



Abstract

Recent developments in compact digital cameras and associated software facilitate digital imagery analysis on small-scale research plots. We refined techniques to quantify daily increases in radiation capture and growth of plant canopies in controlled environments. Percent ground cover as determined by digital imagery was highly correlated ($r^2 > 0.9$) with measurements of light absorption using a light bar and with canopy photosynthesis. Continuous measurements of canopy photosynthesis and respiration provide a direct and accurate measurement of plant growth rates, so digital imagery can be used to non-destructively measure daily growth rates. This poster demonstrates a technique for analyzing digital images to quantify plant growth and provides examples of how this technique can be applied to quantifying plant stress responses.

Methods



Day 11

Day 13

Day 14

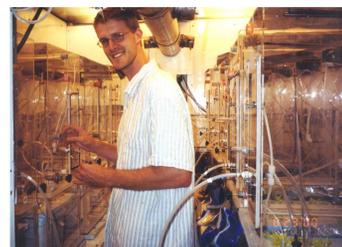
- ✦ Take successive overhead images
- ✦ Download images and save in TIFF format
- ✦ Open into Scion Image (shareware www.scioncorp.com)
- ✦ Use thresholding to isolate plant canopy from background
- ✦ Measure relative area of canopy as compared to the total plot to determine percent ground cover
- ✦ Optional: Calibrate area measurements for absolute area values

Comparisons

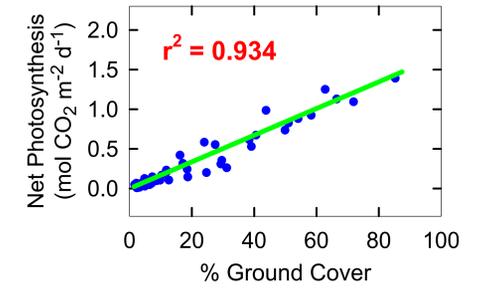
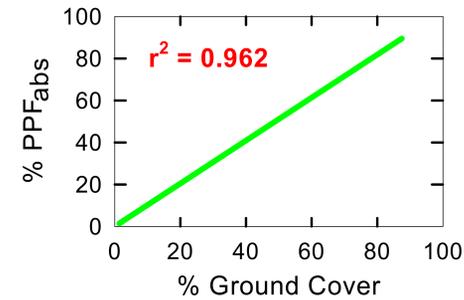
- Light measurements were made above and below the canopy with a light bar to quantify PPF absorbed



- Canopy photosynthesis and respiration were measured using a multi-chamber gas exchange system

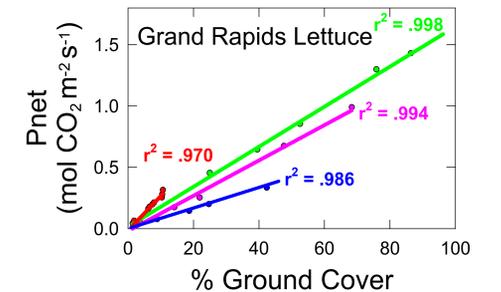


Results

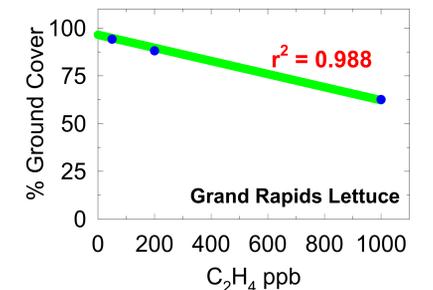
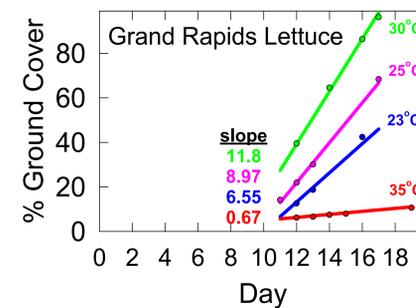


- Percent ground cover was highly correlated with measurements of both radiation capture and photosynthesis (combined data from multiple temperature treatments)

- Correlations were excellent when data was separated by temperature treatment



Applications to plant stress responses

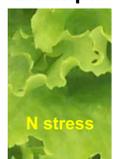


- Characterizing temperature responses
- Characterizing ethylene effects

What about color?

- Plant stress can result in subtle changes in plant color that are characteristic of the specific stress
- Software such as Photoshop has the ability to characterize color (Histogram) but more work needs to be done
- “Color signatures” need to be identified for specific stresses
- Interferences due to interactions of different stresses need to be evaluated

Example



Mean blue = 45



Mean blue = 50

Conclusions

- Digital imagery analysis is a simple, non-destructive, and inexpensive method of quantifying plant growth responses in small scale research plots
- Additional studies are needed to identify and characterize stress color signatures