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THE DETECTION OF AVAILABLE SOIL MOISTURE BY REMOTE SENSING TECHNIQUES

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Purdue University, 1969

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THE DETECTION OF AVAILABLE SOIL MOISTURE BY REMOTE SENSING TECHNIQUES

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This research was designed to study soil moisture – plant moisture relationships and the effect of these relationships on reflected and emitted energy from the soil and plant surfaces. This energy was measured in greenhouse and field environments.

In the greenhouse, several preliminary experiments were conducted on corn plants to provide soil moisture – plant moisture information for use in planning additional greenhouse studies of relationships between leaf moisture and soil moisture. This information was also helpful for interpretation of results obtained from field studies.

Results from these experiments showed leaf moisture content varied significantly with leaf position and that diurnal effects had a definite influence on leaf moisture at the different leaf positions. Leaf moisture was found to vary significantly along the length of individual leaves. Root moisture content did not have a significant effect on gravimetric soil moisture determinations.

Later, more detailed greenhouse studies showed that reflectance changes were found to be inversely related to leaf moisture content. In an available moisture study, statistically significant differences in reflectance were obtained as a function of time. In addition, high correlation values were obtained between leaf moisture and the reflectance values at the following wavelengths: 0.53 μ(green), 0.64 μ(chlorophyll absorption band), 1.43 and 1.94 μ(water absorption bands).

Leaf spectral data obtained from corn and soybean leaves grown in the greenhouse showed a higher response in portions of the near infrared than similar leaves grown in the field.

Fourteen field study plots were established to obtain multispectral data using an aircraft scanner system. These plots contained irrigated and non-irrigated treatments of bare soil, soybeans, sorghum, sudangrass, early planted corn, late planted corn and alfalfa. The field plots were flown at three different altitudes (500, 1000 and 3500 feet) during June, July and September in the 1966 growing season. Ground truth data, to be studied in conjunction with the scanner data were collected from the study plots during the time of the aircraft flights. Soil moisture, plant moisture, leaf moisture, leaf reflectance, profile temperature, percentage ground cover and plant height data were collected.

Percentage ground cover values showed a positive relationship with the reflective responses in the near infrared wavelengths. Available soil moistures as measured in the root zone area did not show a definite relationship with reflective or thermal responses. It was determined that an interrelationship of plant cover, plant height and soil moisture exists which is believed to show more positive relations to reflective and thermal responses. Plant moisture samples taken during the September mission showed a progressively cooler thermal response with increasing plant moisture content.

Separation of the irrigated and non-irrigated treatments of all crop covers showed a high degree of accuracy using a maximum likelihood classification technique assuming Gaussian distribution of the data. Good separation of the 14 different classes was achieved for both morning and noon flights during July. The accuracy of these classification results decreased with the number of wavelength bands used in the classification procedure. Since the irrigated plots were at field capacity and the non-irrigated plots were near the permanent wilting point, these results indicate that available soil moisture levels near each limit can be detected by remote sensing techniques.

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