

Using the GreenIndex+ Smartphone App to Measure Dark Green Color Index (DGCI) in Corn

Harold Reetz Jr., Reetz Agronomics, Monticello, IL

Doug Kieffer, Spectrum Technologies, Aurora, IL

Abstract

One parameter used to help compute sidedress nitrogen recommendations is leaf greenness, which is a proxy for chlorophyll content, and thus plant nitrogen status. There are a number of optical tools that use pre-selected wavelengths of light in the red and infrared bands and generate a greenness index (SPAD number, NDVI, ...). Recent work has shown that color images taken with digital cameras can be processed with PC-based software to produce a Dark Green Color Index (DGCI) that correlates well with existing indexes. Proper color processing requires a neutral (pink) background with yellow and green color standards to properly account for different light levels. The GreenIndex+ system adapts this technology as an App for the iPod, iPhone, and iPad. DGCI results are available immediately and can be geo-referenced using the device's internal GPS receiver. Data transfer is accomplished via an attached e-mail file. The GreenIndex+ provides a relatively low-cost alternative for estimating relative N status of plants. The resulting DGCI can be calibrated to guide sidedress and other in-season supplemental N fertilizer applications.

Introduction

- There are a wide variety of instruments that use wavelengths of red and infrared light to compute greenness indexes such as SPAD value or NDVI.
- Karcher and Richardson¹ found that color digital photographic images (DSLR camera) could be processed to quantify a greenness index that was correlated to turf health.
 - Required transforming the red, green, blue (RGB) data into the hue, saturation, brightness (HSB) color space
 - Created the Dark Green Color Index (DGCI) computed from HSB values

$$DGCI = \frac{1}{3} \left[\frac{Hue - 60}{60} + (1 - Saturation) + (1 - Brightness) \right]$$

- Adapted for use in corn by Purcell et al².
 - Required pink board/color standards for leaf measurements
 - Field testing showed correlation to SPAD and leaf nitrogen concentration

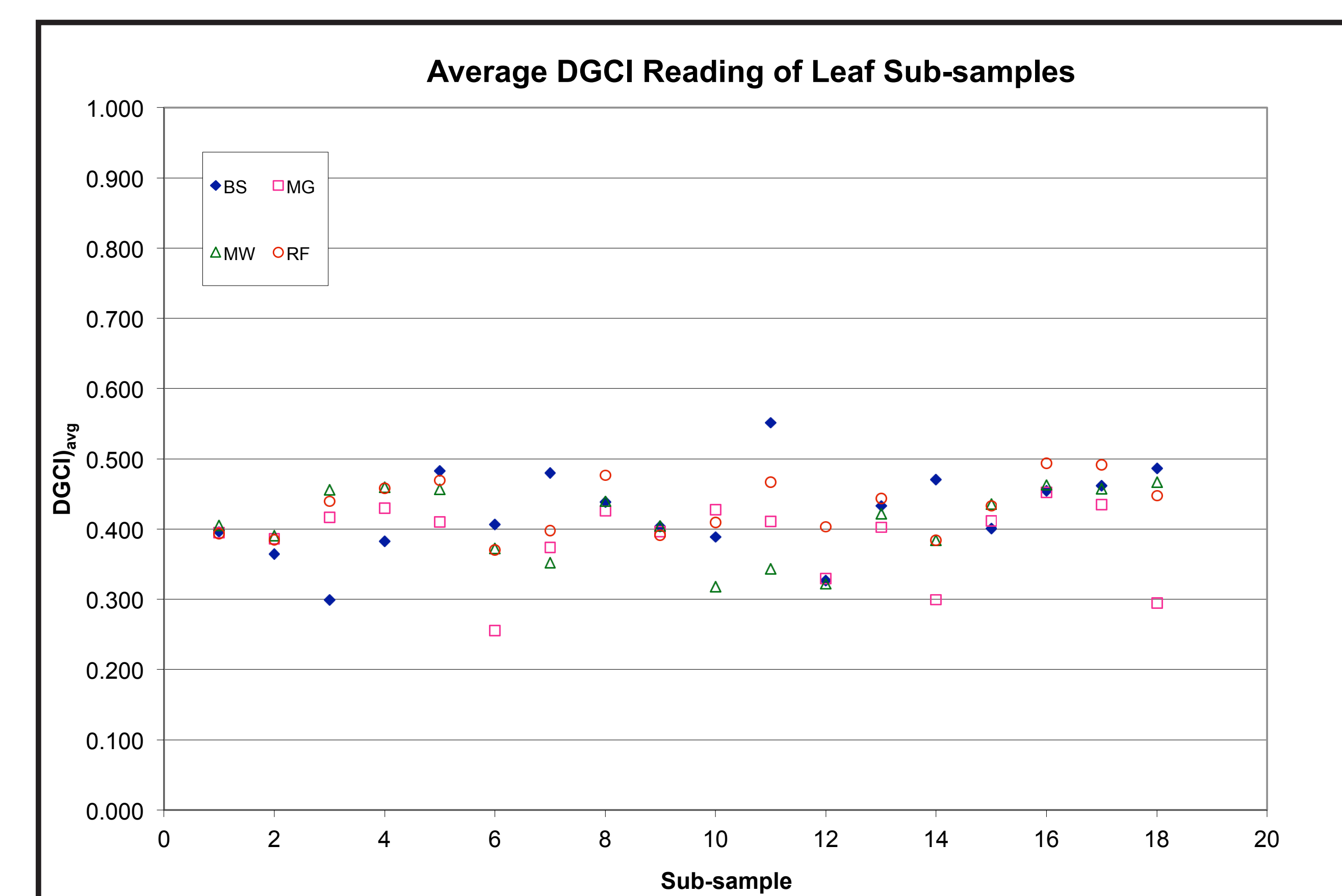


Figure 1. Average of multiple GreenIndex+ readings of plant sub-samples taken by 4 testers.

Adaptation for SmartPhone (iPod, iPhone)

- Confirmed compatibility of iPod camera
- Quality is sufficient (vs DSLR camera)
- App DGCI matched SigmaScan DGCI
- White balance adjustment included
- Use touchscreen to identify measurement regions rather than programmatically finding them using PC-based image analysis
- User-friendly Board
- Adapted for single user (small, hand strap)
- Chose color materials to avoid metamerism (changing of color appearance due to angle of incident light).

Testing/Results

- Data consistent for consecutive readings of individual leaves by multiple users (Fig. 1).
- Locking smart device's white balance improved accuracy (Fig. 2).
- Ongoing field testing in wheat and corn.

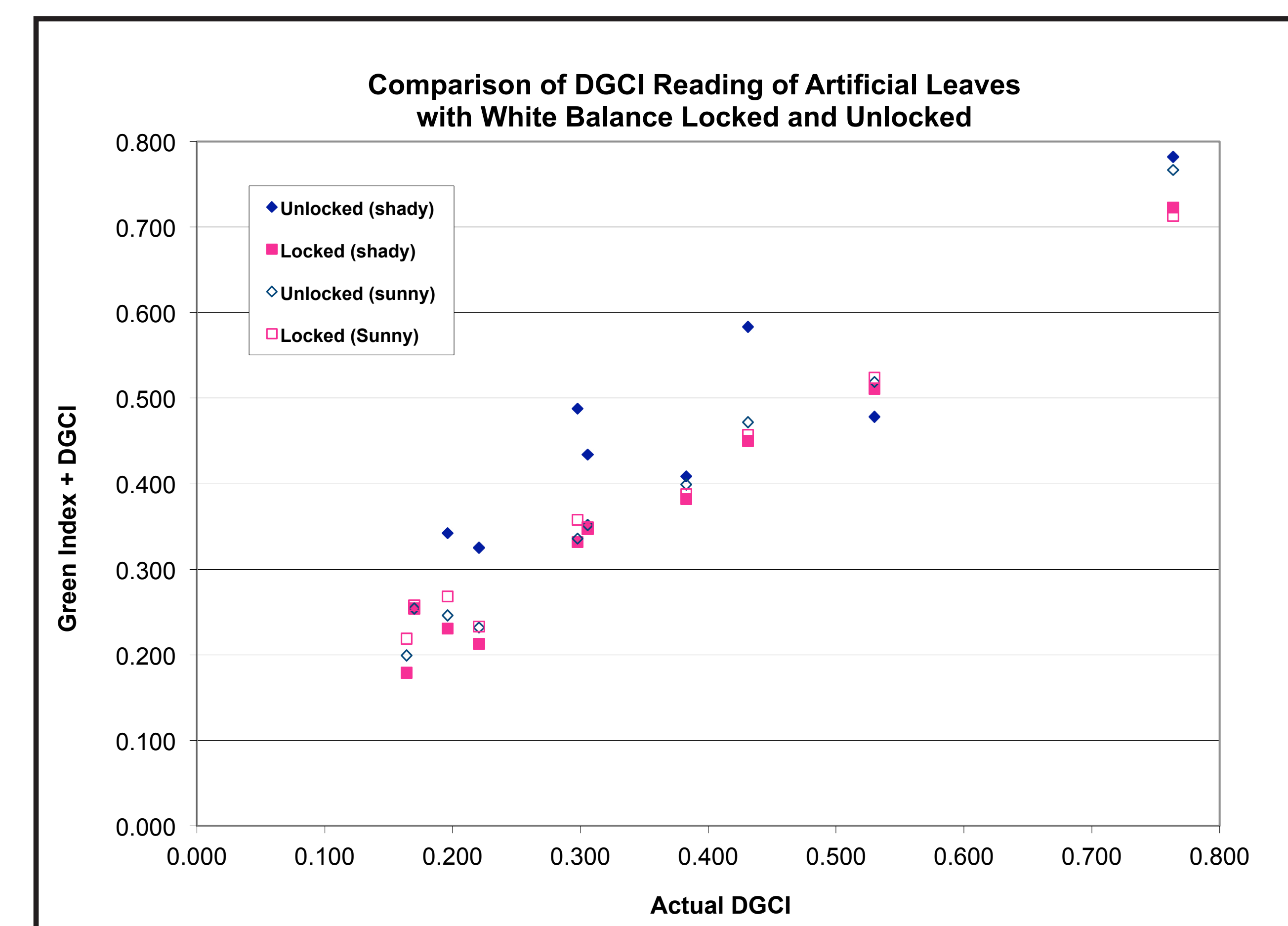


Figure 2. Comparison of GreenIndex+ readings taken with and without locking camera white balance feature.

References

- ¹ Karcher, D.E., and M.D. Richardson. 2003. Quantifying turfgrass color using digital image analysis. *Crop Sci.* 43:943-951.
- ² Rorie, R.L., L.C. Purcell, D.E. Karcher, and C.A. King. 2011. The assessment of leaf nitrogen in corn from digital images. *Crop Sci.* 51:2174-2180.