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VARIABILITY OF REFLECTANCE MEASUREMENTS WITH SENSOR ALTITUDE AND CANOPY TYPE

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Reliance on portable, ground-based sensors for measuring crop reflectance has created a need for comparable and reliable measurement procedures capable of providing calibrated and reproducible canopy reflectance data. Acquisition of reproducible data is assured in part if the field of view (FOV) of the measuring sensor contains a representative sample of the canopy. The particular portion of the canopy in the sensor FOV changes with the altitude of the sensor above the canopy. For example, readings taken at low altitudes might tend to be erratic because a single leaf might fill the sensor FOV, biasing the measurements. As the sensor altitude above the canopy increases, the repeatability of the measurements should improve because the canopy components (stalks, leaves, soil, shadows, etc.) viewed by the sensor tend to better represent the canopy.

The objective of the experiment was to determine how the canopy reflectance varies as a function of sensor altitude above the crop, and particularly, what minimum altitude is needed to acquire repeatable reflectance measurements with a desired precision. Data were acquired in 1979 on three canopies, mature corn planted in 76 cm rows, mature soybeans planted in 96 cm rows with 75 percent ground cover, and mature soybeans planted in 76 cm rows with 100 percent ground cover. Data were acquired using a Landsat band radiometer (Exotech 100) with a 15 degree field of view at ten altitudes ranging from 0.2 m to 10 m above the canopy. At each altitude, measurements were taken at 15 cm intervals along a 2.0 m transect perpendicular to the crop rows.

The reflectance data were plotted as a function of altitude and horizontal position to verify that the variance of measurements at low altitudes was attributable to row effects which disappear at

higher altitudes where the sensor integrates across several rows. The coefficient of variation of reflectance in the red (0.6-0.7 μm) band decreased exponentially from 34.8 percent at 1.0 m above the corn canopy to 1.9 percent at 10 m. In the near infrared (0.8-1.1 μm) band, the coefficient of variation decreased exponentially from 18.9 percent at 1.0 m above the corn canopy to 1.3 percent at 10 m. With simple random sampling at least 13 measurements of red reflectance at 1.0 m or one measurement at 6.0 m above the corn canopy were required for ± 10 percent precision at the $\alpha = 0.05$ level.

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