

## FEATURES

- Upward and downward facing sensors (no need to carry white panel reference in field)
- Can be used in lightly cloudy conditions
- 8 narrowbands (460, 510, 560, 610, 660, 710, 760 and 810 nm)
- Interfaces with the CROPSCAN Data Logger Controller
- Light weight and completely portable
- Can be used in stand-alone unattended operation

## APPLICATIONS

- Describe:
  - normal plant growth
  - plant canopy color
- Estimate:
  - crop biomass
  - biochemical content
  - crop yield components
  - crop quality factors
  - leaf area index
  - crop yield and quality loss due to disease, insect infestation, air pollution, nutrient deficiencies, chemical phytotoxicity, etc.
- Evaluation of plant growth modifiers
- Objective and efficient rating of foliar disease
- Monitoring effects of herbicide activity
- Soil amendment and fertility studies
- Leaf feeding studies
- Irrigation scheduling studies
- Effects of drought on plant growth and yield
- Characterization of different genotypes
- Evaluation of experimental area variability
- Ground truth for Remote Sensing

# CROPSCAN MSR87 System

## THEORY OF OPERATION

Every substance emits, absorbs, transmits or reflects electromagnetic radiation in a manner characteristic of the substance. This is the underlying principle involved in all remote sensing. By measuring the quantity of radiation absorbed, transmitted or reflected in each of the wavelengths, the characteristics of the substances can be defined. In practice, only certain selected wavelength bands need to be chosen to discriminate between selected characteristics of substances. For the **CROPSCAN Multispectral Radiometer (MSR) System**, narrow band interference filters are used to select certain bands in the visible and near infrared (NIR) regions of the electromagnetic spectrum. This region is useful for quantifying the reflectivity of plant canopies as affected by stresses of various kinds. The NIR bands of 750-900 nm are particularly useful for detecting and estimating the severity of foliar disease of plants. Longer wavelengths in the NIR may be useful for estimating biochemical content of plants.



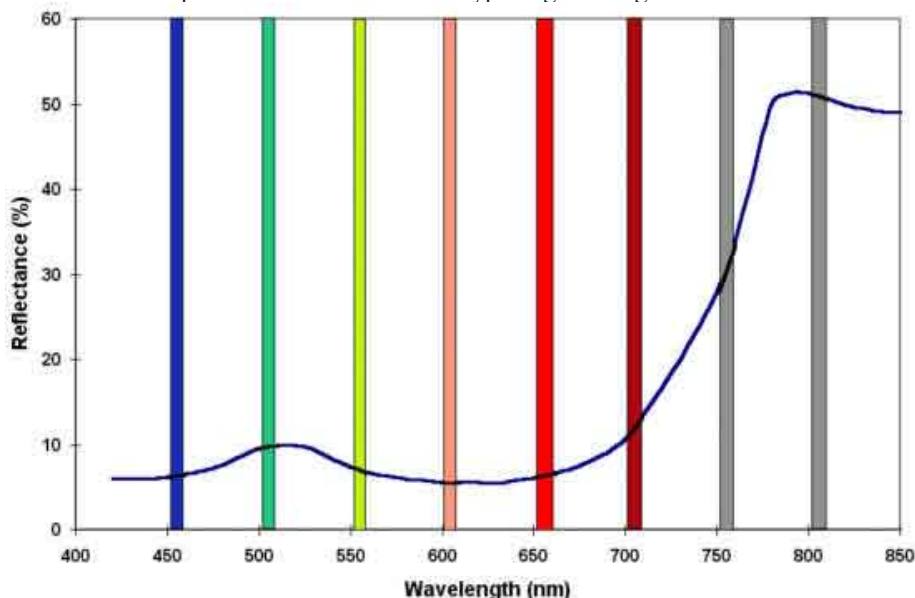
## SYSTEM OPERATION

In the field the radiometer is held level by the support pole above the crop canopy. The diameter of the field of view is one half of the height of the radiometer above the canopy. The data acquisition program included with the system facilitates digitizing the voltages and recording percent reflectance for each of the selected wavelengths. The program also allows for averaging multiple samples. Ancillary data such as plot number, time, level of incident radiation and temperature within the radiometer may be recorded with each scan.

Each scan, triggered by a manual switch or by pressing the space key on a terminal or PC, takes about 2 seconds. An audible beep indicates the beginning of a scan, two beeps indicate the end of scan and 3 beeps indicate the data is recorded in RAM. Data recorded in the RAM file are identified by location, experiment number and date.

The design of the radiometer allows for near simultaneous inputs of voltages representing incident as well as reflected irradiation. This feature permits accurate measurement of reflectance from crop canopies when sun angles or light conditions are less than ideal. Useful measurements of percent reflectance may even be obtained during cloudy conditions. This is a very useful feature, especially when traveling to a remote research site only to find the sun obscured by clouds.

MSR87 Spectral Bands shown over typical green vegetation reflectance



## EXPERIMENTAL RESULTS

Many experiments have been conducted to test the application of multispectral radiometry for measuring severity of foliar diseases of barley and their effects on yield and quality. In all of these experiments it was found that remote sensing using the radiometer was much more efficient and accurate for estimating severity of disease than the conventional visual rating methods. The radiometer is also more effective for estimating the loss in yield due to different levels of disease than is the plot combine. The radiometer is also useful for estimating the efficacy of different rates and

timing of fungicide application and for screening of experimental fungicides in field trials.

## SOFTWARE INCLUDED

Software is included for both the DLC and a PC (Win95-WinXP). The MSR program for the DLC operates it for plot-based data collection. Radiometer sensor millivolt readings are logged in the DLC. The software for a PC includes programs to interface to the DLC to retrieve the data, process the retrieved data to calculate percent reflectance, statistically analyze (ANOVA) the data, save and restore the MSR program and configurations, as well as other programs for data formatting, time of day sampling schedules, and support of stand-alone data collection.

Output reflectance data files are ASCII text files, comma delimited, for easy import into spreadsheet programs for subsequent data analysis and graphing.

## HARDWARE INCLUDED

The system includes the radiometer, data logger, LCD hand terminal, extension pole (extends to 3.2 meters), mounting hardware, memory card, AC adapter charger, cables/adapters, diskette (with software), user's manuals, and shoulder carry pack.

## SPECIFICATIONS

### Radiometer:

**Wavebands:** 8

**Center Wavelengths:** 460, 510, 560, 610, 660, 710, 760, & 810 nm

**Bandwidths:** ~10 nm

**Operating Range:** 0 to +50° C, 0 to 100% RH noncondensing, <20% RH storage

**Reflectance Range:** 0 to 100%

**Resolution:** 0.06%

**Accuracy:** +/-4%

**Detectors:** Photodiodes

**Size:** 80 x 80 x 100 mm

**Weight:** 0.68 kg

### Data Logger Controller (DLC):

**Operating Range:**

-40 to +70° C,

0 to 100% RH noncondensing

**Resolution:** 12 bits

**Accuracy:** +/-0.4%

**Number of Channels:** 16

RS232 Serial Cables to PC or

CT100 Hand Terminal

**Size:** 248 x 178 x 28 mm

**Weight:** 1.4 kg

### Power:

**Battery Type:** NiMH, 10V,

1.6 Ah battery pack, located in DLC, powers complete system

**Operational Capacity:** 9 hours on full charge

**AC Adapter:** Use overnight to recharge batteries



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