Digital Image Analysis of Old World Bluestem Canopy Cover and Leaf Area

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Introduction

- WW-B. Dahl Old World bluestem [*Bothriochla bladhii* (Retz) Blake] is a well adapted perennial forage grass in the semi-arid Texas High Plains.
- WW-B. Dahl is a good option for converting irrigated cropland to limited irrigation pasture where Ogallala aquifer levels are diminishing.
- Digital image analysis (DIA) potentially allows low-labor measurement of grass cover. Cover data are useful for monitoring canopy leaf area and biomass growth.

Objective

- The objective is to determine the potential for using canopy cover from DIA to estimate leaf area index, percentage light interception and forage biomass. Successful application of DIA will aid in developing a simulation model of WW-B. Dahl growth under irrigated pastures conditions.

Method and Material

- An established pasture of WW-B. Dahl at the Texas Tech University New Deal research station was sampled (Figure 1).
- Irradiance was measured with a Li-Cor® line quantum sensor above and below the canopy for calculating light interception.
- Overhead images of the grass canopy were recorded biweekly for 12 randomly selected plots each sampling date.
- The jpg-format images were converted by ImageJ® software (imagej.nih.gov) into two color groupings corresponding to green tissue and non-green cover by manipulating the hue, saturation and brightness levels (Figure 2).
- Field sampling included: measured light interception, took overhead photo and clipped biomass at 8 cm height for yield and leaf area determination (Figure 3).
- There were two growth periods: 1. May 22 to July 16; 2. July 31 to Oct 2. Plot area was mowed at the end of period 1.
- Precipitation: 260 mm; irrigation:280 mm.

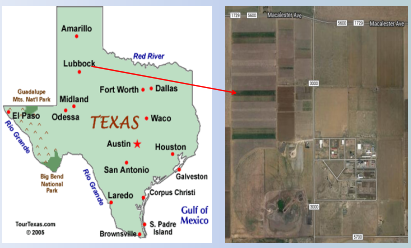

Figure 1. Site Location

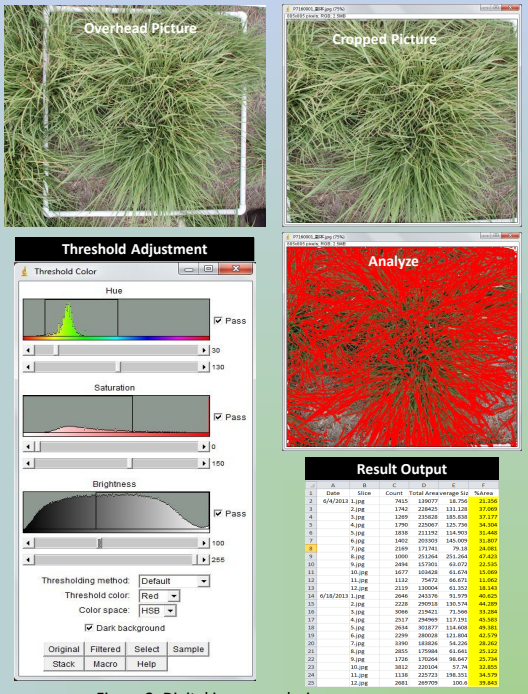

Figure 2. Digital image analyzing process

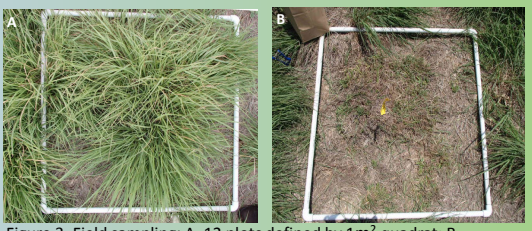

Figure 3. Field sampling: A. 12 plots defined by 1m^2 quadrat; B. Measured light interception, took overhead photo, clipped the biomass

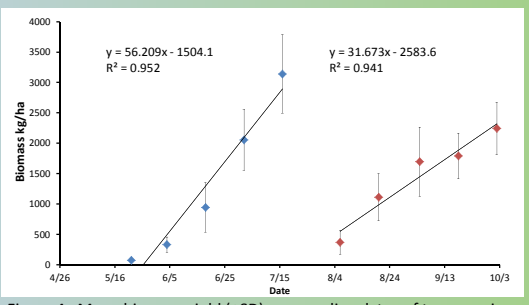

Figure 4. Mean biomass yield (±SD) on sampling dates of two growing periods: May 22 to July 16 and July 31 to October 2

Result

- Digital photography allows capture of large numbers of sampling sites, delayed analysis at flexible times, and long-term raw data storage.
- Growth rate was greater in period 1 than period 2, reflecting more favorable conditions in early summer (Figure 4). Growth during period 1 was mainly vegetation; where as period 2 exhibited flowering.
- Light interception was linearly related to ground cover in both periods, but with a higher R^2 value in period 1. The emergence of stems and seedheads in period 2 likely created more complex and variable canopy structures, which then complicated the image adjustments.
- Leaf area index was curvilinearly related to ground cover from DIA (Figure 6). Stems and seedheads introduced high variability in the latter part of period 2.

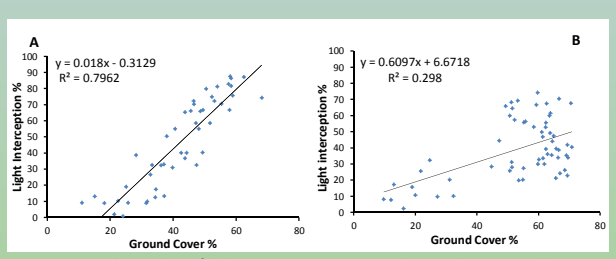

Figure 5. Relationship of light interception to ground cover determined by DIA:
A-first period May 22 to July 16;
B-second period July 31 to October 2

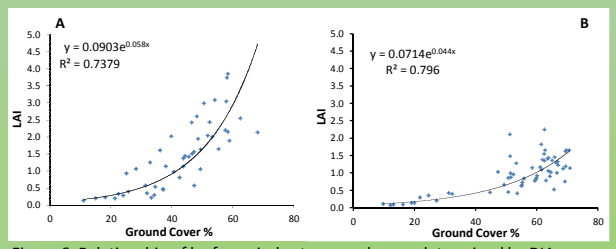

Figure 6. Relationship of leaf area index to ground cover determined by DIA:
A-first period May 22 to July 16;
B-second period July 31 to October 2

Conclusions

- Digital photography offers a low-labor means of collecting ground cover data from grass pasture.
- ImageJ® software is free and easy to use, which reduces cost of image analysis.
- Percentage light interception and leaf area index were fairly well predicted by ground cover from DIA in period 1, but stem elongation in the latter season introduced more variability.
- DIA shows potential for characterizing canopy development of old world bluestem. More study is needed to improve the growth relationship to ground cover, and to evaluate its use under grazing.

Acknowledge

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