ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN

FORMERLY WILLOW RUN LABORATORIES, THE UNIVERSITY OF MICHIGAN

P. O BOX 618 • ANN ARBOR • MICHIGAN • 48107 PHONE (313) 994-1200

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WHEAT PRODUCTIVITY ESTIMATES USING LANDSAT DATA
TYPE II PROGRESS REPORT

for the period

16 August 1975 - 15 November 1975

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Prepared by

Richard F. Nalepka - Principal Investigator
John Colwell - Co-Principal Investigator

for

Mr. G.R. Stonesifer, NASA Technical Officer
Code 902
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt Road
Greenbelt, Maryland 20771

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The following report serves as the second Type II Progress Report for LANDSAT Follow-on Investigation #2062L which is entitled, "Wheat Productivity Estimates Using LANDSAT Data."

This investigation has two primary objectives. These objectives are:

1. To develop techniques and procedures for estimating characteristics of wheat canopies which are correlated with potential wheat grain yield (e.g., leaf-area index [L.A.I.], percent vegetation cover, or dry weight biomass) by use of LANDSAT data.

2. To demonstrate the usefulness of LANDSAT data for estimation of wheat yield on a LACIE (Large Area Crop Inventory Experiment) intensive test site.

A. PROBLEMS

There have been some difficulties in obtaining data which is needed. In particular, there is a need for aerial photographs obtained over the Finney, Kansas site, plus field-reflectance data obtained by the helicopter and by the van. It is hoped that yield data from more of the fields on which we made estimates of vegetative condition can be made available.

B. ACCOMPLISHMENTS

Reduction and analysis of field data has continued with the reduction of radiometric data (hemispherical reflectance and transmittance of wheat canopy components) being completed during this quarter. Most of the harvested wheat sample data has been separated into components and has been dried and weighed. An algorithm for relating leaf dry weight to leaf area has been developed using leaf area data as determined by using the leaf area meter. This algorithm makes it possible to infer biological leaf area (and L.A.I.) from the dry weight of leaf samples. Some of the leaf

weight data has been transformed to leaf biomass and/or biological leaf area index data.

Some of the aerial oblique photographs gathered during the field measurement exercise have been examined to stratify fields into homogeneous areas, and to determine the percentage of each field occupied by a particular stratum. This procedure is necessary in order to properly weigh field samples obtained in various strata. The procedure would be simplified if copies of vertical aerial photographs of the site such as those obtained by the NASA aircraft were available.

Ground photographs of the fields are now being examined to determine the relative projected areas of the various plant canopy components. It was hoped that these relative projected area data could further be reduced to horizontal and vertical projected vegetation area indices. In simple canopies this can be done with reasonable confidence. However, in vegetation canopies in which there are several (radiometrically different) components, and an uneven distribution of these components in the vertical dimension, a considerable number of assumptions have to be made in order to reduce the photographic data. Most of the assumptions are only fair approximations to reality. Therefore, in complex canopies, it may not be possible to reduce relative projected area to horizontal and vertical projected area indices. Stereo ground photographs would make this problem more soluable, and such photographs should probably be taken in the future.

Some of the data collected for this LANDSAT investigation has been analyzed and reduced in ways that would be of benefit to other related projects. In particular, some of the field data is being used to help define wheat canopies and their characteristics for signature analysis and signature extension for ERIM tasks on contract NAS9-14123, the NASA SR&T program.

Details of the field sampling procedure have been documented. The significance of parameters measured or estimated, and their relationships to each other, have also been described. This material will be included in the final report.

LANDSAT imagery and CCT's have been ordered and received. Preliminary analysis of the imagery indicates that there is good data for the Finney test site on November 22, 1974; and May 3 and 21, and June 18, 1975.

Some field data (including crop yield) has been obtained from Finney County Agricultural Stabilization and Conservation Service personnel (Gordon O'Dell). Unfortunately, farmers' estimates of yield on a per-field basis are available on only a few of the 13 fields on which vegetation condition had been monitored by the ERIM field team. An attempt is being made to derive other estimates of yield on the remainder of the 13 fields. Without such data it will be difficult to investigate the relationship between yield and field vegetative conditions. However, yield data on many other fields in the test site are available. Therefore, it should be possible to investigate the relationship between LANDSAT data and yield.

C. RESULTS

Preliminary analysis of the wheat component radiometric data suggests that the radiometric properties of a particular type of component (e.g., live leaves), may vary over time. This factor may make it more difficult to uniquely relate LANDSAT radiance or reflectance data to canopy properties (such as L.A.I.) as a function of time.

The biological leaf area index data shows that there can be large variations in field vegetative condition from point to point. This is especially true in flood-irrigated fields, in which plant density (and development) varies drastically between rows that are in "channels" vs. those that are in "raised" areas. Therefore, considerable care must be used in interpreting the significance of isolated leaf area index measurements made from a single wheat row.

One of the principal advantages of the photographic data is that a fairly large area can be imaged (and hence sampled) on a single photograph. It is felt that we were able to get more representative indications of field vegetative condition from the ground photos than from a harvested sample from one row.

D. PUBLICATIONS

No publications or abstracts of talks will be reported on during this period.

E. RECOMMENDATIONS

1. Delivery of aerial photos and field reflectance data to ERIM by NASA/JSC should be expedited.

2. The possibility of a follow-on program should be considered at this time so that field techniques can be further refined, and personnel can be placed in the field starting in late April or early May. A second-year program will be needed to demonstrate the usefulness of LANDSAT data for forecasting and estimating wheat yield in a year with a different weather sequence. In addition, optimally collected data on field condition will be of considerable use not only to this project, but to other LACIE related projects as well.

F. FUNDS EXPENDED

Total expenditures during the period 16 August through 15 November, 1975 are $57,766.

G. DATA USE

	Value of Data Allowed	Value of Data Ordered	Value of Data Received
USDI EROS Data Center	$12,000	$ 4,000	------
USDA/ASCS Aerial Photography Field Office	$ 1,800	$ 432	$ 432

Submitted by: Richard F. Nalepka/jcd
RICHARD F. NALEPKA
Principal Investigator

Approved by: Jon D. Erickson
JON D. ERICKSON
Head, IS&A

Approved by: Paul R. Lee for
RICHARD R. LEGAULT
Director, IROD

jcd