Spectral imaging of plants for measuring chlorophyll distribution

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Introduction

The CropReporter uses LED (light emitting diode) induced direct fluorescence imaging technology to image the plant health/stress status by calculation of F_v/F_m (variable fluorescence over saturation level of fluorescence). Within a short time interval (≈800 ms) multiple images are captured. For each pixel of the fluorescence image F_v/F_m is calculated and presented as an image that correlate with the quantum yield of PSII photochemistry. The advantage of the technology lies in the imaging of photosynthetic parameters of whole plants within a short time interval and detectable before it can be seen by eye.

Inside the CropReporter there is place for 6 different optical filters. With these filters the following images can be made:

- Chlorophyll fluorescence images
- Separate red, green and blue images
- Chlorophyll reflection images
- Anthocyanin reflection images
- Near Infra Red (NIR) reflection images.

In this example a colour image was calculated from the red, green and blue images (Fig. 2A). Using the reflection image of the chlorophyll filter and a reference image in the NIR an image was calculated that is a measure for chlorophyll content and displayed as an overlay onto the colour image (Fig. 2B). From this image an average anthocyanin index with standard deviation can be calculated.

Figure 1. CropReporter for side view imaging of monocotyledons. Using high intensity red light emitting diodes fluorescence images are being captured, white light emitting diodes together NIR lighting are being used for spectral imaging at six different filter bands. Images are captured at a resolution of 1.4 Mp and 14 bit digital grey values.

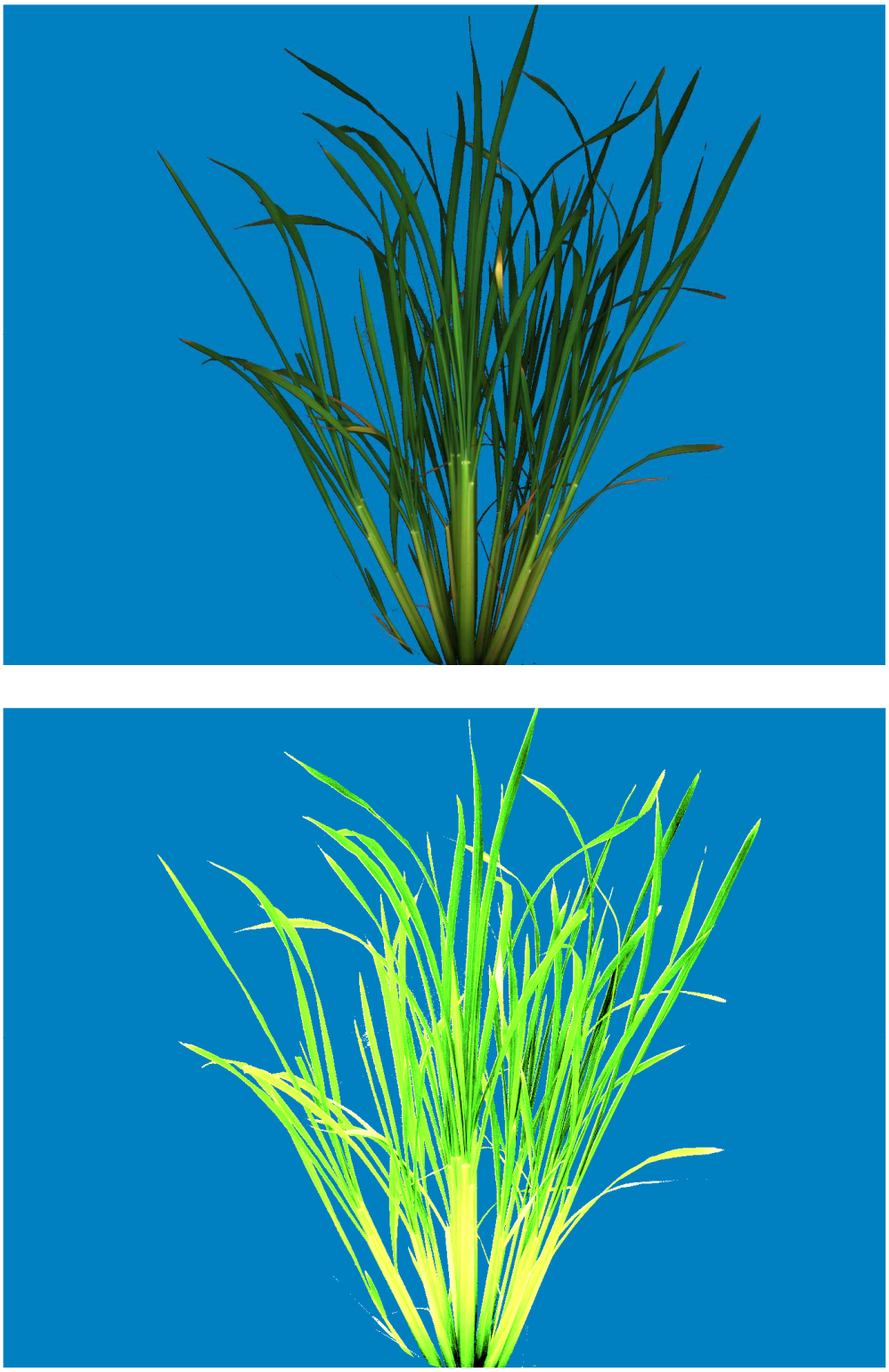

Figure 2. A) Colour image constructed from separate red, green and blue images (top image) of a rice plant (Oryza). B) Image showing the distribution of chlorophyll in false colours ranging from light green for low content to dark green for high content.

Figure 3. Image showing the overlay of low chlorophyll content in white onto the colour image.

Conclusion

The CropReporter was able to capture high resolution colour images and reconstruction of the chlorophyll content as an overlay onto the colour image. The application of the CropReporter was demonstrated having great potential for measuring chlorophyll distribution.

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