# Water Reflectance Characteristics of Creeping Bentgrass and Hybrid Bermudagrass Grown in Various Soil Textures

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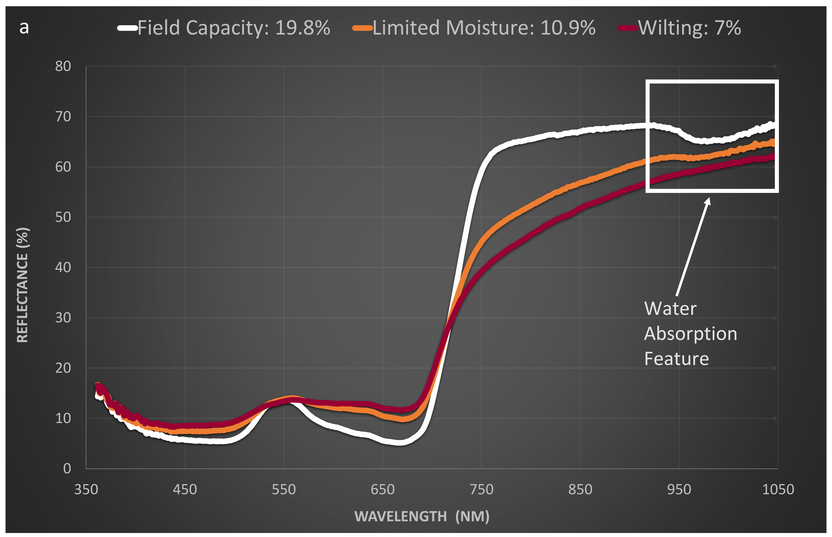
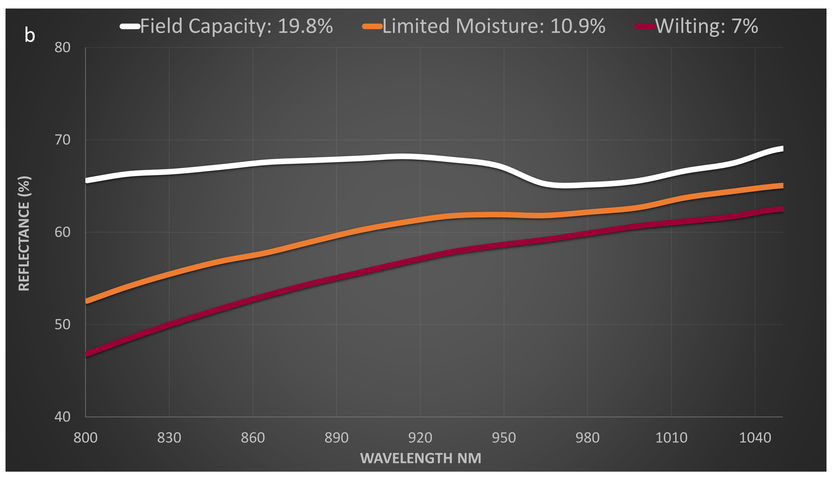
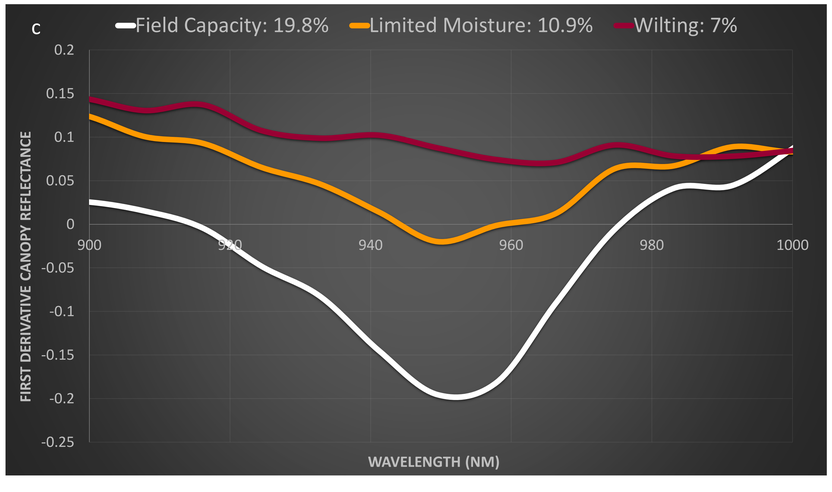
## Background

- The use of spectral characteristics to analyze the Water Absorption Feature (WAF) present within the near infrared range as a predictor of moisture stress.

Figure 1. (a) Spectral characteristics, from 350 to 1050nm, of 'A4' creeping bentgrass at three different moisture levels: field capacity, limited moisture, and wilting. (b) A zoomed in representation highlighting the water absorption feature between 900 to 1000 nm. (c) First derivative calculation of canopy reflectance between 900 to 1000nm.




## Introduction

- Global water demand necessitates conservation efforts.
- U.S golf courses used over 2.2 x $10^9$ $m^3$ of water in 2013, down 21.8% from 2005 (Anonymous 2015). There is still room for improvement.
- Previous research (Fig. 1) indicated a strong relationship between soil moisture and the water band index (WBI = $R_{900}/R_{970}$) from creeping bentgrass (*Agrostis stolonifera*) (CBG) grown in a USGA specified root zone (McCall, 2016).
- Water absorption characteristics have not been quantified for CBG or hybrid bermudagrass (*Cynodon transvaalensis x C. dactylon*) (HBG) grown on various soil textures.

## Objectives

- Explore the water absorption spectral characteristic (900-1000nm) of CBG and HBG grown on various soil textures (Fig. 3).
- Develop unique algorithms (Fig. 1c) to enhance absorption characteristics within the water band that may be useful for predicting water deficiencies.

Figure 2. Conetainers of '007'creeping bentgrass (left) and 'Latitude 36' hybrid bermudagrass (right) for data collection

## Materials and Methods

**Location:** Virginia Tech Glade Road Research Facility, Blacksburg, VA
Greenhouse Conditions: Temperature: 38.1°C, Humidity: 50%

**Experimental Design:** Completely randomized design, 5 replications, 19.6 $cm^2$ plot size

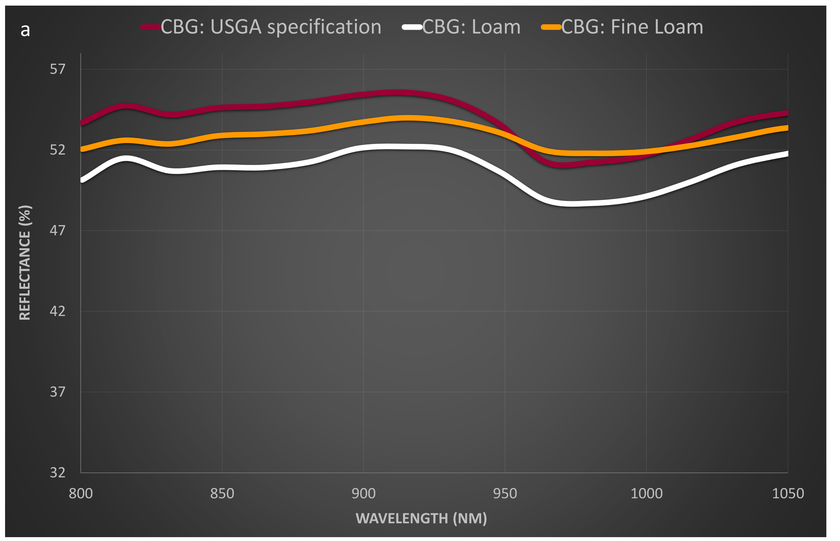
**Treatments:** '007' CBG and 'Latitude 36' HB plugs were transplanted into conetainers (Stuewe & Sons) containing 350 $cm^3$ of different soils.

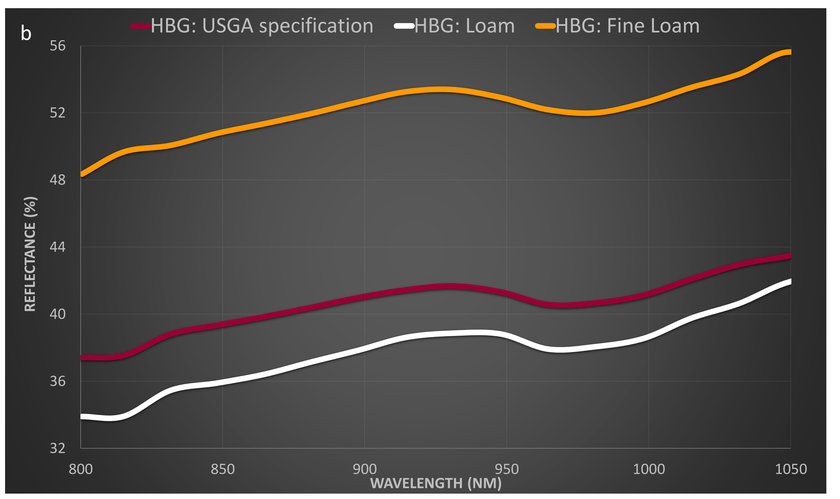
Sand: ( 99.2% sand, 0.5% silt, **0.3% clay**)
*USGA: (97.8% sand, 0.8% silt, **1.4% clay**)
*Loam: ( 35.1% sand, 46.9% silt, **18 % clay**)
Silt loam: ( 22.9 % , 55.1% silt, **22% clay**)
*Fine loam: ( 32 % sand, 43.2 % silt, **24.8 % clay**)

- Data shown in Fig. 3.

**Data Collection:** Data was collected using a portable field radiometer (PSR-1100F, Spectral Evolution) fitted with a plant probe (2.5 cm spot size) over a spectral range of 400 to 1100nm directly from canopy surface. Soil moisture was collected using Field Scout TDR-300 fitted with 3.8cm probes. Conetainers were maintained at field capacity prior to data collection

Figure 3. The water absorption feature (900-1000nm) present in (a) '007 creeping bentgrass and (b) 'Latitude 36' hybrid bermudagrass in three different soils.




## Results and Discussion

- The WAF was found to be present for both '007' creeping bentgrass and 'Latitude 36' bermudagrass (Fig. 3).
- Position of the WAF remains constant under varying soil textures (Fig. 3)
- Algorithms for first derivative may be useful for easier differentiation of water stress.

## Future Research

- Estimate number of days before dry-down occurs for types of soils based on volumetric water content.
- Explore detection of drought stress prior to symptom development using unique algorithms.
- Define a relationship between WBI and soil water content of CBG and HBG grown on various soil textures as an indicator of drought stress.

## Literature Cited

- Anonymous, 2015. Golf Course Environmental Profile. In. *2014 Water Use and Conservation Practices on U.S. Golf Courses.* Lawrence, KS: Golf Course Superintendents Association of America, 30. (I.)
- McCall DS, X Zhang, DG Sullivan, SD Askew, and EH Ervin, Enhanced Soil Moisture Assessment using Narrowband Reflectance Vegetation Indices in Creeping Bentgrass. Crop Science, accepted for publication 2016