# Plant Growth Regulators Can Improve Turf Performance in the Shade

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## Introduction

Research was started in 1992 to develop a management program which would allow a natural turfgrass athletic field to be used inside the Pontiac Silverdome, a covered stadium, for the 1994 World Cup soccer tournament. Lack of sufficient light was the main problem to be overcome. The fiberglass fabric covering the Pontiac Silverdome transmitted less than 10% sunlight, while shading from the seats reduced the actual amount of light on the floor of the stadium to less than 5% sunlight.

While the research was focused on athletic turf, the results also had implications for turf in reduced light conditions (RLC) on golf courses and lawns. A RLC is considered to exist when the amount of light is less than 30% sunlight or its equivalent. In some situations less than 50-70% sunlight can alter turf growth or physiology, quality does not generally suffer until a turf receives less than 30% sunlight. One of the main problems associated with turf in RLC is weak, spindly growth with reduced tillering and root growth. In plants, the hormone gibberellic acid (GA) is known to stimulate stem and leaf elongation. The premise for the research was that plant growth regulators (PGRs) which inhibit GA synthesis might improve turf quality in the shade by preventing excessive shoot elongation.

As more golf courses are built in wooded areas and as trees mature on older courses, RLC are becoming more common turf management problems than ever before. In addition, indoor driving ranges and municipal/professional athletic facilities are becoming more common. One of the most prevalent types of facilities being built are indoor soccer rinks. While indoor facilities currently rely on artificial turf, there is tremendous interest in using natural grass instead of artificial turf. Due to the lack of space in their country, the Japanese are even planning for golf and athletic facilities to be placed in high rise buildings. Of course, indoor facilities may have to rely on artificial lighting. In the 21st century we can be sure to see more turf in RLC than we have in the past.

The objectives of the research were to: 1) Determine the effect of the PGR flurprimidol on Kentucky bluegrass at several levels of RLC, and 2) Determine the effect of various "photoperiods" on turf quality.

## Materials and Methods

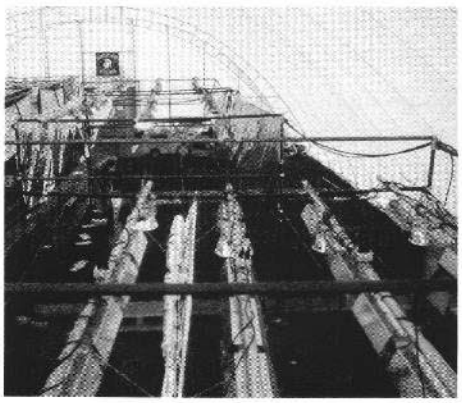
Washed Kentucky bluegrass (20% blend of each 'Trenton', 'Rugby', 'Midnight', 'Kelly', and 'Aspen') was sodded onto a sand:peat (85:15) mix in wooden boxes (4'x4'x6" depth) on October 9, 1992. The sand particle size range was consistent with USGA specifications for putting greens. The pH of the root zone mix was 7.8. Starter fertilizer (13-25-12) had been applied to the root zone mix prior to sodding to supply 3# $P_2O_5$/1000 $ft^2$. The wooden boxes had holes drilled into the bottom for drainage. The turf was maintained at 1.25" height and irrigated as necessary.

The turf boxes were moved into the Indoor Turfgrass Research Facility (ITRF) on Dec. 13, 1992. The 6,000 $ft^2$ ITRF was constructed in August 1992 to simulate the environment inside the Pontiac Silverdome (Stier et al., 1993). The ITRF was covered with a fiberglass fabric which transmitted approximately 10% sunlight. Six turf boxes were moved into each of six RLC (Table 1). Artificial light was supplied for six of the environments using 400 W high pressure sodium lamps. The quality (wavelengths) and quantity of light on each

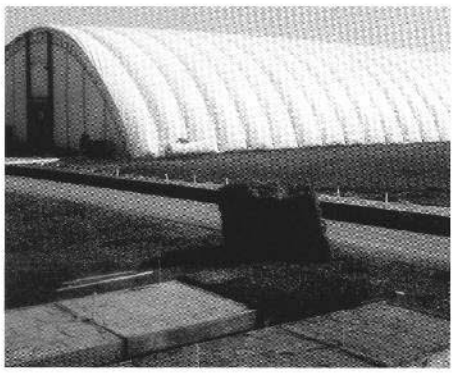
**Table 1. Light regimes for testing flurprimidol effects on Kentucky bluegrass.**

| Light source | Photoperiod (hr) | % Daily total of full sunlight (summer) | Light energy ($W\ m^{-2}$) |
|---|---|---|---|
| Ambient | 10-12 | 2-5 | 10-20 |
| HPS lamps† | 12 | 13 | 40 |
| HPS lamps | 24 | 30 | 50 |
| HPS lamps | 15 | 30 | 75 |
| HPS lamps | 24 | 51 | 75 |
| HPS lamps | 24 | 73 | 110 |

† High pressure sodium lamps, 400W



**Lamps for the lighting study were suspended on scaffolding inside the ITRF.**

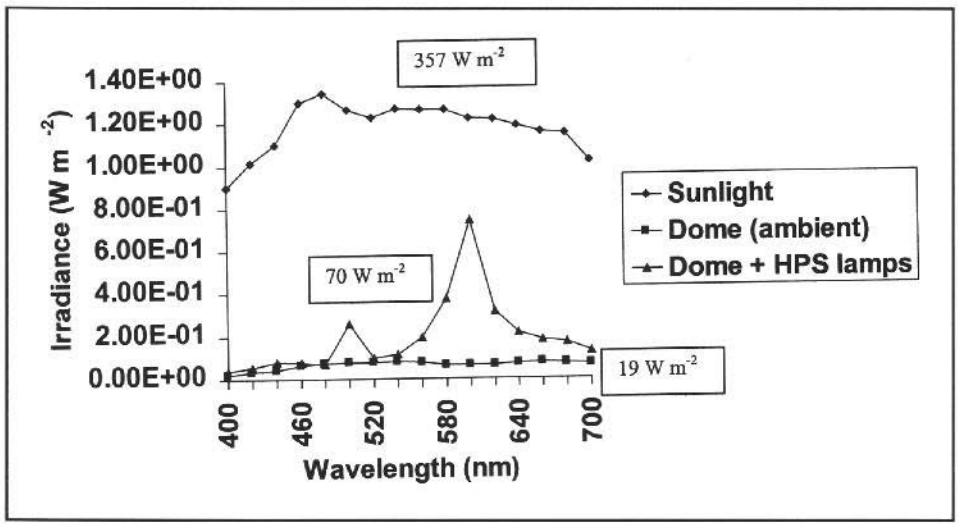


**The Indoor Turfgrass Research Facility (ITRF) and preparation of portable plots on October 1,1992**

turf plot was measured periodically using a LiCor 1800 spectroradiometer (Figure 1). An equation was derived from these measurements and outdoor solar radiation measurements to determine the average daily quantity of light energy impacting the turf. During the next seven months, the turf was fertilized monthly with 1 lb N/1000 ft², and bimonthly with approximately 1 lb K/1000 ft². Irrigation was supplied as necessary to prevent moisture stress. Flurprimidol (1 lb ai/A) was applied at six week intervals from 18 Dec. through 10 April, 1993, and irrigated into the turf according to label instructions. Plots were mowed with a reel mower set at 1.25". Plots were mowed as needed to prevent more than one-third the leaf tissue from being removed at any one mowing (generally once to twice per week).

Traffic was applied to the plots by having an approximately 250 lb person walk across each plot 50 times two of every three weeks while wearing soccer cleats. Plots were rated monthly for color, quality, and density. Traffic was applied from December through March, followed by a recovery period from April through July.

**Figure 1. Spectral analysis of light sources for testing Kentucky bluegrass under reduced light conditions. Data collected approximately 12 pm, August 23, 1993, East Landing, MI.**




## Discussion and Conclusions

Flurprimidol treatments resulted in higher quality turf than turf left untreated (Table 2). Flurprimidol greatly enhanced turf color, turgidity, and uniformity. The increased turgidity allowed a much better quality of cut compared to untreated turf which tended to bend in front of the reel, resulting in a scraggly turf. Turf subjected to traffic did not survive at 2-5% sunlight, while 13% simulated sunlight was nearly sufficient to provide an acceptable turf when treated with flurprimidol. Interestingly, PGRs did not enhance turf quality when maintained under a 24 hr photoperiod; the turf was lighter green than turf maintained at a similar or lesser light intensity under 12 or 15 hr photoperiods. Apparently the continuous light caused a lesser amount of chlorophyll to be generated in the plants although overall turf density and growth did not appear to be impaired.

**Table 2. Flurprimidol effects on Kentucky bluegrass quality under reduced light conditions (adapted from Rogers et al., 1996).**

| | | February 8, 1992 | | July 19, 1993 | |
|---|---|---|---|---|---|
| | | Turf Quality† | | | |
| Light treatment, W m⁻², Time | % Full sunlight | No PGR | PGR* | No PGR | PGR |
| 10, 10 hr | 2-5 | 4.7 | 4.8 | 1.0 | 1.0 |
| 40, 12 hr | 13 | 7.3 | 7.7 | 1.8 | 4.0 |
| 50, 24 hr | 31 | 7.3 | 7.7 | 5.3 | 5.3 |
| 75, 15 hr | 30 | 7.7 | 8.3 | 4.3 | 6.0 |
| 75, 24 hr | 51 | 7.8 | 8.2 | 5.7 | 5.0 |
| 110, 24 hr | 73 | 7.5 | 7.8 | 5.7 | 4.7 |
| LSD (0.05) | | 0.7 | 0.7 | 1.3§ | |

† Quality was rated on a 1-9 scale; 1=necrotic turf/bare soil, 9=dark green, dense, uniform turf, 5=acceptable quality.

* The plant growth regulator (PGR) flurprimidol was applied at 1.0 lb ai/A on Dec. 18, 1992 and 1 Feb. and 10 April, 1993, according to label instructions.

§ Interaction between PGR and light treatment occurred on this date. The LSD value is for comparing among light treatments within a PGR treatment and between PGR treatments at a given light treatment.

The research is important because it helps to define the minimum levels of light necessary for growing turf under varying management practices (e.g., PGR applications, nitrogen rates, etc.). An eventual goal of this research program is to define the minimum amounts of light necessary for different grass species when maintained under different conditions (e.g., putting green, athletic field, etc.). With this type of information, golf course superintendents and other turf managers can measure the amount of light in a given situation and make the appropriate adjustments (e.g., at 12% sunlight, with PGR treatments, a 1/4" cutting height may be needed while at 18% sunlight, with PGR treatments, a 3/16" cutting height may provide acceptable turf of a 'Penncross' creeping bentgrass). Related research is showing that with proper species/cultivar selection and refined management practices, it is possible to maintain turfgrasses in high wear areas under RLC on a long term or even permanent basis (e.g., golf domes or athletic fields in covered stadia).

## Literature Cited

Rogers, J.N., III, J.C. Stier, J.R. Crum, T.M. Krick, and J.T. Vanini. 1996. The sports turf management program at Michigan State University. p. 132-144. In Earl F. Hoerner, (ed.) Safety in American Football, ASTM STP 1305, American Society for Testing and Materials, 1996.

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