TYPE II PROGRESS REPORT NO. 2
UNIVERSITY OF TENNESSEE AGRICULTURAL REMOTE SENSING
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(a) PROJECT TITLE: Utilization of ERTS data to detect plant diseases and nutrient deficiencies, soil types and moisture levels.

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(b) GSFC ID UN650 MMC #139, Contract No. NAS5-21873

(c) Turn-around time for computer printouts still sometimes causes delays. The microdensitometer has been out of operation since mid-April. Also, different outputs have been obtained from different type drives on the University computer using the same tape and command cards. Thus, there has been no automated data processing during this period.

(d) Accomplishments

1. Delineation of Soil Associations: (Parks)

Previously, locating small cropland areas and correlating aerial photos of these areas with prints of satellite imagery has been difficult. This problem has been resolved by using enlargements of satellite imagery and carefully examining the various color shades of the satellite imagery as compared with the aerial photos. The problem resulted from the over two months time delay between the aerial photographs and the space imagery used for comparisons.

Due to cloud cover, haze, and similar related problems, only about one image of four is sufficiently clear to use for comparison purposes. This has created a time differential resulting in comparison problems since sometimes drastic changes in crop maturity, soil moisture, and soil temperature have occurred.

Two primary West Tennessee target sites, the West Tennessee Experiment Station and the Ames Plantation, have been definitely located on satellite imagery and correlated with aerial photos. Crops on these areas and surrounding areas have been determined by ground surveys. This information has been used in attempts to predict crops on un-surveyed areas which have corresponding color shades to those of the surveyed areas.

Currently, computer densitometer printouts are being used in the development of crop "signatures" based on light density values of the imagery as determined by the scanning microdensitometer. This procedure involves comparisons of various stages of crop maturity for each MSS Band. Availability of clear, uniform, time-segmented imagery has presented a minor problem.

Of the imagery received to date, only the 1 October, 1972 imagery has been sufficiently clear to use in signature development. However, as clear imagery of other dates is received, it will be used for further comparisons. Results of the study of the 1 October imagery have been promising.

MSS channels 4, 5, 6, and 7 were scanned, and a corresponding density printout for each was analyzed. If density values appearing on each transparency were divided into four groups, the following results were found to hold true for each channel. Water had the highest density value. Forest land occupied the next highest level. Cropland (mainly Soybeans and Cotton) had the third highest density level. Pasture and similar grassland had the lowest density value. Results of printout analyses by MSS channels for Ames Plantation are given in Table 1. Further refinement of scanning and printout techniques is expected to enable further differentiation of areas into types of crops on cropland and types of trees in forested areas.

A Mosaic of 4 X enlargements of satellite imagery showing both target sites and the area in between is currently being prepared. This Mosaic is being prepared from a series of photos developed from imagery taken on 1 October, 1972 which is very clear and has very good detail. This Mosaic should aid in locating significant features in relation to areas which previously have been difficult to locate on full scale imagery. Both target areas can be seen clearly.

2. Crop Discrimination and Plant Disease Detection: (Hilty and Ellis)

The most suitable imagery obtained to date is October 1972. To date efforts have been concentrated on establishing spectral signatures for three crops in Obion County, Tennessee, and determining acreage of each. The crops involved are corn, soybeans, and pasture, all in the mature stage. Acreage measurements have been made with a point planimeter. Ground truth was provided by 25,000 ft. photos and information provided by local county agents. All data were taken from channel 4.

Only moderate success has been achieved in crop discrimination using channel 7 alone. Channel 7 includes density values in the range 100-140. On a 255 point density subrange the signatures for these three crops fell over a 30 unit span. Corn registered on the dense end of the spectral range studied, soybeans on the lighter, with pasture registering in a small (5 unit) intermediate band. In areas where only corn and soybeans were present, 70-75 percent accuracy was obtained in spectral discrimination.

Future plans include searching other channels for their spectrally close crops in hopes to find a multi-band set of signatures.

A five-acre plot of blight-susceptible corn has been established at Ames Plantation and will be monitored and photographed for disease detection. It is anticipated that the 25,000 ft. imagery will be most useful.

3. Forestry: (Rennie and Birth)

Considerable ground truth was collected in Polk County on 15, 16, and 17 May. Of main interest was the classification of forest stands by species group (pine, hardwood, pine-hardwood) on the strip of aircraft imagery taken from 23,000 feet on 23 March 1973. Our effort was concentrated on those stands observable from roads. This information has served as the basis for classifying all stands on roll 18 (film 2402 with #25 filter) of the aircraft imagery.

Presently, roll 21 (film 2424 with #89B filter) is being used to classify all the stands on the aircraft imagery into three volume groups.

Also, during the current period (June-July) the sampling design to use the satellite imagery, the aircraft imagery, and ground plots for classifying the forest stands of Polk County by volume and species group will be finalized. In addition, the forest land of the country will be classified into pine, hardwood, or pine-hardwood if the automated data processing system is operable.

(e) Significant Findings

Significant findings are given in Table 1. These findings demonstrate the feasibility of delineating major terrain features, land uses, and crop species through computerized analyses. Channel 6 appears to give the most information for making separations of this type.

By enlarging satellite imagery and visually comparing this with high altitude aerial photographs, locating small terrain features and cropland areas on satellite imagery is greatly facilitated.

TABLE 1. Results of Computer Printout Analysis for 1 October 1972 Imagery of Ames Plantation

MSS Channel	Density Subrange*	Land Use, Terrain Features, or Crops
	Density Range 140-190	
4	140-153	Pasture
4	154-169	Cropland
4	180-188	Forest
4	190	Water
	Density Range 150-240	
5	168-196	Cropland
5	218-238	Forest
5	240	Water
	Density Range 115-160	
6	115-133	Cropland
6	124-133	Pasture
6	133-144	Area Around House & Barn
6	144-157	Forest
6	159-160	Water
	Density Range 100-140	
7	105-120	Cropland
7	121-132	Forest
7	140	Water

Significant results found to date are that forest types are discernable on the 2402 imagery with a #25 filter: pine stands have dark tones, hardwood stands have light tones and pine-hardwood have intermediate tones. No textural differences are evident on this type of imagery. However, on the 2424 imagery with a #89B filter, textural differences are evident but tonal differences are absent. Areas of considerable texture are interpreted as stands of high volume while areas of suppressed texture are of low volume. The 2402 imagery with a #57 filter appears to have little information of importance in timber inventory.

(f)

(g) NASA aircraft support has been very cooperative and useful.

(h)

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