Fusion of Remotely Sensed Data from Airborne and Ground-based Sensors for Crop Discrimination

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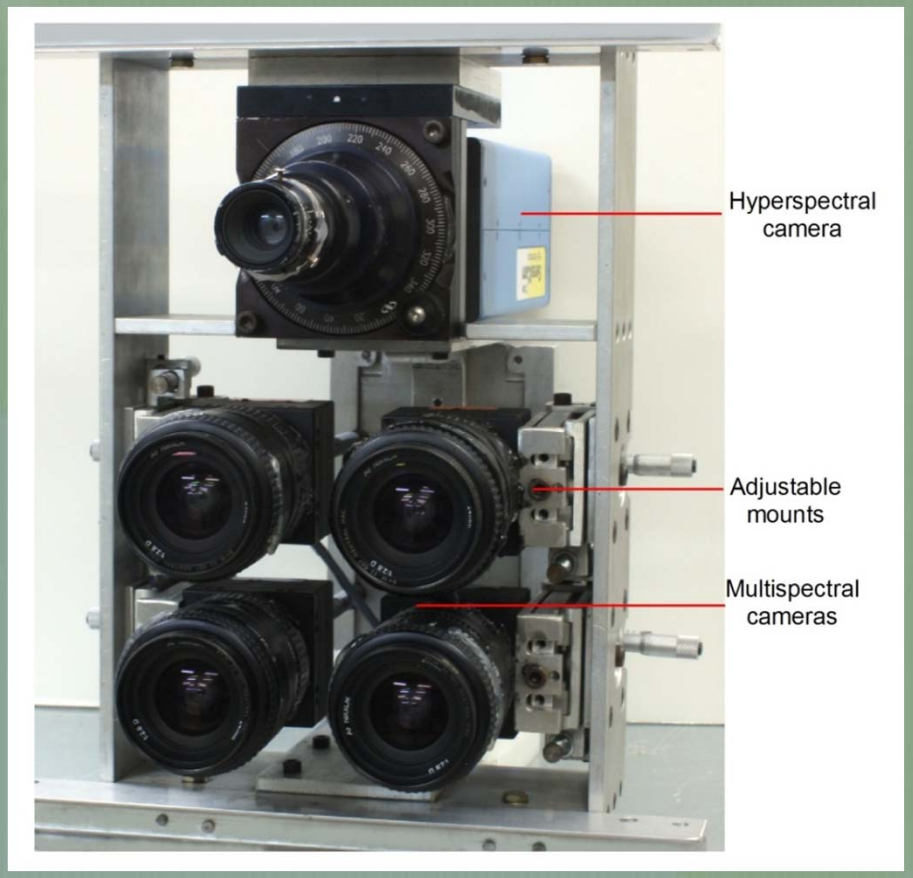
USDA-ARS Multispectral Systems



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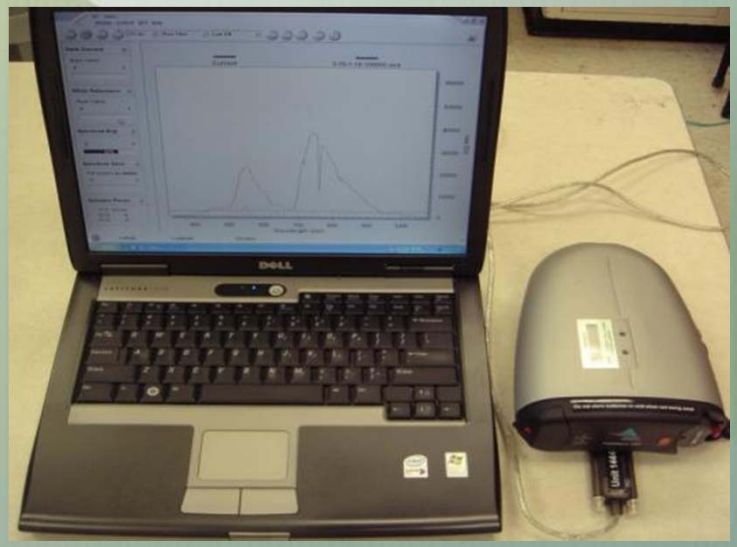
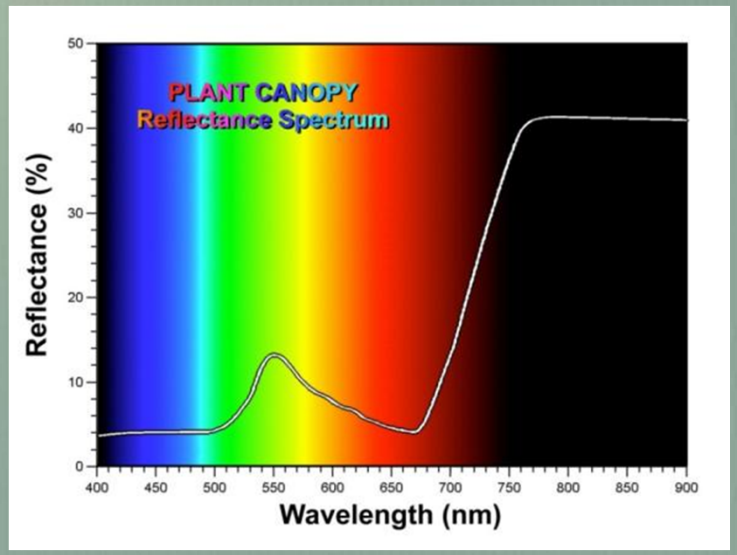
Airborne Remote Sensing System for Aerial Applicators

- The multispectral camera is coupled with a camera control system to become a pest management tool for airborne remote sensing.
- The system produces precise images for the spatial analysis of pest infestations.
- Through image processing, data from the system is converted into prescription map for variable rate aerial application.

Ground-based Remote Sensing

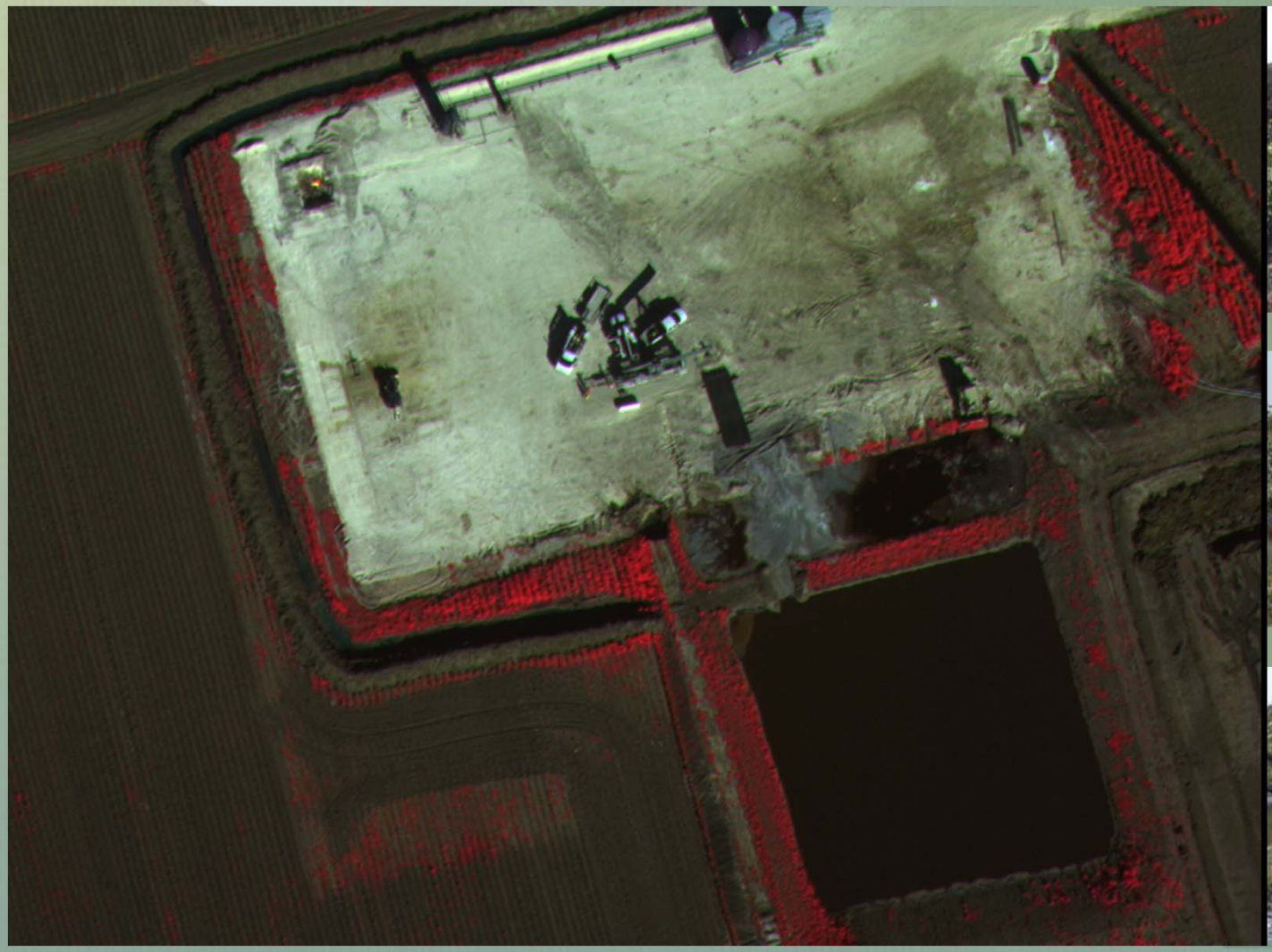




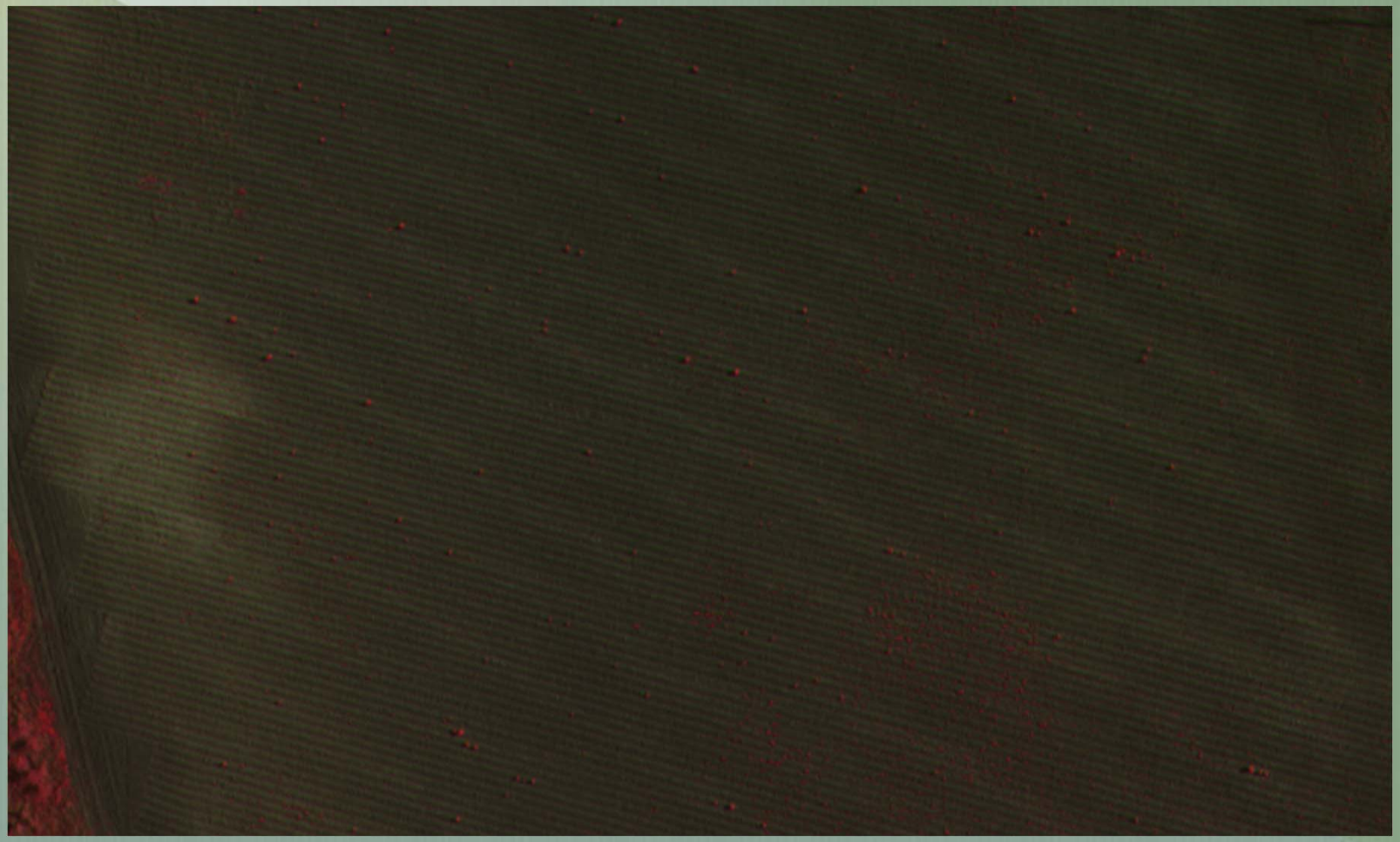
Why Detect Volunteer Cotton Plants?

- Timely detection and remediation of volunteer cotton plants in both cultivated and non-cultivated habitats is critical for completing boll weevil eradication in Central and South Texas.

Cotton Plants within an Oil Pad



Multispectral Image of Volunteer Cotton



The Purpose of This Study

- Investigated the use of aerial imagery and ground-based remotely sensed data for the discrimination of different crop types and timely detection of cotton plants over large areas.

Benefits for Aerial Applicators

- This research may benefit aerial applicators by creating a new revenue source for using the similar cameral system and then taking aerial images and selling the images to other users

- This research may benefit aerial applicators for using your airplane to spray chemicals to destroy the cotton regrowth or volunteer cottons.

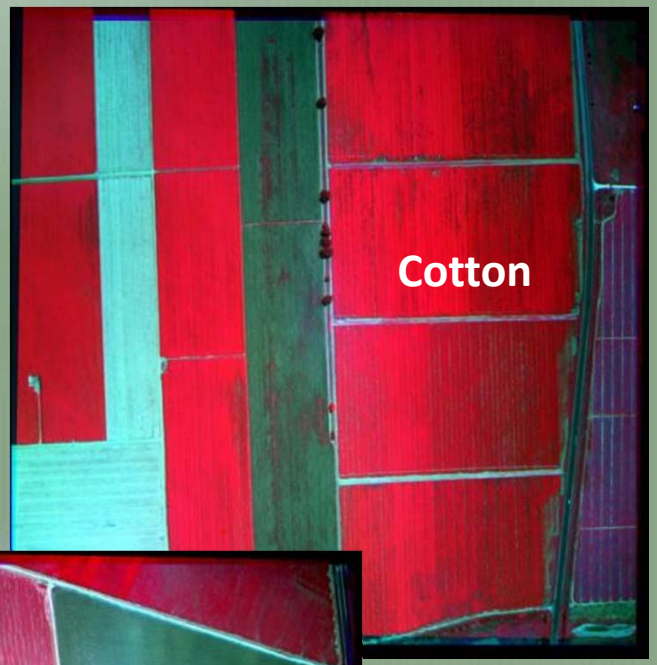
What We Did

- Airborne multispectral imagery and ground-based spectral reflectance data were acquired at the same time over three large agricultural fields in Burleson Co., Texas during the 2010 growing season.

Data Used for Distinguishing Crop Types

- Airborne multispectral imagery
- Ground-based spectroradiometer data
- Combined data from the airborne and ground-based spectral measurements

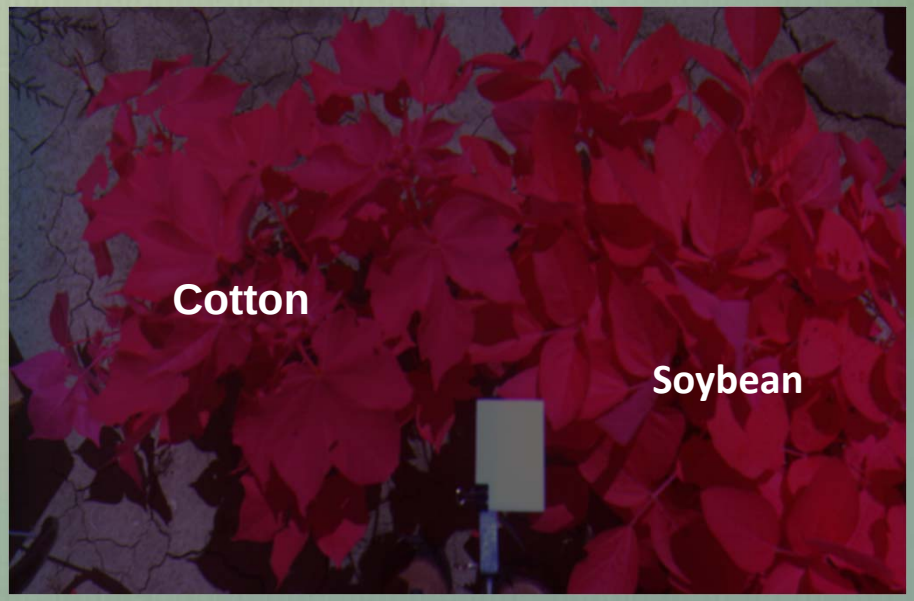
Airborne Multispectral Imagery

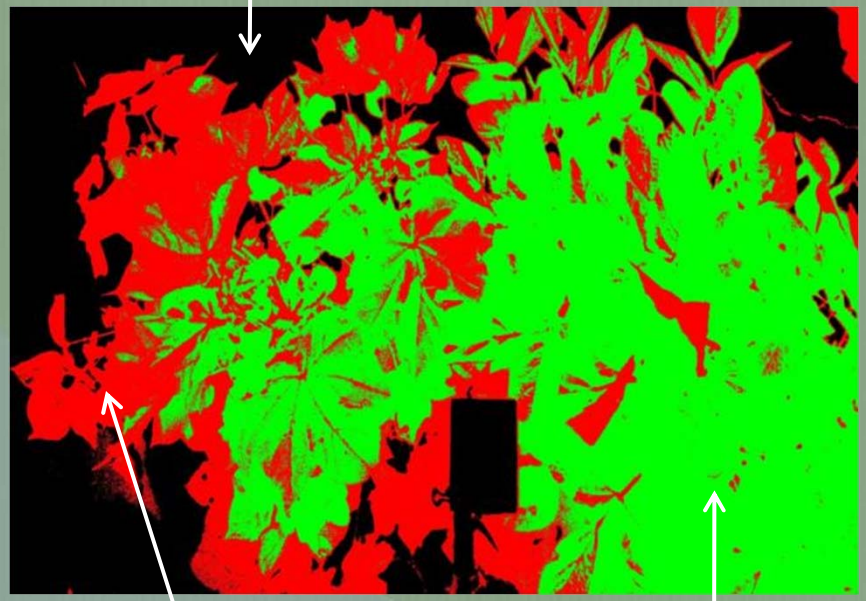


Ground Sensing-Field Measurement

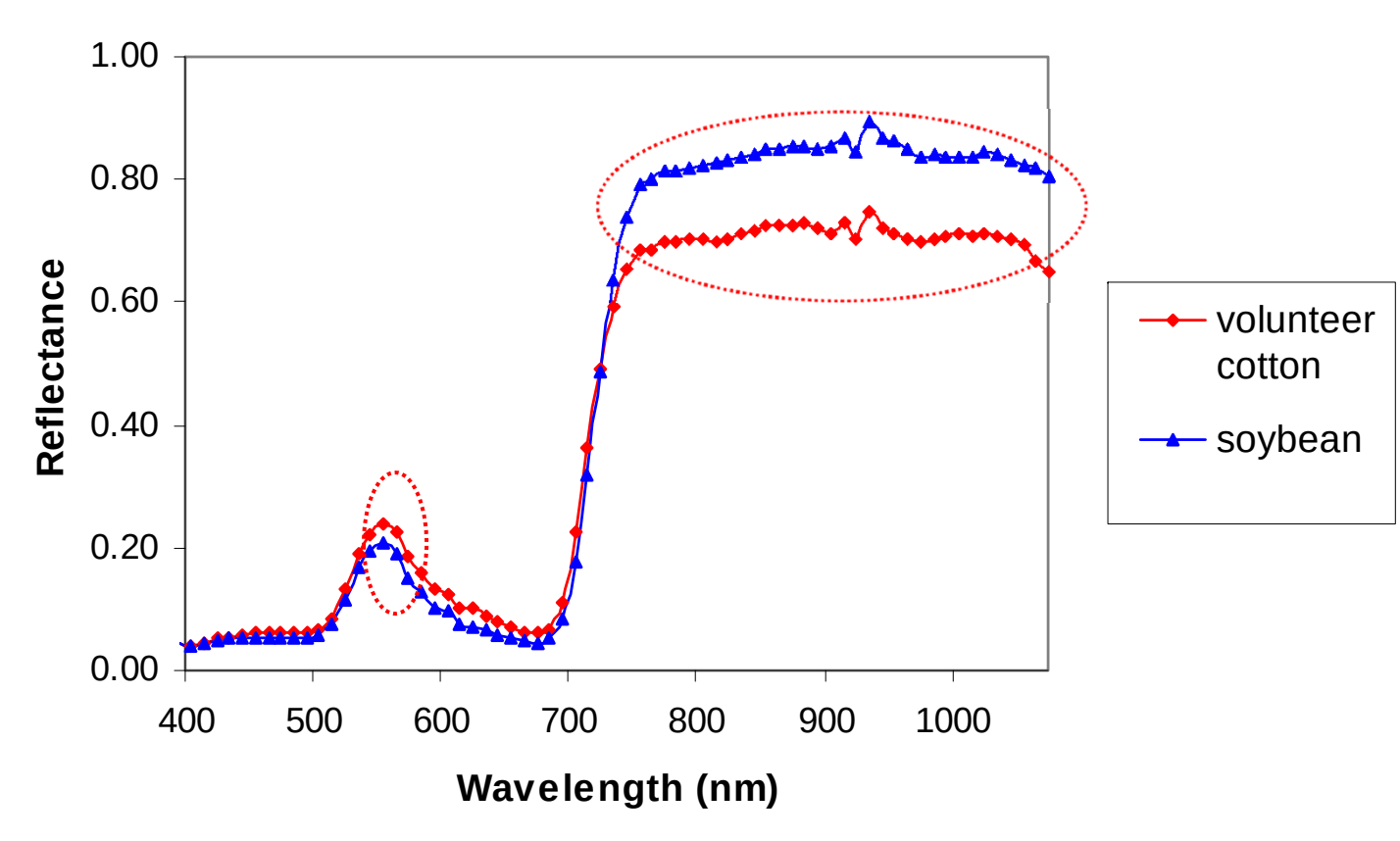
- The discrimination accuracy of aerial- and ground-based data were examined individually; then a multi-sensor data fusion technique was applied on both datasets in order to improve the accuracy of discrimination.

Ground Multispectral Imagery

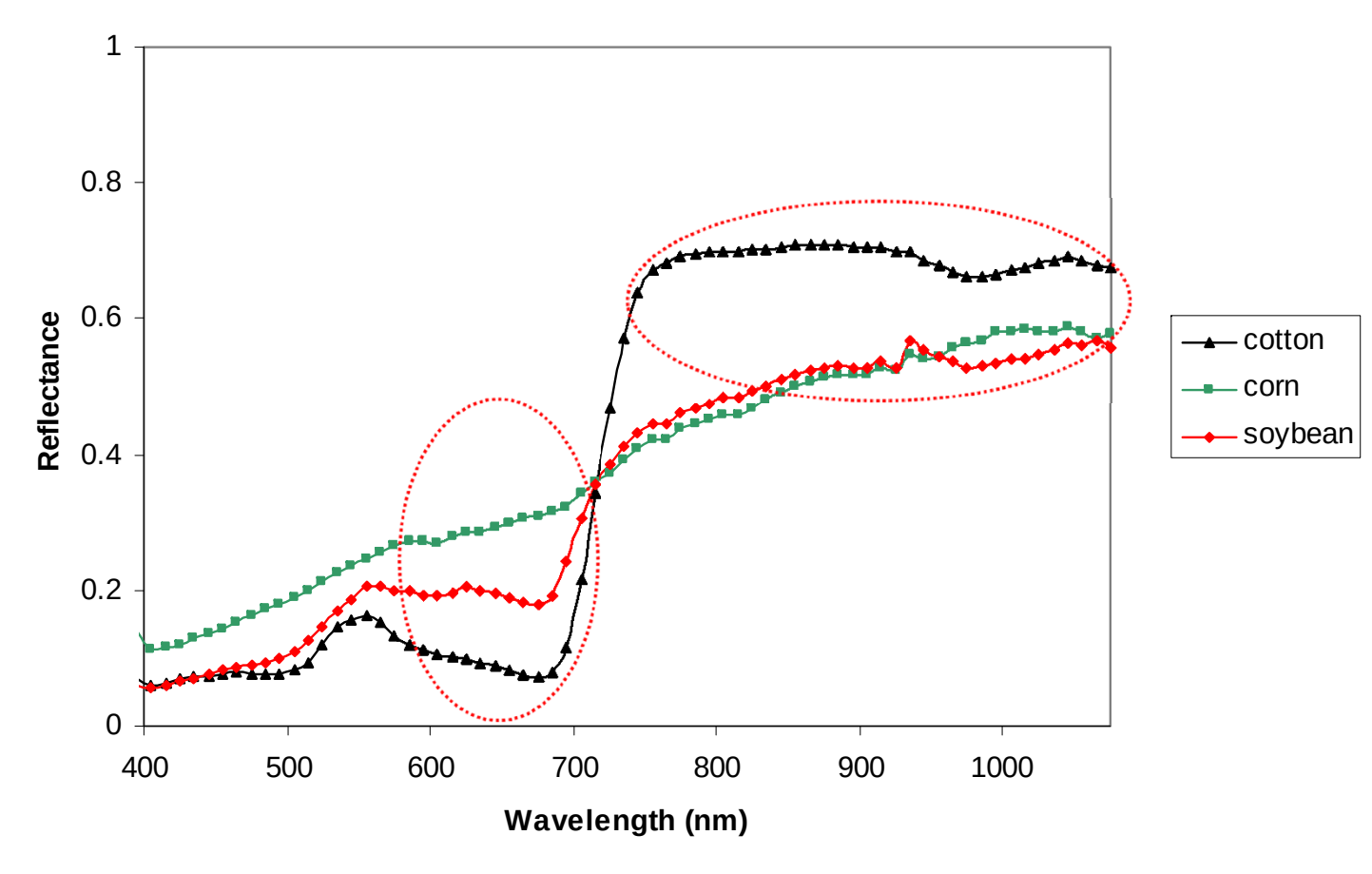




Reflectance spectra of Volunteer Cotton and Soybean Plants



Comparison of Cotton, Corn and Soybean Spectra



Classification Results

Data Source	Classification Accuracy
Multispectral Image	90%
FieldSpec Spectroradiometer	93.3%
Image & FieldSpec Spectoradiometer	100%

Results

- The individual classification accuracy of data taken with the aerial- and ground-based sensors were 90% and 93.3%, respectively. In comparison, the accuracy of discriminating crop types with fused data was 100%.

Conclusions

- Reflectance spectra of the volunteer cotton plant and soybean plant are different.

- Even for one crop type in the same field, the reflectance spectra differed, especially in the near infrared region of the spectrum.

Conclusions (cont.)

- Neither airborne imagery nor ground spectroradiometer measurements alone could differentiate different crop types with 100% accuracy.

- The fused dataset performed better in discriminating crop types than did the datasets using a single sensor alone.

Conclusions (cont.)

- These results suggest data fusion techniques could:
  - enhance our ability to detect volunteer cotton plants occurring in cultivated and non-cultivated habitats
  - produce prescription map for herbicide application

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Thank You !