cont.)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **8/24** | **9/2** | **9/14** | **9/29** | **10/6** | **10/29** |
|  | ------------------------------------------- 0-1, 1 is greenest ------------------------------------------- |
| **No Traffic** |  |  |  |  |  |  |
| Primo Low | 0.422 abcde | 0.433 abc | 0.414 abcd | 0.387 bcde | 0.409 abcd | 0.407 ab |
| Primo High | 0.411 bcdef | 0.428 abc | 0.389 cdefg | 0.366 de | 0.357 de | 0.339 def |
| Trimmit 2SC Low | 0.348 gh | 0.344 ef | 0.351 fgh | 0.359 de | 0.336 e | 0.312 f |
| Trimmit 2SC High | 0.328 h | 0.327 f | 0.334 h | 0.351 e | 0.335 e | 0.327 def |
| Cutless Low | 0.399 cdef | 0.387 cdef | 0.363 defgh | 0.365 de | 0.375 cde | 0.348 cdeff |
| Cutless High | 0.369fgh | 0.349 ef | 0.344 gh | 0.368 cde | 0.358 de | 0.320 ef |
| Aneuw Low | 0.435 abcde | 0.421 abcd | 0.388 cdefg | 0.363 de | 0.379 bcde | 0.383 abcd |
| Aneuw High | 0.442 abcd | 0.350 ef | 0.401 cdef | 0.387 bcde | 0.416 abc | 0.408 a |
| Control | 0.416 abcdef | 0.403 bcde | 0.388 cdefg | 0.352 e | 0.342 e | 0.338 def |
| **Traffic** |  |  |  |  |  |  |
| Primo Low | 0.463 a | 0.457 ab | 0.462 a | 0.437 a | 0.443 a | 0.427 a |
| Primo High | 0.436 abcde | 0.430 abc | 0.420 abc | 0.403 abcd | 0.408 abcd | 0.384 abcd |
| Trimmit 2SC Low | 0.394 adefg | 0.401 bcde | 0.409 bcde | 0.389 bcde | 0.381 bcde | 0.340 def |
| Trimmit 2SC High | 0.351 gh | 0.364 def | 0.356 efgh | 0.364 de | 0.365 bce | 0.336 def |
| Cutless Low | 0.392 efg | 0.400 bcde | 0.388 cdefg | 0.370 bcde | 0.381 bcde | 0.344 def |
| Cutless High | 0.390 efg | 0.402 bcde | 0.393 cdefg | 0.386 bcde | 0.376 bcde | 0.348 bcdef |
| Aneuw Low | 0.454 ab | 0.438 abc | 0.432 abc | 0.413 abc | 0.430 ab | 0.377 abcde |
| Aneuw High | 0.462 a | 0.466 a | 0.459 ab | 0.440 a | 0.458 a | 0.426 a |
| Control | 0.444 abc | 0.458 ab | 0.459 ab | 0.415 ab | 0.431 ab | 0.405 abc |



**Figure 2**. Turfgrass color reflectance (NDRE) during the study period.

**Table 5.** Clipping mass at each rating date during the study. Different letters indicate statistically significant differences (p = 0.05)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **6/16** | **6/28** | **7/14** | **7/27** | **8/10** | **8/24** | **9/14** | **10/29** |
|  | ----------------------------------------------------------- g m-2 ---------------------------------------------------------- |
| **No Traffic** |  |  |  |  |  |  |  |  |
| Primo Low | 39.8 bcd | 10.0 bc | 4.9 b | 17.2 b | 16.4 bc | 11.9 bcd | 24.8 bc | 8.25 abc |
| Primo High | 32.4 defg | 5.8 cd | 5.6 b | 6.4 cdef | 8.7 cdef | 5.1 bcde | 6.4 de | 1.7 cd |
| Trimmit 2SC Low | 49.2 b | 8.2 bcd | 9.9 b | 4.9 def | 5.0 def | 2.2 de | 3.0 e | 0.5 d |
| Trimmit 2SC High | 48.2 bc | 10.2 bc | 11.1 b | 1.8 ef | 1.4 ef | 0.7 de | 0.8 e | 0.5 d |
| Cutless Low | 40.6 bcd | 14.2 b | 7.4 b | 11.5 bcde | 7.6 cdef | 6.2 bcde | 11.7 cde | 1.4 cd |
| Cutless High | 38.9 cde | 9.5 bcd | 5.6 b | 3.4 ef | 2.6 ef | 2.4 de | 2.3 e | 0.3 d |
| Aneuw Low | 40.9 bcd | 10.5 bc | 12.2 b | 21.5 b | 20.3 ab | 16.0 abc | 12.4 cde | 3.1 bcd |
| Aneuw High | 34.1 defg | 7.5 bcd | 4.7 b | 14.0 bcd | 13.9 bcd | 6.8 bcde | 18.9 bcd | 2.5 cd |
| Control | 61.5 a | 30.2 a | 29.9 a | 35.3 a | 26.9 a | 15.7 a | 40.8 a | 14.0 a |
| **Traffic** |  |  |  |  |  |  |  |  |
| Primo Low | 27.9 fg | 4.3 cd | 2.8 b | 2.2 ef | 1.0 f | 1.7 de | 8.0 de | 2.3 cd |
| Primo High | 26.2 g | 2.7 d | 3.2 b | 0.7 f | 0.3 f | 0.5 e | 1.1 e | 0.1 d |
| Trimmit 2SC Low | 36.5 def | 5.0 cd | 5.6 b | 0.9 f | 0.6 f | 1.0 de | 0.5 e | 0.2 d |
| Trimmit 2SC High | 33.5 defg | 3.9 cd | 5.2 b | 0.7 f | 1.9 ef | 0.4 e | 0.4 e | 0.2 d |
| Cutless Low | 29.4 efg | 4.1 cd | 0.9 b | 1.1 f | 0.6 f | 2.6 de | 0.9 e | 0.4 d |
| Cutless High | 36.1 defg | 3.6 cd | 1.2 b | 0.4 f | 0.7 f | 2.1 de | 0.5 e | 0.4 d |
| Aneuw Low | 26.5 g | 3.7 cd | 3.2 b | 2.9 ef | 1.1 f | 4.9 cde | 4.4 de | 0.6 d |
| Aneuw High | 26.3 g | 4.4 cd | 2.1 b | 2.3 ef | 1.7 ef | 2.6 de | 4.5 de | 1.4 cd |
| Control | 47.9 bc | 13.9 b | 14.6 b | 16.3 bc | 11.1 bcde | 16.2 ab | 31.9 ab | 10.4 ab |



**Figure 3**. Clipping mass during the study period.



**Figure 4.** Average air temperature (blue line), daily precipitation total (bars), and 1 inch soil temperature (red line) at the O.J. Noer Turfgrass Research Facility in Verona, WI for the study period.