On-Pivot Sensing System for Site-Specific Cotton Management (Field 5)
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Objective: To implement and test a device, installed on a center-pivot irrigation system, for collecting remote sensing data for use in managing the cotton crop in that field.

Methodology: The system consisted of three basic parts: 1.) A series of sensors located at regular intervals along the irrigation pivot; 2.) A centralized data logger to collect the data from the sensors; and 3.) A GPS antenna and receiver to allow determination of the position of the pivot. The sensor package contained three sensors--one operating in the thermal infrared wavelengths (TIR, approximately 10 microns), one operating in the red wavelengths (RED, approximately 660 nm), and the third operating in the near-infrared wavelengths (NIR, approximately 850 nm). Data from the RED and NIR sensors were to be used to determine ground cover of the crop, while data from the TIR sensor were intended to monitor surface temperature. The need to monitor both ground cover and surface temperature was recognized from previous research that showed that they could be combined to determine water stress.

Miniature RED and NIR sensors for the sensor package were obtained from CropScan, Inc. Miniature TIR sensors were obtained from Exergen, Inc. A set of three sensors (one each of the RED, NIR, and TIR sensors) were installed at regular intervals along the center-pivot irrigation system. Three spans of the irrigation system were fitted with nine sensor packages per span.

Sensors were enclosed in cases to protect them from precipitation, dew, and dust in the field environment. The Exergen TIR sensors were already water-proof from the factory, so cases design for them were intended primarily to provide thermal insulation. An example of the TIR case is shown in Fig. 1a. The CropScan sensors were sensitive to moisture, so they were enclosed in an aluminum case. A number of designs were tried over the course of the study, with varying degrees of success. Most tended to admit water (either from rain or dew). A design was finally developed in the fall of 2004 that appeared to be water-tight. This is shown in Fig. 1b.

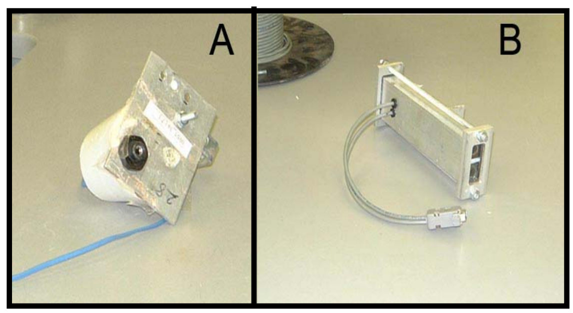

Fig. 1. Cases developed for the TIR sensors (A) and pairs of RED and NIR sensors (B).

Results: The system developed was susceptible to a number of operational problems. The main problems were: 1.) The design and fabrication of a water-proof case for the RED and NIR sensors caused significant delays in the project. On several occasions, RED and NIR sensors had to be sent to CropScan for repair following leaks in the cases; 2.) Untimely rains during the project made it difficult to install and maintain the sensors on the pivot. The forklift used to work on the sensors could not get into the muddy field after rains. Since the TIR sensors came in a water-tight form from the factory, they were able to operate with reasonable dependability and produce usable data. An example of a surface temperature map constructed for part of the study field is shown in Fig. 2.

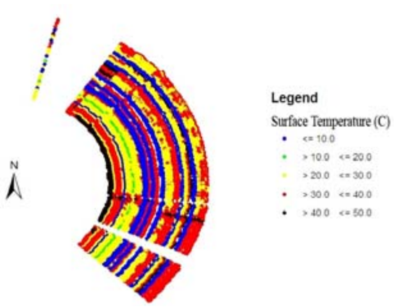

Fig 2. Map of surface temperature derived from the TIR sensors.