Proc. Fla. State Hort. Soc. 116:319-321. 2003.

TECHNOLOGY FOR IRRIGATION SCHEDULING FOR ST. AUGUSTINEGRASS

JOON H. LEE, LAURIE E. TRENHOLM[1] AND J. BRYAN UNRUH
University of Florida
Department of Environmental Horticulture
1549 Fifield Hall
Gainesville, FL 32611

Additional index words. multispectral reflectance, nitrate leaching, nitrogen fertilizers, slow-release fertilizer, St. Augustinegrass, turfgrass quality

Abstract. **Water is one of the greatest limiting factors influencing turfgrass growth. Due to increased pressure to preserve water resources, there is interest in development of sensor-based technologies to indicate turfgrass irrigation requirements. This study is designed to determine what technologies might reliably and accurately predict irrigation scheduling needs of warm-season turfgrass. 'Floratam' St. Augustinegrass was established in 19 inch diameter tubs in the Envirotron Turfgrass Research facility in Gainesville in the spring of 2002. Each grass was subjected to repeated dry-down cycles where irrigation was withheld. Data were collected on: a) shoot quality, leaf rolling, leaf firing, turf color; b) soil moisture content; c) leaf relative water content (RWC), and d) chlorophyll content index. Results of this study indicated that turf quality was highly correlated with soil moisture ($P \leq 0.0001$) throughout the dry-down cycle. As turf quality declined below acceptable levels, these sensor-based technologies were able to predict the need for irrigation scheduling.**

Water is one of the greatest limiting factors influencing turfgrass growth. In recent years there has been increasing interest in deficit irrigation, or providing water at less than the maximum evapotranspiration (ET) rate over the growing season. With demand on urban water resources often exceeding available supplies, it has become important to understand and quantify the responses of turf to deficit irrigation and to have a more thorough understanding of relative drought tolerance. Thus, this research will focus on sensor-based technologies to determine irrigation scheduling needs of warm-season turfgrasses.

Drought is defined as a condition caused by a prolonged period of dry weather that may cause plant damage and water supply shortages (Kneebone et al., 1992). Turfgrass species respond to water stress to varying degrees and drought is a major limiting factor in turfgrass management (White et al., 1993). Drought suppresses turfgrass growth and causes deterioration of turf quality. The use of cultivars and species with superior drought resistance is one of the ways in which water use can be reduced while maintaining good quality and growth of turfgrass (White et al., 1992).

Turfgrasses have their own means of drought resistance via dehydration avoidance, dehydration tolerance, and escape. Sifers and Beard (1999) assessed drought resistance and dehydration avoidance of selected genotypes within St. Augustinegrass (*Stenotaphrum secundatum* [Walt.] Kuntze), centipedegrass (*Eremochloa ophiuroides* [Munro] Hack.), seashore paspalum (*Paspalum vaginatum* Swartz), and buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.). St. Augustinegrass genotypes were remarkably drought tolerant and capable of remaining green through lengthy drought stress periods. There was a significant drought stress reaction such as early color loss and dormancy in some drought tolerant species such as buffalograss.

Rodriguez and Miller (2000) evaluated the capacity of a hand-held chlorophyll meter (SPAD-502) to provide a relative index of chlorophyll concentration, nitrogen concentration, and visual quality in St. Augustinegrass. The chlorophyll meter readings were positively correlated with chlorophyll concentrations ($r = 0.79$).

The objective of this research was to determine what technologies might reliably and accurately predict irrigation scheduling needs of warm-season turfgrass.

Materials and Methods

This research consisted of two repeated studies conducted consecutively on 'Floratam' St. Augustinegrass. Grasses were established on Arrendondo fine sand soil in 43.2 cm diameter tubs that were 35.6 cm deep. This study was conducted at the University of Florida Envirotron greenhouse in Gainesville. Study 1 was conducted from 19 Apr. to 7 May 2002, while study 2 was conducted from 29 May to 8 July in 2002. Grass was transplanted from established sod that was washed free of soil before planting. Grasses were mowed once a week at 2 inches and irrigation was provided as needed during establishment. When grass was uniformly established, irrigation was withheld and data were obtained over the duration of each dry-down.

Evaluations included turf quality, leaf rolling, leaf firing, soil moisture content, relative water content of leaves (RWC), and chlorophyll content (CCI). Turf quality was rated daily on a 1 to 9 scale based on shoot density and uniformity, where 1 equaled no live grass; 6 equaled acceptable quality for a home lawn; and 9 equaled optimum color, density, and uniformity. Leaf rolling and leaf firing were rated every day on a 1 to 9 scale, where 1 equaled totally rolled or fired leaf and 9 equaled no leaf rolling or leaf firing.

Soil moisture content (%) data were measured with Field-Scout time domain reflectometry (TDR) (Spectrum Technologies, Inc., Plainfield, Ill.). The measurement data were the average volumetric water contents to a depth of eight inches.

Relative water content of leaves was determined using the following equation: RWC = (Fresh wt – Dry wt)/(Turgid wt – Dry wt) × 100, where dry weight was measured after drying at 75 °C for 24 h, and turgid weight was measured after soaking in ionized water for 4 h at room temperature (20 °C).

Chlorophyll content index of leaves was randomly measured from two locations within each pot with a Field Scout CM1000™ chlorophyll meter (Spectrum Technologies, Inc., Plainfield, Ill.). This chlorophyll meter senses light at wavelengths of 700 nm and 840 nm and develops an index to estimate the quantity of chlorophyll in leaves.

This research was supported by the "Toro" Company and by the Florida Agricultural Experiment Station, and approved for publication as Journal Series No. N-02368.

[1]Corresponding author; e-mail: ltrenholm@ifas.ufl.edu.

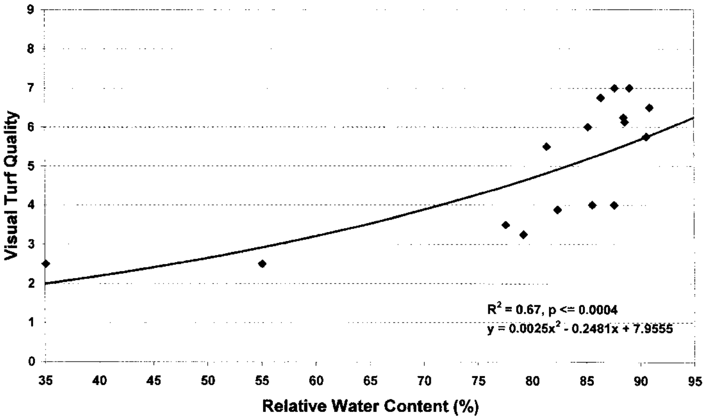

Fig. 1. Correlation between turf quality and relative water content.

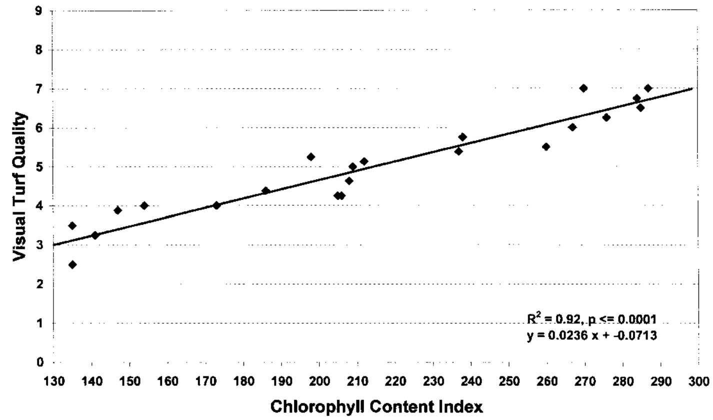

Fig. 3. Correlation between turf quality and chlorophyll content.

Experimental design was completely randomized with eight replications. Data were analyzed with general linear regression or correlation models (SAS Institute, 1987). Means were separated using the LSD test ($P < 0.05$). Regression analysis was used to test correlations among turf quality, RWC, soil moisture content, and CCI.

Results and Discussion

Correlations with Turf Quality. RWC of leaves was highly correlated with turf quality ($R^2 = 0.67$, $p \leq 0.0004$). Turfgrasses maintained acceptable quality (≥6) between 85 and 90% of RWC (Fig. 1). Soil moisture was highly correlated with turf quality ($R^2 = 0.91$, $p \leq 0.0001$). Turf quality was at acceptable levels when soil moisture ranged from 11 to 23%. Turf quality was significantly decreased when soil moisture content dropped below 6% (Fig. 2). CCI was also highly correlated with turf quality ($R^2 = 0.92$, $p \leq 0.001$). Turfgrasses maintained acceptable quality (≥6) when the CCI was over 257 (Fig. 3).

Correlations with Soil Moisture. RWC of leaves was highly correlated with soil moisture ($R^2 = 0.51$, $p \leq 0.0096$). Floratam maintained 80% of water level in the cell even below 9% of soil moisture (Fig. 4). There was little change of RWC when soil moisture content ranged from 5 to 22%. Chlorophyll content index of leaves, as measured by chlorophyll meter, was also highly correlated with soil moisture ($R^2 = 0.91$, $p \leq 0.0001$). There was a strong correlation between chlorophyll content and soil moisture content (Fig. 5).

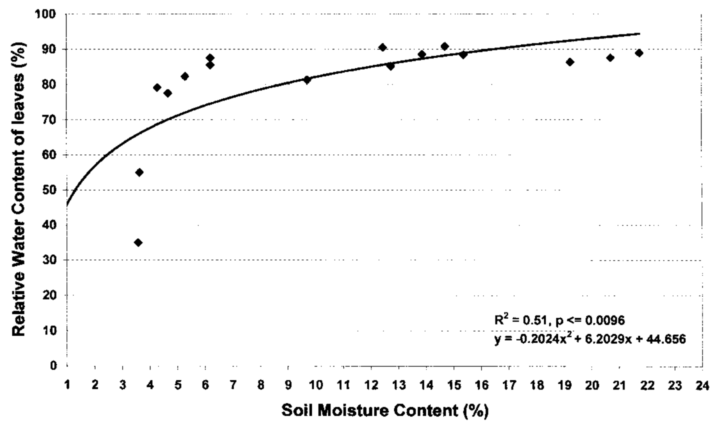

Fig. 4. Correlation between relative water content and soil moisture.

This research indicates that drought stress can be determined by sensor-based technology such as TDR. Strong correlations exist among turf visual quality, soil moisture, RWC of leaves, and CCI. The decline in turf quality below an acceptable level provides a baseline for determining when other critical parameters such as soil moisture and RWC can be used to determine onset of drought stress.

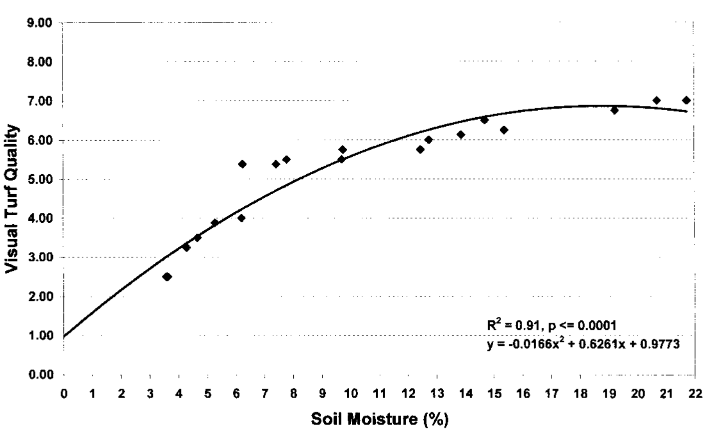

Fig. 2. Correlation between turf quality and soil moisture.

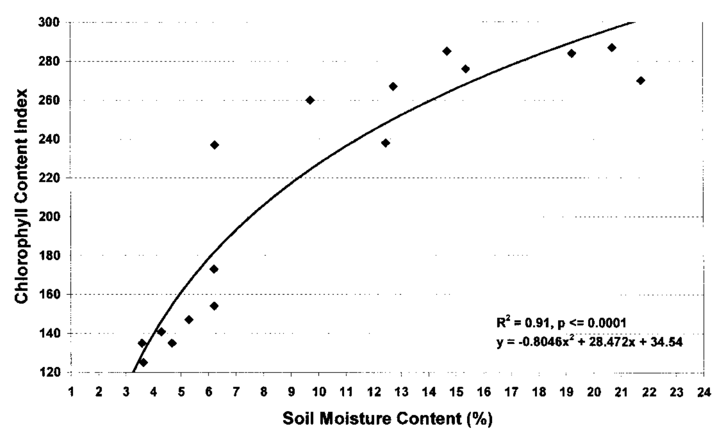

Fig. 5. Correlation between chlorophyll content and soil moisture.

Although differences in microenvironment, soil conditions, turf rooting depth, and management level influence turfgrass water use, it appears likely that the measurement of soil moisture content can be used to provide an accurate prediction of turfgrass irrigation scheduling requirements.

In this research, 'Floratam' St. Augustine grass maintained acceptable visual quality down to 6% SMC, with significant reductions in turfgrass quality when SMC dipped below 6%. This implies that Floratam can maintain good quality during periods of drought. Deficit irrigation is one key to enhance drought stress tolerance through drought hardening. Further study is needed to investigate the correlation between growth rate and deficit irrigation.

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