LARS Contract Report 083079

QUARTERLY REPORT

Reporting Period: June 1, 1979 - August 31, 1979
Contract Number: NAS9-15466
Title of Investigation:

Research in Remote Sensing of Agriculture,
Earth Resources, and Man's Environment

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16. Abstract

This report summarizes progress for the current quarter on the three tasks of the subject contract which are:

1. Agricultural Scene Understanding and Supporting Field Research
2. Processing Techniques Development
3. Computer Processing and Data Base Services

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TABLE OF CONTENTS

Task 1. Agricultural Scene Understanding and Supporting Field Research

A. Experiment Design and Data Analysis

The objectives of this task are (1) to design the Supporting Field Research program, including initial experiments to be conducted in 1979 and longer term experiments to be conducted during 1980-85, and (2) to conduct analyses of field research data on wheat, corn and soybeans.

During the last quarter, a draft of the project plan for the 1979 field research was completed and submitted to JSC. The plan describes the objectives and experimental approach to be followed in 1979. The plan is currently being revised to include additional information describing data analysis objectives and approaches. Secondly, analyses of corn and soybean spectral and agronomic data acquired in 1978 at the Purdue Agronomy Farm were continued. Thirdly, in support of the data analysis, the documentation of the graphics and analysis system used for analyzing spectrometer and agronomic measurements is being upgraded.

PROJECT PLANNING AND EXPERIMENT DESIGN

ACCOMPLISHMENTS

- 1979 MULTICROP SUPPORTING FIELD RESEARCH PROJECT PLAN WRITTEN AND REVIEWED
  - CURRENTLY BEING REVISED TO INCLUDE MORE INFORMATION ON DATA ANALYSIS OBJECTIVES AND APPROACHES

PLANS FOR NEXT QUARTER

- COMPLETE PROJECT PLANS
  - TECHNICAL OBJECTIVES
  - EXPERIMENTAL DESIGN AND APPROACH
  - DATA REQUIREMENTS
  - DATA ACQUISITION AND PREPROCESSING
  - DATA ANALYSIS
  - SCHEDULES, MANAGEMENT

DATA ANALYSIS

Accomplishments

Preliminary analyses have been completed on two topics and will be presented at the Quarterly Review.

1. Soybean canopy reflectance-maturity stage and cultural practices effects.
2. Effect of nitrogen fertilization on reflectance characteristics of corn.

Plans for Next Quarter

Complete analyses of 1978 corn and soybean experiments.

DEVELOPMENT AND DOCUMENTATION OF GRAPHICS AND ANALYSIS SOFTWARE

IN SUPPORT OF DATA ANALYSIS AT LARS AND JSC, DEVELOPMENT AND DOCUMENTATION OF LARSPEC AND STATISTICS AND GRAPHICS SOFTWARE IS BEING UPGRADED.

ACCOMPLISHMENTS THIS QUARTER

- CONTROL CARD DICTIONARY DESCRIBING SYNTAX, DEFAULT PARAMETERS, AND OPTIONS AVAILABLE COMPLETED FOR GSPEC, SPECIAL ACTION MONITOR CONTROL CARDS, AND LARSPEC TERMINAL COMMANDS.

- A 3-DIMENSIONAL PLOTTING TOOL (3GCS) WAS IMPLEMENTED FOR USE IN THE ANALYSIS OF SPECTRAL-AGRONOMIC DATA.

PLANS FOR NEXT QUARTER

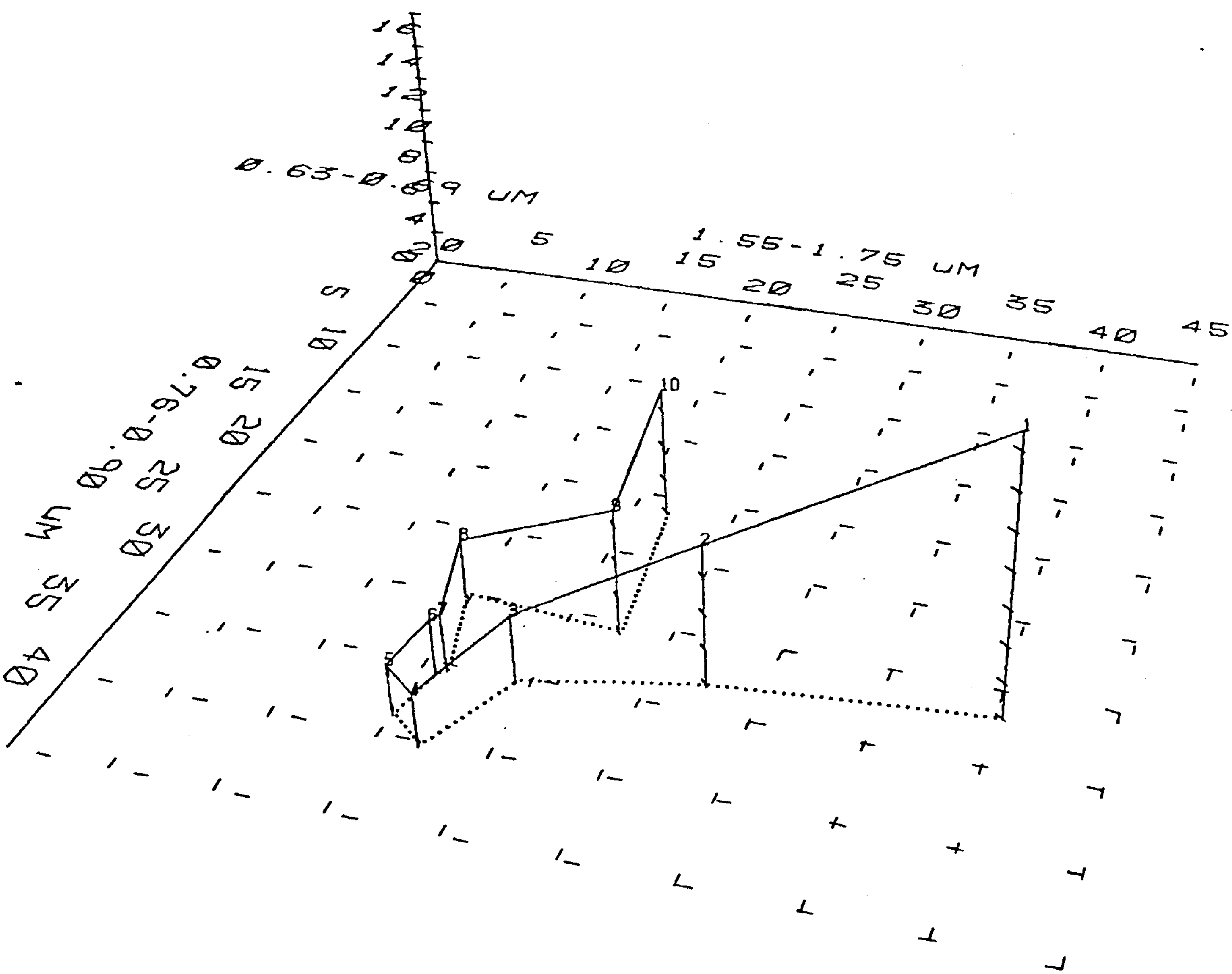
- LARSPEC TRAINING MANUAL WILL BE COMPLETED.

3DEXMP1

View Point 100, 50, 60
View Site 5, 20, 0
Window -50, 50, -50, 50

PLOT 732

SYMBOL	MATURITY STAGE
1	1.5
2	2.0
3	2.5
4	3.5
5	6.0
6	
7	6.2
8	7.0
9	8.0
10	9.0



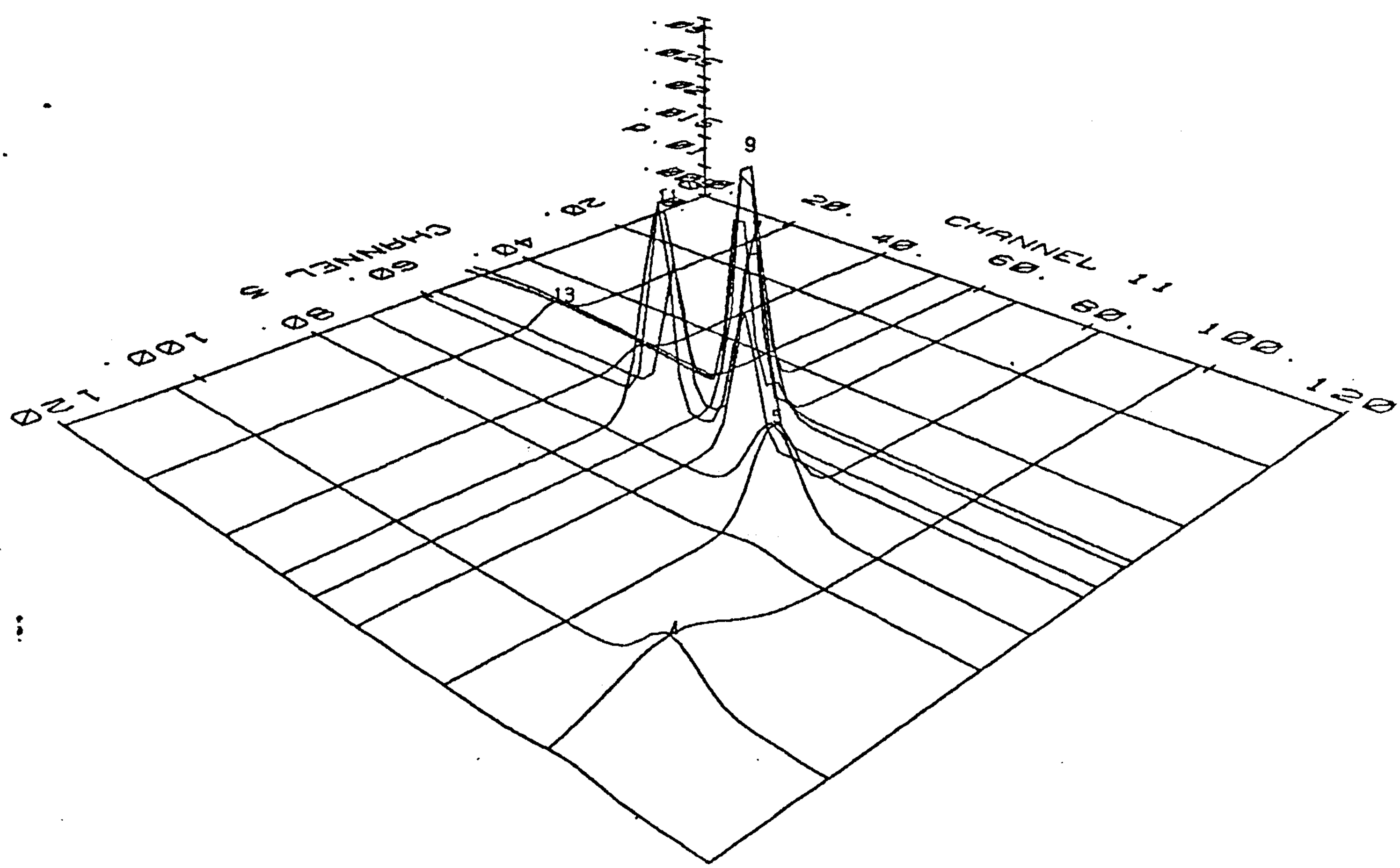
JOINT DENSITY FUNCTION PLOT

CLASS	CLASS NAME	CLASS	CLASS NAME
4	EXTRATI	9	DECID
5	SOIL	11	RIVER
7	VEGION	13	LAKE2

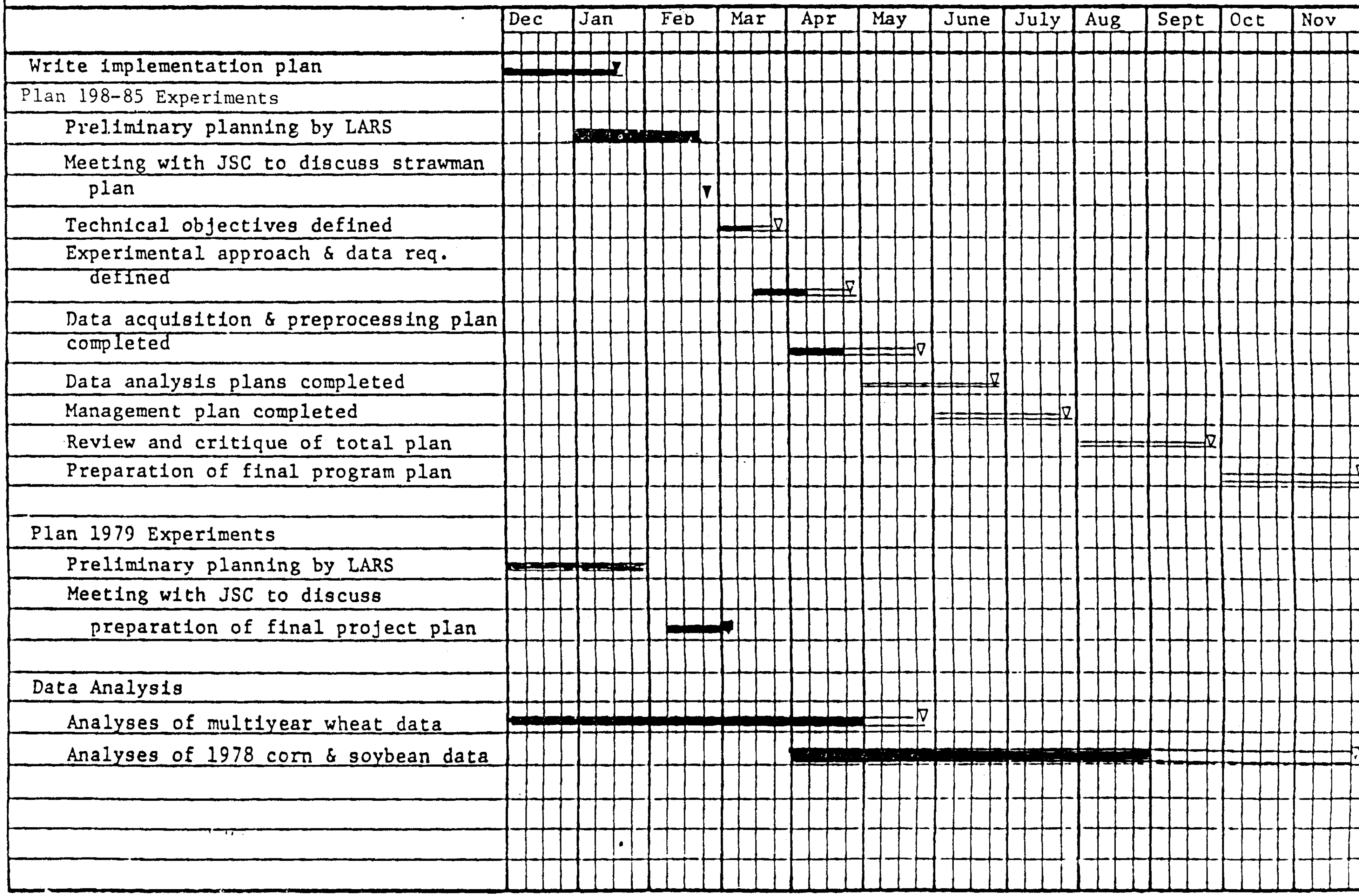
View Point 240, 240, .11

Site Point 24, 24, 0

Window -120, 120, -.11, .11



Implementation Schedule for Task 1A, Experiment Design and Data Analysis



1B. Field Research Data Acquisition and Preprocessing

The objectives of this task are to acquire and preprocess the data required to accomplish the objectives of the Multicrop Supporting Field Research project. The key accomplishments this quarter were (1) completion of preprocessing of Exotech 100 multiband radiometer data acquired in 1978 and (2) acquisition of approximately 4000 spectral observations, along with agronomic and meteorological measurements. These data were acquired on 25 different days for the eight experiments at the Purdue Agronomy Farm.

ACCOMPLISHMENTS THIS QUARTER

- Processing of the 1978 Exotech 100 Field Multiband Radiometer Data collected at the Purdue Agronomy Farm was completed.
- Approximately 4000 spectral observations of eight experiments at the Purdue Agronomy Farm were acquired on 25 different days.
- Processing of the 1979 Agronomy Farm data was begun.

NUMBER OF OBSERVATIONS ACQUIRED WITH THE EXOTECH 20C SPECTRORADIOMETER SYSTEM AT THE PURDUE AGRONOMY FARM FROM MAY THROUGH AUGUST 1979.

DATE	EXPERIMENT NAME					
Week Ending	Winter Wheat	Moisture Stress	Corn Nitrogen	Corn Leaf Blight	Soybean Cultural Practices	Other Crops
May 5	39					
12	38					
19	38					
26	-					
June 2	38					
9	38					
16	87	10	16			
23	38	6	18			
30	38	8	16			4
July 7	38		30			
14			15	3		
21			32	19		
28			-			
Aug. 4			15			
11		5		9		3
18			15			
25						
Sep. 1						
Total	392	29	157	31		7
Grand Total	616					

NUMBER OF OBSERVATIONS ACQUIRED WITH THE EXOTECH 100 RADIOMETER SYSTEM AT THE PURDUE AGRONOMY FARM FROM MAY THROUGH AUGUST 1979.

DATE	EXPERIMENT NAME					
Week Ending	Winter Wheat	Corn Cultural Practices	Soybean Cultural Practices	Soil Background	Row Direction	Other Crops
May 5						
12						
19	82	44		4		
26						
June 2	20	56	22			
99	60	80	48	20		
16	120	240	134	80	40	
23	60	80	104	20		
30	120	160	208	80		8
July 7	60	80	100	20		8
14		80	52	20		4
21		160	182	40		12
28		-	-			
Aug. 4		58	-	10		
11		80	104	20		
18		40		10	320	
25		-				
Sep. 1		40		10		
Total	542	1198	954	334	360	32
Grand Total	3420					

Summary of Supporting Field Research Experiments
Purdue Agronomy Farm, 1979

1. <u>Winter Wheat: Nitrogen Fertilization and Disease</u>

   3 cultivars

   3 Nitrogen fertilizer rates (0, 60, and 120 kg/ha)

   3 Replications

2. <u>Corn: Cultural Practices</u>

   3 Planting Dates (May 2, 16, and 30)

   3 Plant populations (25, 50, and 75 thousand plants/ha)

   2 Soil types (Chalmers-dark and Fincastle-light)

   2 Replications

3. <u>Soybeans: Cultural Practices</u>

   3 Planting dates (May 10, 24 and June 7)

   2 Cultivars (Amsoy-narrow, group II maturity and Williams-bushy, group III maturity)

   2 Soil types (Chalmers-dark and Fincastle-light)

   2 Replications

4. <u>Corn: Nitrogen Fertilization</u>

   4 Nitrogen fertilizer rates (0, 67, 134, 202 kg/ha)

   3 Replications

5. <u>Corn: Disease (Leaf Blight)</u>

   3 Leaf Blight Treatments (None-resistant, early and late infection)

   2 Hybrids (Pioneer 3545 and DeKalb XL43)

   2 Replications

6. <u>Corn and Soybeans: Moisture Stress</u>

   3 Moisture levels

7. <u>Corn: Soil Background</u>

   2 Surface moisture levels (moist and dry)

   2 Surface tillage conditions (rough and smooth)

   2 Replications

8. <u>Soybean: Row Direction</u>

   9 Row Directions

   Multi observations during day

Spectral Measurements

Stress Experiments (nutrition, moisture, disease)

- Exotech 20C field spectrometer system
  - Bidirectional reflectance factor (0.4-2.4μm)
  - Radiant temperature
  - Color photographs

Cultural Practices Experiments

- Exotech 100 field radiometer system
  - Bidirectional reflectance factor (Landsat MSS spectral bands)
  - Radiant temperature
  - Color photographs

Each experiment will be measured at approximately weekly intervals from planting to maturity.

Agronomic Measurements

Crop Development Stage

Amount of Vegetation

- Plant height
- Percent soil cover
- Number of plants per square meter
- Number of leaves per plant
- Leaf area index
- Total fresh and dry biomass (g/m^2)
- Dry biomass of leaves, stems, and heads, ears or pods (g/m^2)

Crop Condition

- Percent leaves green, yellow, and brown
- Plant water content (g/m^2)
- Presence and severity of stress

Soil Background Condition

- Percent moisture
- Munsell color
- Roughness

Additional data for specific experiments

- Leaf nitrogen and chlorophyll concentrations (wheat and corn nitrogen fertilizer experiments)
- Leaf water potential (moisture stress experiments)
- Leaf blight infection levels (corn blight experiment)

Photography

- Overhead and ground level views of canopies

Grain Yield

Meteorological Measurements

On days spectral data are collected (continuosly)

- Total irradiance
- Termperature
- Relative humidity
- Barometric pressure
- Wind speed and direction
- Percent cloud cover and type

Daily, hourly records from Purdue Agronomy Farm Weather Station

Air temperature, relative humidity, precipitation, pan evaporation, dew, dew point, wind speed, solar radiation, net radiation

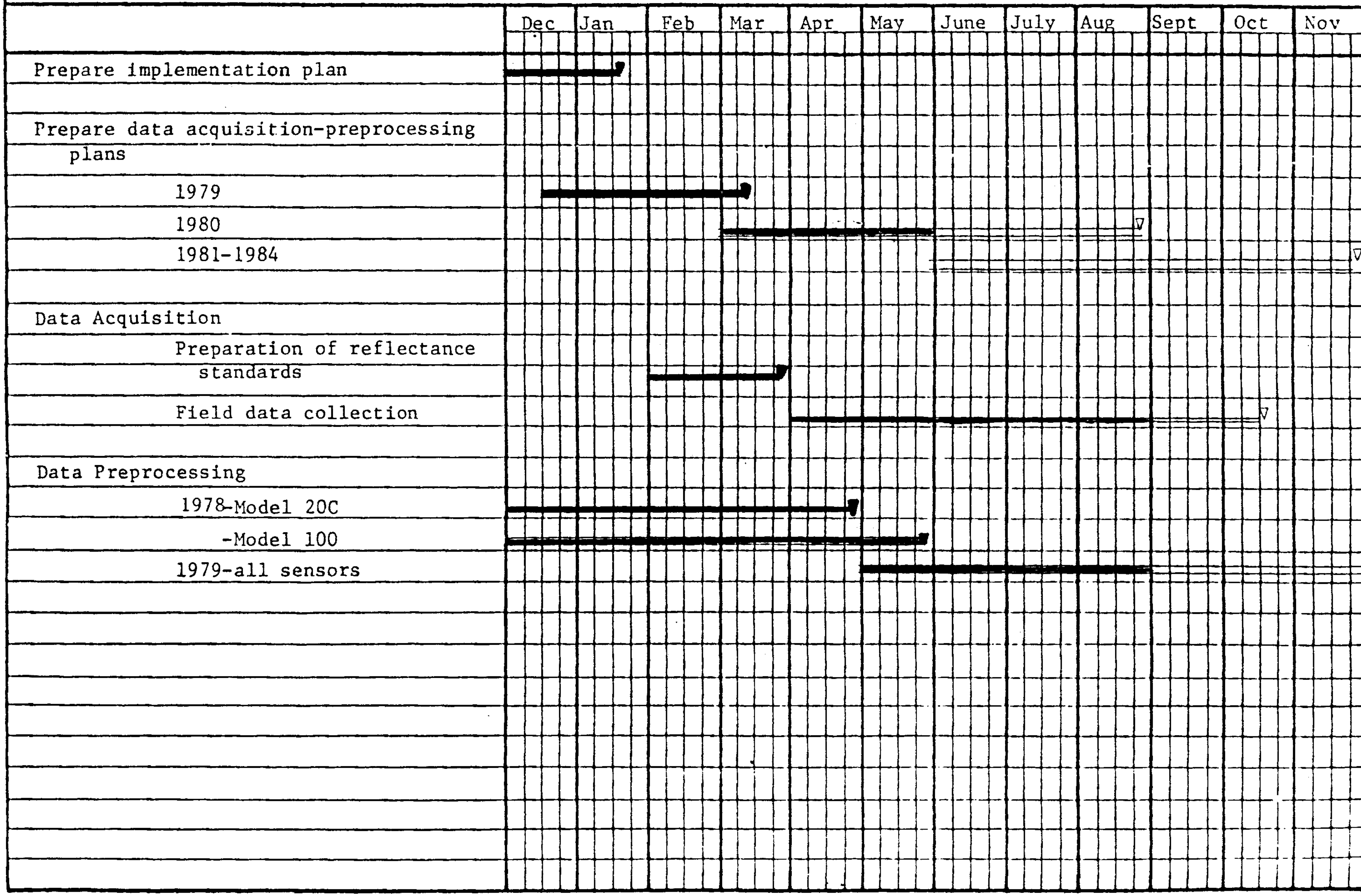
PLANS FOR NEXT QUARTER

* THE 1979 DATA COLLECTION AT THE PURDUE AGRONOMY FARM WILL BE COMPLETED.

* PROCESSING WILL CONTINUE WITH THE 1979 DATA. A PORTION WILL BE COMPLETED.

Figure 1.

Detailed implementation schedule for field research data acquisition and preprocessing



1C. Development of Multiband Radiometer System

The overall objective of this task is to specify, develop, and test a prototype multiband radiometer and data logger for field research. During this quarter bids for the radiometer were reviewed and a vendor selected, a pick-up truck-mounted boom was designed and is being constructed, and supporting software for proprocessing radiometer data is being developed.

1C. DEVELOPMENT OF MULTIBAND RADIOMETER SYSTEM

OBJECTIVE:

DEVELOP A MULTIBAND RADIOMETER SYSTEM FOR AGRICULTURAL FIELD RESEARCH. THE SYSTEM IS TO BE LOW-COST, SIMPLE TO OPERATE, AND ADAPTABLE TO A VARIETY OF PLATFORMS.

SPECIFIC OBJECTIVES

- SPECIFY, DEVELOP AND TEST
  - A PROTOTYPE MULTIBAND RADIOMETER
  - A PROTOTYPE DATA ACQUISITION SYSTEM

- PREPARE A SYSTEM MANUAL INCLUDING
  - DESCRIPTION OF SYSTEM
  - OPERATION INSTRUCTIONS
  - DATA HANDLING INSTRUCTIONS
  - INSPECTION, TEST, MAINTENANCE AND CALIBRATION PROCEDURES

- PREPARE A MANUAL DESCRIBING THE USE OF THE INSTRUMENT IN AGRICULTURAL REMOTE SENSING EXPERIMENTS

- DEVELOP SOFTWARE FOR ENTRY, STORAGE, USE AND PRESENTATION OF MULTIBAND DATA IN CONCERT WITH AGRONOMIC, METEOROLOGICAL, AND ANCILLARY DATA.

ACCOMPLISHMENTS FOR THE QUARTER

- RECEIPT AND EVALUATION OF BIDS FOR MULTIBAND RADIOMETER AND DATA ACQUISITION SYSTEM.

- SELECTION OF VENDOR FOR MULTIBAND RADIOMETER:
  BARNES ENGINEERING, STAMFORD, CT.

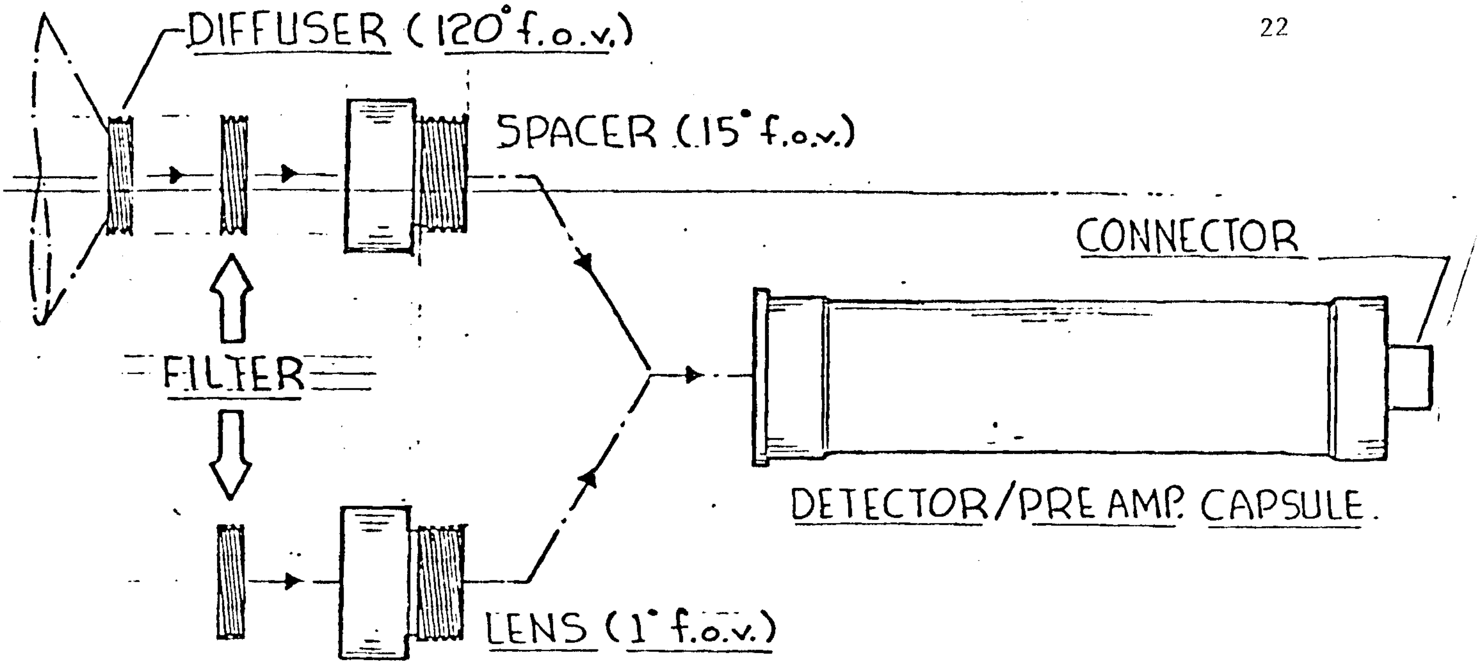
- PREPARATION OF CONTRACT FOR PROCUREMENT OF PROTOTYPE OF MULTIBAND RADIOMETER IN CONCERT WITH TECHNICAL MONITOR.

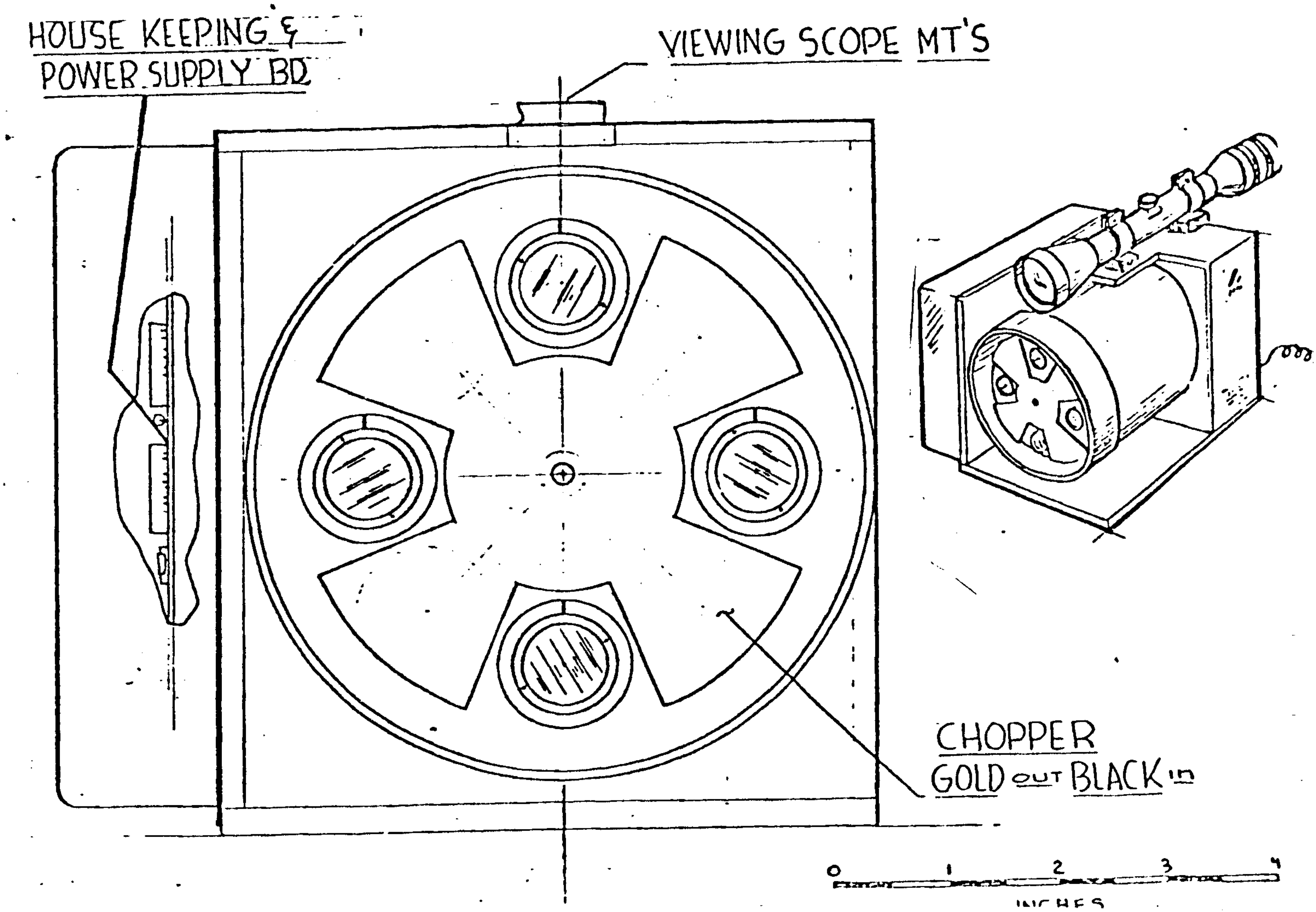
- CONSTRUCTION OF PICK-UP TRUCK MOUNTED BOOM DESIGN COMPLETE. BOOM IN CONSTRUCTION SINCE EARLY JULY. NEARLY COMPLETE AWAITING TWO PARTS (NORMALLY STOCK ITEMS). DESIGN FULLY DOCUMENTED.

- SOFTWARE DEVELOPED AND IMPLEMENTED TO HANDLE UP TO TWELVE CHANNELS OF FORMATTED MULTIBAND RADIOMETER DATA. SOFTWARE IS DESIGNED WITH PROVISION FOR DATA FOR EITHER CARD OR DATA LOGGER INPUTS.

- CALIBRATION SOFTWARE IMPLEMENTED TO INTERPOLATE REFERENCE DATA BETWEEN TWO OBSERVATIONS OF REFERENCE PANEL.

- HARDWARE AND PROCEDURES WERE DEVELOPED FOR PARALLEL INTERFACE TO THE PDP 11.





MULTIBAND RADIOMETER

STATUS

'MULTIBAND RADIOMETER CONTRACT COMPLETE (EARLY SEP.).

'METHOD FOR ACQUISITION OF DATA LOGGER TO BE DECIDED IN CONCERT WITH CONTRACT MONITOR (EARLY SEP.).

'BOOM NEAR COMPLETION.

'DOCUMENTATION STILL IN OUTLINE FORM.

'SOFTWARE IMPLEMENTED AND READY FOR OPERATIONAL TESTING.

'HARDWARE FOR INTERFACE, READY FOR INSTALLATION AND PRELIMINARY TESTING.

PLANS FOR FOURTH QUARTER

'PROTOTYPE RADIOMETER AND LOGGER

- PREPARE PRELIMINARY DESIGN REPORT FOR MULTIBAND RADIOMETER.
- IN CONCERT WITH TECHNICAL MONITOR, CONSTRUCTION OF DATA LOGGER TO BE BEGUN.
- FIRST DRAFT OF SYSTEM MANUAL.

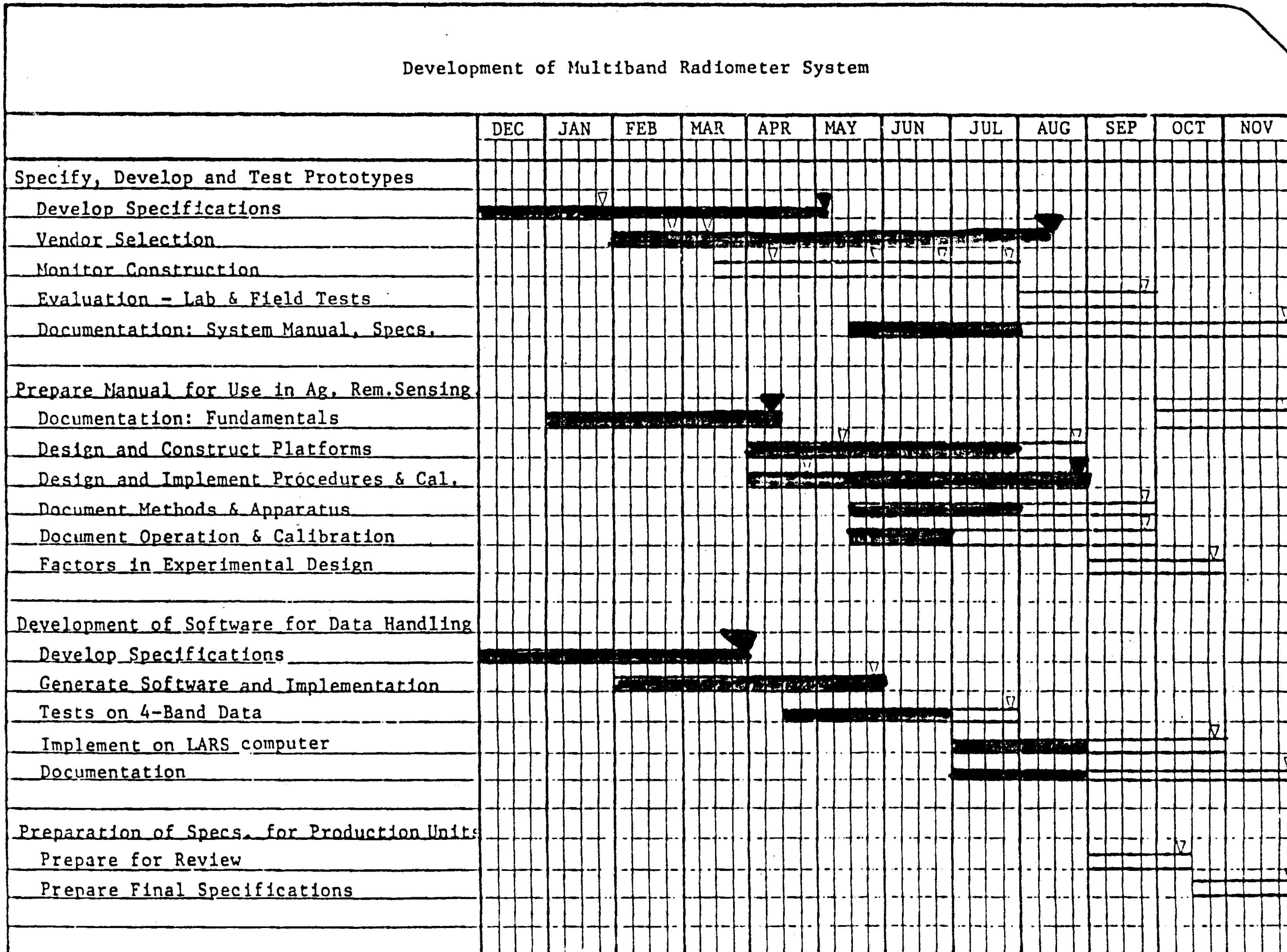
'FIELD MEASUREMENTS EXPERIMENT DESIGN MANUAL

- DRAFT DOCUMENTATION.
- FIELD TESTING OF BOOM. - DOCUMENTATION COMPLETE.
- FIELD TESTING OF PROCEDURES AND CALIBRATION WITH DRAFT DOCUMENTATION.

'DEVELOPMENT OF SOFTWARE FOR DATA HANDLING

- DOCUMENTATION FOR DATA PROCESSING AND DATA HANDLING SYSTEM FOR RADIOMETER AND ANCILLARY DATA (INCLUDING AGRONOMIC PARAMETERS).
- OPERATIONAL TESTS ON MODEL 100 AND ANCILLARY DATA.
- DESIGN OF DATA ENTRY PROCEEDURES - SOFTWARE CONTINUED.
- INSTALLATION OF HARDWARE FOR PARALLEL INTERFACE TO PDP 11. PRELIMINARY TESTING.

B. Detailed Implementation Schedule



1D. Soils Data Base

A. Work Accomplished During the Reporting Period

Data logging was completed this quarter, with the remainder of the iron oxide analysis results being added to the data base. A complete soils data base is now available for analysis using the LARSPEC software program for over 500 individual soil samples from the continental United States, Brazil, Spain, Jordan, and Sudan.

Plans to publish the Atlas of Soil Reflectance Spectra are underway as work continues on the layout of the already completed tables and figures. Agronomic and site data will be displayed together with reflectance curves for 251 soil series representing many varied climatic zones and soil orders.

Data analysis was completed with prediction models developed to help explain differences in reflectance in individual wavelength bands. Other regression models were used to predict contents of certain soil parameters from reflectance data.

B. Statistical Correlation

As reported last quarter, reflectance data were arbitrarily divided into ten wavelength bands (Table 1-D). Statistical correlations between five soil parameters and reflectance in these individual bands is listed for various groupings of soils (Tables 2-D and 3-D). Correlations are seen to improve with more specific climatic grouping of soil data. The 95% confidence intervals on the correlation coefficient give an idea of the range of correlation values that can be expected based on the number of soils in each climatic grouping.

Reflectance in all of the spectral bands is seen to be negatively correlated with the natural logarithmic transformation of organic matter content. Reflectance in the important 2.08-2.32 μm band is negatively correlated, in addition, to moisture content, cation exchange capacity, iron oxide content and clay content, while it is positively correlated with medium and fine sand contents.

Table 1-D. Spectral reflectance bands for statistical analysis

band	wavelength (μm)	spectral region	band	wavelength (μm)	spectral region
1	0.52-0.62	visible	6	1.02-1.12	near IR
2	0.62-0.72	visible	7	1.12-1.22	near IR
3	0.72-0.82	near IR	8	1.22-1.32	near IR
4	0.82-0.92	near IR	9	1.55-1.75	middle IR
5	0.92-1.02	near IR	10	2.08-2.32	middle IR

Table 2-D. Simple correlation coefficients between five soil parameters and reflectance in individual bands for all soils and for soils grouped by moisture zone and by temperature regime.

r values for most highly correlated band (parentheses) with 95% confidence intervals on r

	soil parameter				
climatic grouping no. of soils in class	$\log_e$(O.M.)	moisture percentage by weight	particle size distribution	cation exchange capacity	iron oxide content
all soils 481	-.68(2) -.73<r<-.63	-.53(10) -.59<r<-.46	clay -.41(10) -.48<r<-.33	-.48(10) -.55<r<-.41	-.16(10) -.25<r<-.07
moisture zone					
humid 185	-.68(1) -.72<r<-.64	-.47(10) -.53<r<-.41	clay -.25(10) -.32<r<-.18	-.50(1) -.55<r<-.44	.18(2) .11<r<.25
subhumid 128	-.78(6) -.81<r<-.74	-.78(10) -.81<r<-.74	clay -.61(10) -.66<r<-.55	-.71(10) -.75<r<-.66	-.16(10) -.25<r<-.07
semiarid 94	-.53(3) -.60<r<-.45	-.39(10) -.48<r<-.30	fine sand .47(10) .38<r<.55	-.22(10) -.31<r<-.11	-.55(8) -.62<r<-.47
arid 62	-.73(2) -78<r<-.66	-.71(2) -.77<r<-.64	fine sand .68(2) .60<r<.74	-.37(10) -.47<r<-.25	-.28(1) -.40<r<-.16
temperature regime					
frigid 102	-.43(1) -.54<r<-.34	-.41(10) -.49<r<-.32	clay -.40(10) -.47<r<-.31	-.47(10) -.54<r<-.38	.40(3) .31<r<.48
mesic 211	-.68(1) -.71<r<-.64	-.48(10) -.53<r<-.42	clay -.27(10) -.33<r<-.20	-.52(10) -.57<r<-.47	.08(4) .01<r<.15
thermic 140	-.64(6) -.69<r<-.59	-.68(10) -.72<r<-.63	clay -.57(10) -.61<r<-.51	-.48(10) -.54<r<-.41	-.19(10) -.27<r<-.10
hyperthermic 28	-.75(3) -.82<r<-.65	-.75(8) -.82<r<-.65	fine silt -.68(8) -.77<r<-.56	-.65(8) -.75<r<-.52	-.23(10) -.40<r<-.03

Table 3-D. Simple correlation coefficients between five soil parameters and reflectance in individual bands by climatic zone.

r values for most highly correlated bands (parentheses) with 95% confidence intervals on r

climatic subgroup no. of soils in class	soil parameter $\log_e$(O.M.)	 moisture percentage by weight	 particle size distribution	 cation exchange capacity	 iron oxide content
humid frigid 38	-.66(10) -.74<r<-.55	-.43(1) -.55<r<-.28	fine sand .37(10) .22<r<.51	-.45(1) -.57<r<-.31	.56(2) .43<r<.66
humid mesic 75	-.66(1) -.72<r<-.59	-.29(10) -.39<r<-.18	fine silt .58(9) .50<r<.65	-.73(1) -.78<r<-.67	.30(2) .19<r<.40
humid thermic 60	-.71(8) -.77<r<-.64	-.65(10) -.72<r<-.56	clay -.53(10) -.62<r<-.43	-.73(9) -.79<r<-.66	-.18(10) -.30<r<-.05
subhumid frigid 42	-.77(4) -.83<r<-.70	-.75(10) -.81<r<-.67	clay -.67(9) -.75<r<-.57	-.86(9) -.90<r<-.81	-.20(10) -.35<r<-.04
subhumid mesic 46	-.81(6) -.89<r<-.75	-.64(10) -.72<r<-.54	clay -.63(10) -.71<r<-.53	-.71(10) -.78<r<-.63	.52(2) .40<r<.62
subhumid thermic 36	-.62(2) -.72<r<-.50	-.82(10) -.87<r<-.75	sand .76(2) .68<r<.82	-.63(10) -.72<r<-.51	-.44(6) -.57<r<-.29
semiarid frigid 18	-.28(1) -.50<r<-.03	-.48(10) -.65<r<-.26	clay -.67(10) -.79<r<-.50	-.60(10) -.74<r<-.41	.26(2) 0<r<.48
semiarid mesic 46	-.32(2) -.45<r<-.18	-.34(10) -.47<r<-.20	very fine sand .43(2) .30<r<.55	-.44(1) -.56<r<-.31	-.42(9) -.54<r<-.29
semiarid thermic 20	-.58(3) -.72<r<-.40	-.55 (10) -.70<r<-.36	medium sand .66(10) .50<r<.78	-.40 (3) -.58<r<-.18	-.67(9) -.78<r<-.51
arid mesic 32	-.79(3) -.85<r<-.71	-.79(3) -.85<r<-.71	clay -.62(3) -.72<r<-.49	-.73(4) -.80<r<-.63	.39(4) .22<r<.54
arid thermic 24	-.67(2) -.77<r<-.53	-.75(10) -.83<r<-.63	fine sand .90(4) .85<r<.93	-.47(10) -.62<r<-.28	-.73(9) -.82<r<-.61

C. Prediction Models

A forward stepwise inclusion procedure was used to estimate the reflectance in individual wavelength bands using certain agronomic and site characteristics as predictors. The importance of climatic zone, parent material, and drainage characteristics in explaining soil reflectance was brought out in this analysis (Table 4-D). Other soil parameters had an expected influence on reflectance, with organic matter being the single most important variable in all but band 10, where moisture content was the first variable to be included in the regression equation. Although the R^2 values were not high for this analysis of 481 soils, the inclusion of site characteristics pointed to the importance of these soil-forming factors as contributors to soil reflectance.

Prediction models for certain soil parameters using only soil reflectance data as inputs reveal high R^2 values when soils are grouped by specific climatic zone (Table 5-D). The importance of visible, near infrared, and middle infrared reflectance data is seen repeatedly. Iron oxide has high predictive values only in the humid frigid and some arid regions. Results are highly climate-specific. As in previous studies of this type, cation exchange capacity often shows higher R^2 values than other soil parameters which are known to exhibit inherent spectral behavior. Cation exchange capacity seems to be acting as a natural integrating factor for several other soil parameters such as organic matter and particle size.

These results are highly suggestive that reflectances of soils in one climatic zone may not be similar to reflectances of soils formed under very different climatic conditions. Soils that vary widely in their agronomic and site characteristics are to no extent more similar in their reflectance properties than are different species of plants throughout their growth cycles.

Table 4-D. Agronomic and site characteristics as predictors of reflectance in individual spectral bands.

order of inclusion of first ten variables into stepwise regression equations

band (R^2)	agronomic characteristics						site characteristics (dummy variables): climate												drainage		parent material			
	$\log_e$(O.M.)	moisture percentage by weight	fine sand	fine silt content	clay content	iron oxide content	humid frigid	humid mesic	humid thermic	subhumid frigid	subhumid mesic	subhumid thermic	semiarid frigid	semiarid mesic	semiarid hyperthermic	arid frigid	arid mesic	arid thermic	somewhat poorly	poorly	sedimentary	marine	alluvial	igneous
1 (.52-.62) (.59)	1			2				8	7	4	3	5					10	6	9					
2 (.62-.72) (.63)	1		8	5		10			2	6	4							3	7	9				
3 (.72-.82) (.61)	1		10	8	9	4			2	6	5							3	7					
4 (.82-.92) (.58)	1		9	6					2	5	4						7	3	8	10				
5 (.92-1.02) (.56)	1		8	7			10		2	5	4						6	3			9			
6 (1.02-1.12) (.55)	1	8						10	2	5	4		9	6			3				7			
7 (1.12-1.22) (.53)	1		8	7			9		3			4			6		2	5			10			
8 (1.22-1.32) (.51)	1		10	9					3			4			5		2	6					8	7
9 (1.55-1.75) (.45)	1		7	6					3			4			8	10	2				9	5		
10 (2.08-2.32) (.48)	3	1	8	7	6	10			5			9					4					2		

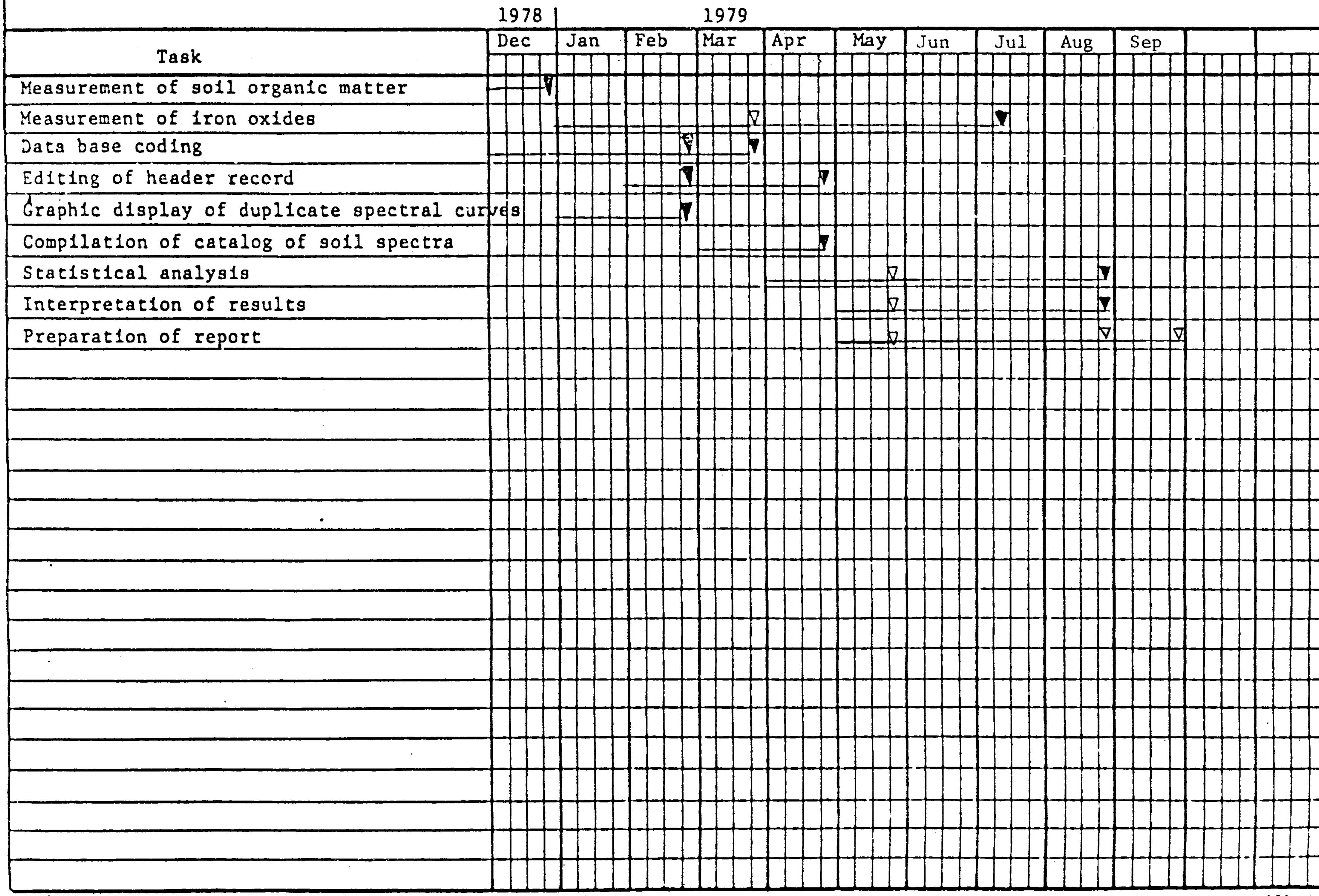
Table 5-D. Soil reflectances in individual bands as predictors of soil parameters within certain climatic zones.

R^2 values and spectral bands entered into regression equations

soil parameter

climatic subgroup no. of soils in class	$\log_e$(O.M.)	moisture percentage by weight	particle size distribution	cation exchange capacity	iron oxide content
humid frigid 38	.78 10,9,2,8,4,1	.95 1,6,10,3,8	clay .54 10,2,1,3,4,8	.84 1,8,10,4	.67 2,10,5,9,8,4,1
humid mesic 75	.61 1,10,3,5,9	.32 10,8,9,5,2,1	fine silt .48 9,1,4,10	.65 1,10,9,8,4	.21 2,1,4,8,5,10
humid thermic 60	.53 8,10,2,4	.54 10,2,3,7,1	clay .30 10,9	.65 9,2,3,6,10,1	.49 10,2,1,4,8,5,9
subhumid frigid 42	.66 4,9,6,1,10	.60 10,9,8	clay .51 9,6,4,2,10	.75 9,7	.23 10,2,1,3,7,6,9
subhumid mesic 46	.70 6,10,1,3,	.52 10,5	clay .73 10,9,7,3	.72 10,1,6,9,4	.51 2,1,4,8,3,9,5,10
subhumid thermic 36	.73 2,3,5,9,10,1	.87 10,2,9,8,4,1	clay .69 5,1,7,10,9	.77 10,9,8,3	.51 6,2,7,1,3,8,10,9
semiarid frigid 18	.67 1,5,10,4,8	.77 10,8,3,9,2,1	clay .90 10,9,4,2,6,1	.74 10,8,4,2,9,1	.37 2,1,3,9,5,4,10,8
semiarid mesic 46	.40 2,8,4,9	.64 10,9,1,4	clay .49 10,9,1,3	.57 1,3,6,10,9	.38 9,1,6,8,5,2,3,10
semiarid thermic 20	.59 3,1,9	.68 10,3,1,8	clay .65 3,1,10,9	.74 3,1,10,9	.68 9,10,7,5,1,2
arid mesic 32	.68 3,1,10,5	.75 3,1,10,9	clay .80 3,1,8,10	.73 4,1,8,10	.40 4,1,9,7,3,10
arid thermic 24	.60 2,4,1	.76 10,9,3,8	fine sand .83 4,10,9,8	.60 10,9,1,8,4	.70 9,10,7,1,6,4,3

Figure 1D-A. Detailed implementation schedule for Task 1D.



'C Form 1058C (Rev Jun 88)

NASA-JSC

2A. Application and Evaluation of Landsat Training, Classification, and Area Estimation Procedures for Crop Inventory

Activities this quarter have been in the areas of data receipt, data preparation, programming support, and data analysis.

Data Receipt. The data requests for this task are largely complete except for full-frame data and digital ground truth. Details of the data status are given in an attached chart.

Programming Support. The last compatibility program was completed to convert results from EOD-LARSYS to LARSYS format. All four programs were then documented.

A capability for LARSYS to read universally formatted tapes was installed with partial funding from this project. This capability removes the need for the costly and time-consuming reformatting procedures.

Data Analysis. The comparison of five classifiers was extended to four additional sites. The classifiers compared were classifypoints, ECHO, classify, minimum distance, and layered. All classifiers were trained using a modified supervised approach. Training fields were chosen on a systematic grid and all training fields of the same cover type were clustered together. A second training method, using dots to seed the ISOCLS algorithm, was used with the classify algorithm. There were no significant differences in classification accuracy except on small grains, where the sum-of-densities classifier using LARSYS statistics outperformed the other methods by about 2%.

A study was conducted to investigate the "best" subset of bands for crop separability. Four segments in the Corn Belt were analyzed. Training data were generated using a modified supervised approach. The best combination of four from the sixteen available channels (4dates) was selected using the separability function in LARSYS. Channel combinations are ranked according to the average transformed divergence. The first channel on each date was very rarely selected. While channels 3 and 4 on each date were both selected with high frequency, channel 4 was selected a little more often. It was discovered that the 30 best channel combinations in 4 segments, neither two visible nor two infrared channels from the same date were ever selected. Thus, we should select either channel 3 or channel 4, but not both for consideration.

In conclusion, channels 2 and 4 from each date appear to give a good subset to classify with or select another subset from.

A study of the impact of acquisition history on classification was initiated. Segments from each test site are being analyzed. Some initial results on missing acquisitions and acquisition selection are presented. In addition, the study addresses the gains or losses by selecting subsets of bands, methods for subset selection, and classifier comparisons. Results for five segments are presented.

Next quarter, data receipt and preparation will continue. Full-frame study plans will be finalized when the data status becomes known. The acquisition history study will be completed. Classifications of Corn Belt segments will be conducted, studying the interrelationships of training, classification, and area estimation procedures.

OBJECTIVES

-ASSESS THE EFFECT OF SAMPLING IN TRAINING AND CLASSIFICATION ON AREA ESTIMATES.

-ASSESS THE POTENTIAL ACCURACY OF CORN AND SOYBEAN ESTIMATES AS A FUNCTION OF GROWTH STAGE, BOTH UNITEMPORALLY AND MULTITEMPORALLY.

-COMPARE SEVERAL METHODS FOR OBTAINING TRAINING STATISTICS:

- ECHO
- SAMPLING FROM SPECTRAL RATHER THAN SPATIAL DOMAIN FOR CLUSTER INITIALIZATION
- CLUSTERING PIXELS, FIELDS, OR BLOCKS OF DATA

-ASSESS THE ABILITY OF SEVERAL CLASSIFIERS TO PROVIDE ACREAGE ESTIMATES OF CORN AND SOYBEANS IN SEVERAL REGIONS OF THE CORN BELT:

- LAYERED (MULTISTAGE DECISION)
- MINIMUM DISTANCE (LINEAR)
- ECHO (SPECTRAL/SPATIAL)
- SUM OF DENSITIES (P-1)
- MAXIMUM LIKELIHOOD PER POINT (LARSYS)

-ASSESS THE EFFECT OF SEPARATING THE FUNCTIONS OF SAMPLING FOR TRAINING AND SAMPLING FOR AREA ESTIMATION.

PROGRESS THIS QUARTER

- DATA RECEIPT
- DATA PREPARATION AND PROCESSING
- PROGRAMMING SUPPORT
- DATA ANALYSIS

DATA STATUS

- DATA REQUESTED FOR 80 HIGH DENSITY AND 1 LOW DENSITY SAMPLE SEGMENTS IN INDIANA, ILLINOIS, AND IOWA.

- DATA RECEIVED
  - LANDSAT MSS DATA FOR SEGMENTS IS COMPLETE
  - PFC PRODUCT 1 IS COMPLETE
  - AERIAL PHOTOGRAPHS AND FIELD OVERLAYS
    - IN FOR 69 SEGMENTS
    - NOT AVAILABLE FOR 12 SEGMENTS
  - 418 DOT GRIDS FOR 50 SEGMENTS
  - DIGITAL WALL-TO-WALL "GROUND TRUTH" FOR 15 SEGMENTS

- DATA EXPECTED
  - ADDITIONAL DIGITAL "GROUND TRUTH" TAPES
  - FULL-FRAME DATA

PROGRAMMING SUPPORT

COMPATIBILITY PROGRAMS

- PROGRAMS TO MADE EOD-LARSYS AND LARSYS COMPATIBLE

  - STATISTICS CONVERSION (EOD-LARSYS ⟶ LARSYS)
  - STATISTICS CONVERSION (LARSYS ⟶ EOD-LARSYS)
  - RESULTS CONVERSION (LARSYS ⟶ EOD-LARSYS)
  - RESULTS CONVERSION (EOD-LARSYS ⟶ LARSYS)

- ALL PROGRAMS ARE COMPLETED, DEBUGGED, AND DOCUMENTED.

- PERMIT USE OF ASPECTS OF EACH ANALYSIS SYSTEM INTERCHANGED.

UNIVERSAL READING CAPABILITY

- ALL PROCESSORS OF THE LARSYS SYSTEM WILL NOW READ UNIVERSAL FORMAT TAPES.

- THIS CAPABILITY REMOVES NEED FOR COSTLY AND TIME-CONSUMING REFORMATTING PROCEDURES.

- DOCUMENTATION IS BEING PREPARED.

Comparison of Several Classification Approaches
Experimental Approach

- Five Classifiers Were Used:
  - CLASSIFYPOINTS (Gaussian maximum likelihood per point classifier in LARSYS)
  - ECHO (uses local spatial information to identify homogeneous objects which are classified using a Gaussian maximum likelihood sample classification rule)
  - CLASSIFY (sum of normal densities maximum likelihood classifier in EOD-LARSYS)
  - MINIMUM DISTANCE (linear classifier which assigns each pixel to the class whose mean is closest in Euclidean distance)
  - LAYERED (multistage decision tree classifier which uses an optimum subset of features at each tree node to classify each pixel)

- All classifiers were trained using a modified supervised approach where all training fields of the same cover type were clustered together.

- A second training method, using dots to seed the ISOCLS algorithm, was used with the CLASSIFY algorithm.

- This test was carried out on 4 additional sites, so that results are presented for 7 sites. Last quarter, preliminary results were available on 3 sites.

COMPARISON OF SEVERAL CLASSIFICATION APPROACHES

- DATA SETS EXAMINED:
  - FAYETTE IL (CITARS)
  - POTTAWATTAMIE IA
  - SHELBY IA
  - TIPPECANOE IN
  - IROQUOIS IL
  - FOSTER ND (LACIE)
  - GRANT KS (LACIE)
- APPROACH
  - MULTITEMPORAL (4 DATE)
  - BEST 4 OF 16 CHANNELS USED IN CLASSIFICATION
- EVALUATIONS MADE OF CLASSIFICATION ACCURACIES

COMPARISON OF SEVERAL CLASSIFICATION APPROACHES

AVERAGE PERCENT CORRECT

MAJOR CROPS	SEGMENTS	CLASS	MINIMUM DISTANCE	CLASSIFY POINTS	LAYERED	ECHO	CLASSIFY USING ISOCLS STATS[1]	CLASSIFY USING LARSYS STATS[2]
CORN/SOYBEANS	5	CORN	91.9	88.6	87.3	87.5	88.5	89.8
		SOYBEANS	88.7	88.6	88.1	87.6	81.6	90.2
		OTHER	85.4	87.9	75.4	86.7	74.8	87.1
		OVERALL	89.8	89.2	88.6	88.1	82.7	89.8
SMALL GRAINS	2	SMALL GRAINS	96.5	96.0	96.1	95.6	94.1	98.0
		OTHER	82.6	80.2	83.2	78.4	81.3	81.3
		OVERALL	87.9	85.6	87.8	84.2	87.0	87.0

[1] TRAINING METHOD GENERALLY USED WITH CLASSIFY. USES A RANDOM SELECTION OF INDIVIDUAL PIXELS TO DEFINE INITIAL CLUSTER SEEDS FOR CLUSTERING THE ENTIRE AREA.

[2] TRAINING METHOD USED WITH ALL OTHER CLASSIFIERS. TRAINING FIELDS WERE CLUSTERED TO DEVELOP MEANS AND COVARIANCES TO DEFINE SPECTRAL SUBCLASSES FOR EACH OF THE CLASSES OF INTEREST.

COMPARISON OF SEVERAL CLASSIFICATION APPROACHES
SUMMARY OF RESULTS

- SEGMENT-TO-SEGMENT VARIABILITY WAS SIGNIFICANT
- THERE WAS NO SIGNIFICANT DIFFERENCE IN PERCENT CORRECT CLASSIFICATION FOR CORN, SOYBEANS, OR OTHER IN THE 5 CORN BELT SEGMENTS.
- THERE WAS NO SIGNIFICANT DIFFERENCE IN OVERALL ACCURACY USING ALL 7 SEGMENTS.
- THE SUM-OF-DENSITIES CLASSIFIER USING LARSYS STATISTICS DID SIGNIFICANTLY BETTER AT IDENTIFYING SMALL GRAINS (ABOUT 2% CLASSIFICATION IMPROVEMENT).

WAVELENGTH BAND SELECTION

- MULTITEMPORAL DATA ON FOUR SEGMENTS IN THE CORN BELT WERE USED.
- TRAINING DATA WERE GENERATED FROM GROUND TRUTH USING A MODIFIED SUPERVISED APPROACH WITH A SYSTEMATIC GRID.
- THE BEST 30 COMBINATIONS OF 4 OF 16 CHANNELS WERE COMPUTED BASED ON AVERAGE TRANSFORMED DIVERGENCE.
- NEITHER TWO VISIBLE CHANNELS NOR TWO INFRARED CHANNELS WERE EVER SELECTED FROM THE SAME DATE.
- CHANNELS 2 AND 4 FROM EACH DATE APPEAR TO GIVE A GOOD SUBSET TO CLASSIFY WITH OR SELECT ANOTHER SUBSET FROM.

Segments and Acquisitions Used in the Wavelength Band Selection Study

Segment	Date	Growth Stage of Corn
824	6/12	emergence
	8/5	tasseling
	8/31	dent
	9/28	mature
854	6/10	emergence
	7/26	tasseling
	8/21	dough
	9/26	mature
886	6/16	emergence
	7/23	tasseling
	9/6	dent
	9/24	mature
892	6/16	emergence
	7/23	tasseling
	8/9	blister
	9/24	mature

WAVELENGTH BAND SELECTION

NUMBER OF APPEARANCES OF EACH INDIVIDUAL CHANNEL IN THE TOP 30.

Corn Growth Stage	Channel	Segment 824	854	886	892	Total	Rank
Emergence	1	-	2	-	5	7	13
	2	11	12	2	16	41	7
	3	18	16	7	11	52	3
	4	7	14	21	4	46	5
Tasseling	5	-	-	6	-	6	14
	6	-	4	10	6	20	10
	7	10	11	11	10	42	6
	8	11	15	19	20	65	2
Blistering to Dent	9	-	-	4	-	4	15
	10	-	8	6	-	14	12
	11	9	18	12	12	51	4
	12	21	12	18	18	69	1
Mature	13	3	-	-	-	3	16
	14	16	-	-	-	16	11
	15	8	6	1	9	24	8
	16	6	2	3	9	20	9

ACQUISITION HISTORY IMPACT STUDY

·OBJECTIVES

- DETERMINE A MINIMUM NUMBER AND DISTRIBUTION OF ACQUISITIONS NECESSARY FOR ACCURATE ESTIMATION OF CORN AND SOYBEAN AREAS.
- ASSESS THE ACCURACY OF EARLY SEASON ESTIMATES.
- DETERMINE THE GAIN OR LOSS BY USING A SUBSET OF CHANNELS OVER ALL CHANNELS IN A UNITEMPORAL AS WELL AS MULTITEMPORAL MODE.
- COMPARE TWO METHODS FOR CHANNEL SELECTION.
- COMPARE MINIMUM DISTANCE, MAXIMUM LIKELIHOOD, AND SUM OF DENSITIES CLASSIFICATIONS IN OTHER BAND/DATE COMBINATIONS THAN PREVIOUSLY ASSESSED.

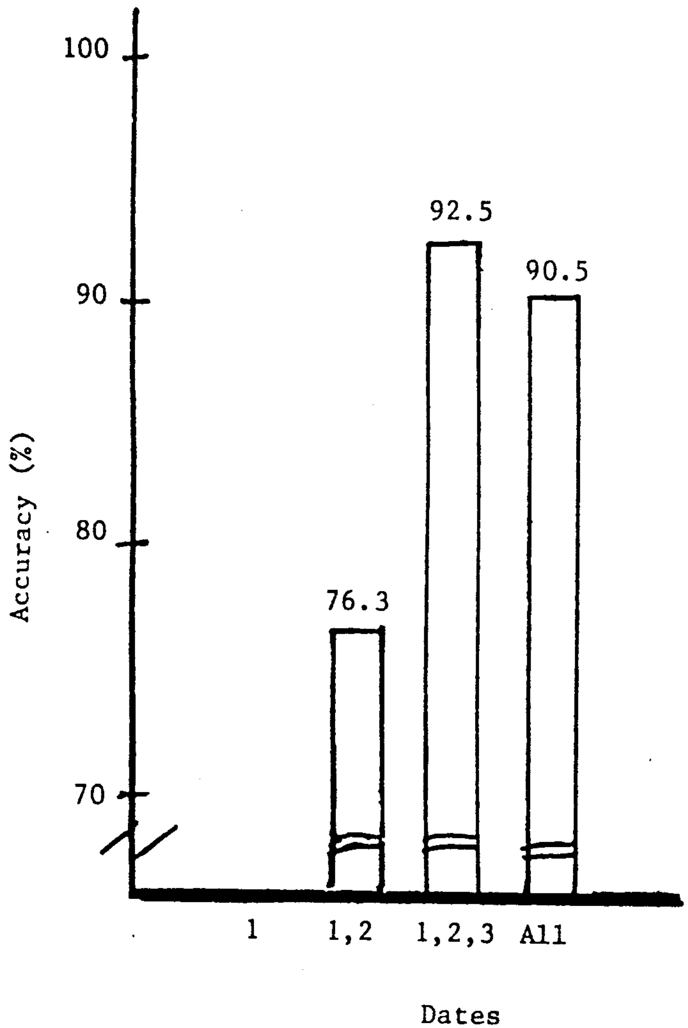
·EIGHT SEGMENTS WERE ANALYZED, TWO FROM EACH TEST SITE:

EAST INDIANA	843,860
WEST INDIANA	837,854
N. CENTRAL IOWA	862,883
W. CENTRAL IOWA	886,892

·FOUR ACQUISITIONS WERE ANALYZED. STAGES WERE BASED ON CORN GROWTH.

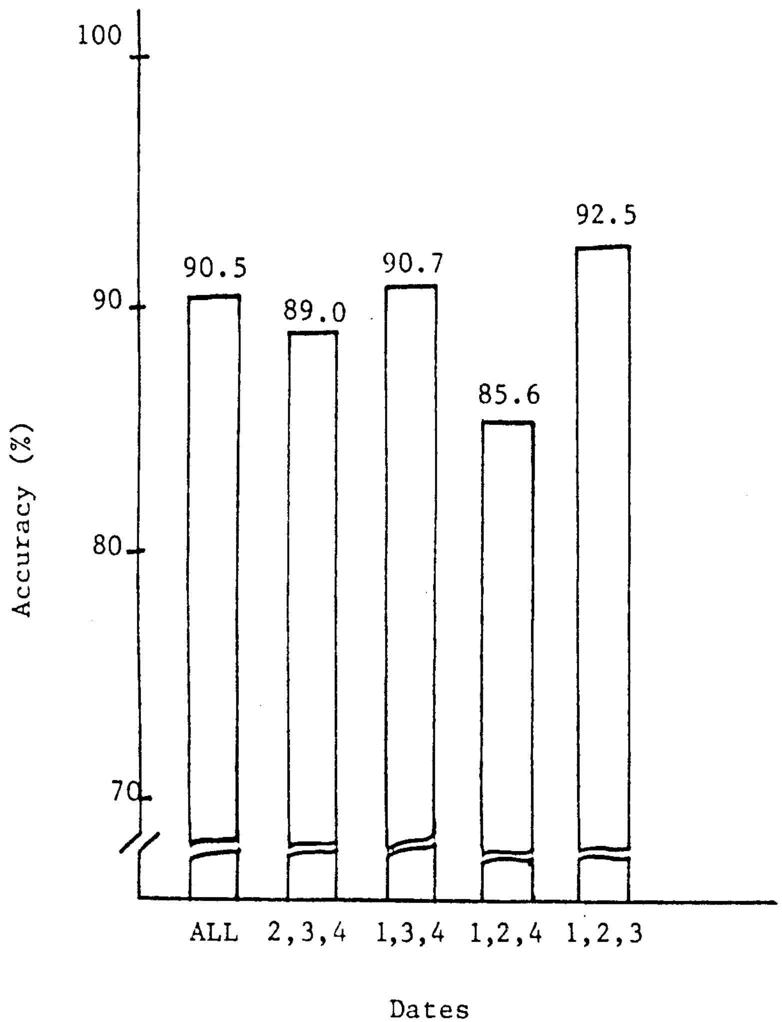
STAGE 1	PREPLANT - 8 LEAVES
STAGE 2	10 LEAVES - TASSEL
STAGE 3	TASSEL-BEG. DENT
STAGE 4	DENT-MATURE

Classification Performance Using
Cumulative Spectral Information

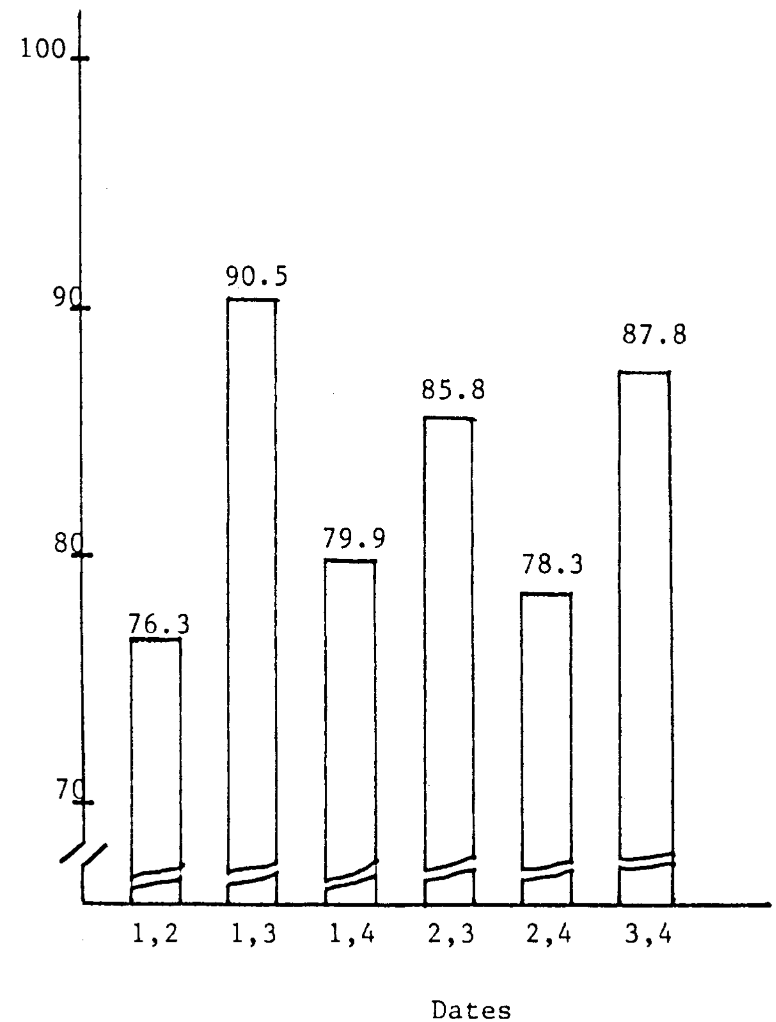


Note: Single dates from growth stages 1 and 2 were not sufficient for classification.

Overall Accuracies of
Three and Four Date Classifications



Overall Accuracies of
Two Date Classifications



ACQUISITION HISTORY IMPACT STUDY
CHANNEL SELECTION

· SINGLE DATA ANALYSIS

- CLASSIFICATIONS DONE WITH 2 AND 4 BANDS.
- SINGLE DATE ANALYSES WERE NOT CONDUCTED FOR STAGES 1 AND 2.
- STAGE 3: NO SIGNIFICANT DIFFERENCES IN ACCURACY.
- STAGE 4: SIGNIFICANT DIFFERENCE (α=.10) IN ACCURACY OF CORN ESTIMATES (ABOUT 12% AVERAGE).

· MULTIDATE ANALYSIS

- COMPARISONS MADE ON THREE AND FOUR DATE COMBINATIONS.
- ALL EVEN CHANNELS (6 OR 8) WERE COMPARED WITH THE "BEST" SUBSET OF 4.
- LOSSES IN ACCURACY BY GOING TO A SUBSET WERE SIGNIFICANT, BUT NEVER EXCEEDED 3%.
- ANALYSES SHOULD BE DONE SEPARATELY ON 3 AND 4 DATES WHEN MORE DATA ARE AVAILABLE.

· SUBSET SELECTION

- WEIGHTED AND UNWEIGHTED SEPARABILITY MEASURES WERE USED TO SELECT THE BEST OF 4 OF 6 OR 8 CHANNELS FOR USE IN CLASSIFICATION.
- IN ABOUT ONE HALF OF THE CASES, THE SAME SUBSET WAS SELECTED.
- NO SIGNIFICANT DIFFERENCES IN ACCURACY WERE FOUND BETWEEN THE 2 METHODS.

ACQUISITION HISTORY IMPACT STUDY
CLASSIFIER COMPARISON

- MINIMUM DISTANCE CLASSIFICATION IDENTIFIED CORN BETTER WHILE MAXIMUM LIKELIHOOD DID BETTER FOR NON-CORN/SOYBEAMS.

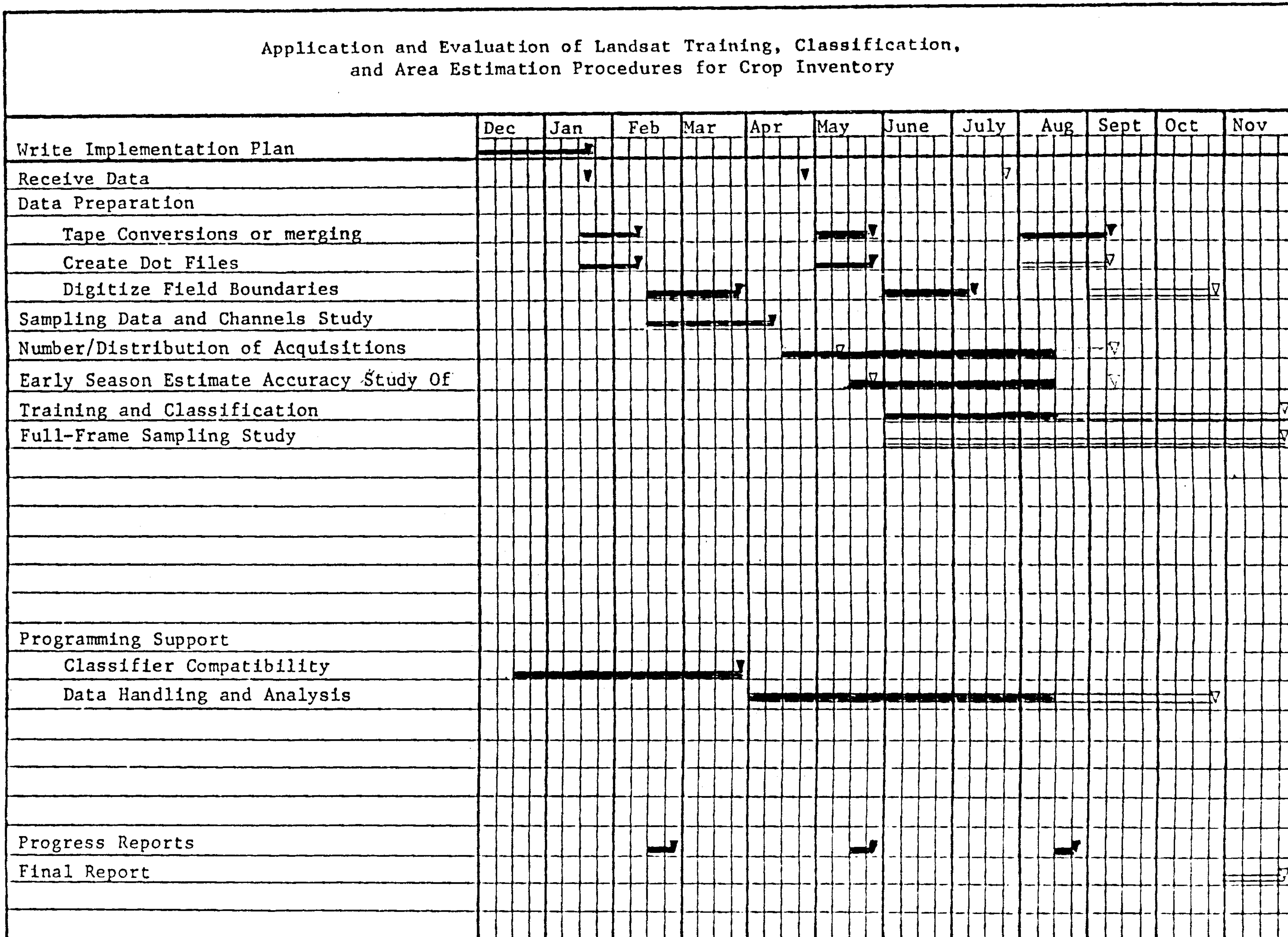
- IN GENERAL, THERE WAS NO SIGNIFICANT DIFFERENCE IN OVERALL ACCURACY.

- COMPARISONS WITH SUM-OF-DENSITIES CLASSIFIER HAVE NOT BEEN COMPLETED.

PLANS FOR NEXT QUARTER

- DATA RECEIPT AND PREPARATION CONTINUES
- COMPLETE STUDY OF IMPORTANCE OF ACQUISITION HISTORY ON IDENTIFICATION AND ESTIMATION OF CROPS.
  - USING DIFFERENT SETS OF ACQUISITIONS, EVALUATE CLASS SEPARABILITY AND CLASSIFICATION PERFORMANCE.
  - INVESTIGATE CROP SEPARABILITY BY EXAMINING CHANGE IN SPECTRAL PROPERTIES THROUGHOUT THE GROWING SEASON.
- STUDY THE INTERRELATIONSHIPS OF TRAINING, CLASSIFICATION, AND AREA ESTIMATION PROCEDURES.
  - BASED UPON RESULTS TO DATE, TRAINING WILL RECEIVE MOST EMPHASIS.
  - SEVERAL GEOGRAPHIC AREAS WILL BE EXAMINED.
  - ACQUISITIONS DETERMINED FROM PREVIOUS STUDY WILL BE USED.
- PLAN FULL-FRAME STUDIES WHEN DATA STATUS BECOMES KNOWN.

Figure 1. Detailed implementation schedule.



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Task 2B. Initial Development of a Spectromet Crop Response Information System for Corn.

I. Introduction

Considerable evidence indicates that remote sensing technology can provide information about crop condition and yields. If this spectral information about crops can be combined effectively with meteorological and ancillary data, then potentially much better information about crop production could be gained.

The overall objective of this task represents a multiyear research effort to integrate the best mix of spectral, meteorological, and ancillary data into a crop information system for estimating crop condition and expected yield during the growing season. This goal represents multiyear, interdisciplinary research efforts to combine the latest techniques and technologies of crop yield forecasting.

II. Activities of Previous Quarters

1. Literature relevant to this task has been reviewed and as a result, the physiologically-based crop simulation approach was selected as having the most potential to use spectrally-derived information. A further advantage of these physiologically-based models over the multiple regression and regression-integral models is that long periods of record are not required for development of the models. The statistical approaches will be pursued where sufficient data exist but in general they will receive less attention than the physiological approaches.

2. Computer compatable tapes of weather data for the test sites have been ordered from the National Climatic Center in Ashville, N.C. but have not been received. Alternative sources of daily air temperatures, precipitation, and solar radiation data are being explored.

3. Soil productivity indicies are available for several of the Corn Belt states. These indicies appear to work best within the state in which they were developed but are not necessarily extendable to other states with different soils, climates and management practices. The characteristics of these systems are

being reviewed and methods to reduce the numerous input variables and assumptions required to generate these indices are being examined. The goal is to summarize existing soil information and develop widely applicable measures of native soil productivity.

4. Examination and analysis of 1978 Landsat MSS data from ten test sites and spectrometer data from the Purdue Agronomy Farm are in progress. Correlations, regressions and trajectory plots of these spectral data and various transformations (e.g. Kauth's greenness and brightness) with crop maturity stage and harvested grain yields are generally incomplete and inconclusive at this time. Direct relationships between reflectance and grain yields are tenuous at best and can be expected to change with different data sets. Significant within segment correlations of reflectance with yields are almost non-existent.

5. Conceptually a corn yield model based on physiological-logic has been formulated. Examination of this model has suggested several areas where additional information is needed. Since daily solar radiation data is not readily available from the National Climatic Center, the consequences and limitations of developing these relationships without solar radiation data are being explored. SIMBAL Version 3, a soil moisture model, has been placed on the LARS computer. The data bases and driving programs to run the crop and soil moisture models are being developed.

6. Twelve runs of aircraft scanner (MMS) data from DeKalb Experiment Station in Yuma, Colorado have been reformatted into LARSYS format and some initial examinations of the data using gray scale maps have been made. No further analyses of these data are planned until aerial photographs and plot maps of this experiment are delivered to LARS.

III. Plans for Next Quarter

1. Continue to assemble the required spectral, meteorological, soil and ancillary data sets from the Multicrop Test Sites as the data becomes available.

2. Write computer programs for the crop models and begin initial calibrations of these models with whatever data is available.

3. Continue to support Task 1A for analysis of spectral data collected in 1978 at the Purdue Agronomy Farm. These analyses will examine:

- basic spectral characteristics of corn as functions of biomass and maturity,
- effects of agronomic treatments on spectral characteristics of corn, and
- interrelationships among possible information sources.

OBJECTIVE:

TO INTEGRATE SPECTRAL, METEOROLOGICAL, SOIL, AND ANCILLARY DATA INTO CROP INFORMATION SYSTEM FOR ESTIMATING CROP CONDITION AND EXPECTED YIELD DURING THE GROWING SEASON.

SPECIFICALLY:

- DEFINE IMPORTANT FUNCTIONAL RELATIONSHIPS
- SELECT AND FURTHER DEVELOP SEVERAL CANDIDATE APPROACHES
- FORMULATE APPROACH INCORPORATING OPTIMUM DATA SOURCES
- CALIBRATE MODEL AND CONDUCT INITIAL TESTS
  - SPECTROMETER DATA
  - LANDSAT MSS DATA
  - AIRCRAFT MSS DATA

APPROACH

1. REVIEW CURRENT MODELING APPROACHES

2. SELECT REPRESENTATIVE APPROACHES

3. ANALYZE SPECTROMETER DATA
   - BASIC SPECTRAL CHARACTERISTICS
   - AGRONOMIC TREATMENTS AND CULTURAL PRACTICES
   - INTER-RELATIONSHIPS OF DATA SOURCES

4. FORMULATE APPROACH TO INCORPORATE OPTIMUM AVAILABLE DATA

5. ASSEMBLE DEVELOPMENTAL DATA SETS

6. CONDUCT INITIAL CALIBRATIONS AND TESTS OF MODELS

CRITERIA FOR MODELING CROP GROWTH AND YIELD

PHYSIOLOGICAL DETAIL

1. DIFFERENT TEMPERATURE OPTIMA FOR NIGHT AND DAY
2. DAILY EVALUATION AND UPDATE OF WEATHER IMPACT
3. WEATHER IMPACT WEIGHTED MORE HEAVILY IN CRITICAL GROWTH STAGES, (E.G., GRAIN FILLING, FLOWERING)
4. STRESS ADAPTATION

MORPHOGENETIC DETAIL

1. DATES OF EMERGENCE (OR PLANTING)
2. DATES OF (TASSELING OR SILKING)
3. DATES OF MATURITY

FLEXIBILITY

1. MANAGEMENT FACTOR
2. CATASTROPHE FACTOR (EG., HAIL, FLOOD)

YIELD = YIELD POTENTIAL X WEATHER FACTOR X EPISODE FACTOR X MANAGEMENT FACTOR

WHERE,

YIELD POTENTIAL REPRESENTS THE YIELD THAT WOULD BE OBTAINED ON A GIVEN AREA WITH ITS PARTICULAR SOIL CONDITIONS IF THE YIELD WERE NOT LIMITED BY WEATHER, EPISODES OF DISEASES AND INSECTS, OR MANAGEMENT CONDITIONS THAT WERE PECULIAR TO THAT PARTICULAR YEAR.

WEATHER FACTOR IS A NUMBER BETWEEN 0 AND 1 REPRESENTING THE LIMITATIONS IMPOSED ON YIELD BY WEATHER CONDITIONS PREVAILING DURING THAT SEASON.

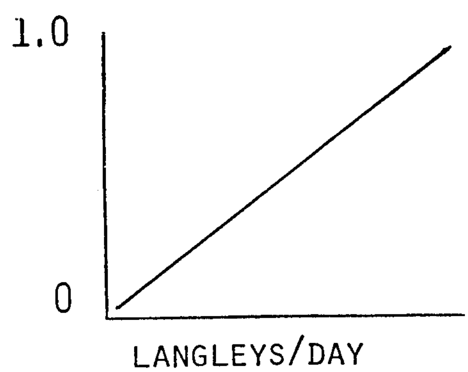
EPISODE FACTOR REPRESENTS A NUMBER BETWEEN 0 AND 1 REPRESENTING THE LIMITATIONS PLACED UPON YIELD BY INFESTATIONS OF DISEASES OR INSECTS OR BY CATASTROPHIC WEATHER CONDITIONS, SUCH AS HAIL, FLOODS, OR HIGH WINDS.

MANAGEMENT FACTOR IS A NUMBER REPRESENTING THE AVERAGE IMPACT OF MANAGEMENT DECISIONS MADE IN THAT PARTICULAR AREA WHICH CAUSES THE GENERAL LEVEL OF MANAGEMENT TO DIFFER FROM OTHER YEARS.

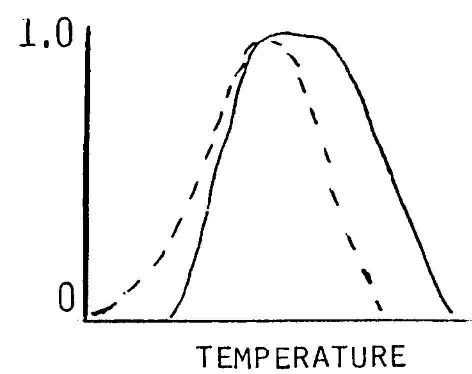
WEATHER FACTOR = SOLAR * AIR TEMP * SOIL MOISTURE * GROWTH STAGE

WEATHER FACTOR IS THE DAILY SUMMATION OF THE PRODUCTS OF

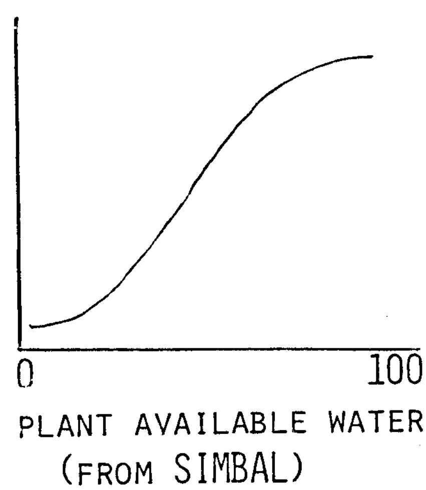
1. SOLAR RADIATION



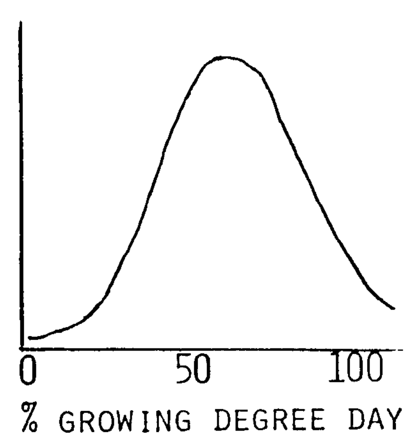
2. AIR TEMPERATURE



3. SOIL MOISTURE



4. GROWTH STAGE



CORRELATION OF YIELD WITH GREENNESS FOR COMBINED SEGMENTS

	Corn		Soybean	
DATE	MATURITY	R	MATURITY	R
Aug. 5-12	4-6	.70	R1-R5	.64
Aug. 17-23	6-8	.74	R3-R6	.63
Aug. 29-Sept. 4	6-9	.27	R3-R7	.11

CORRELATION OF YIELD WITH GREENNESS WITHIN SEGMENTS

DATE	SEGMENT	STATE	CORN R	SOYBEANS R
Aug. 17-23	146	KY	-.02	.46
	185	MN	.01	.21
	241	SD	.30	.31
	804	IA	.25	.55
	812	MS		.50
	824	IL	-.50	.36
	854	IN	.23	-.22

PLANS FOR NEXT QUARTER

1. CONTINUE TO ASSEMBLE REQUIRED SPECTRAL, METEOROLOGICAL, SOIL AND ANCILLARY DATA SETS.

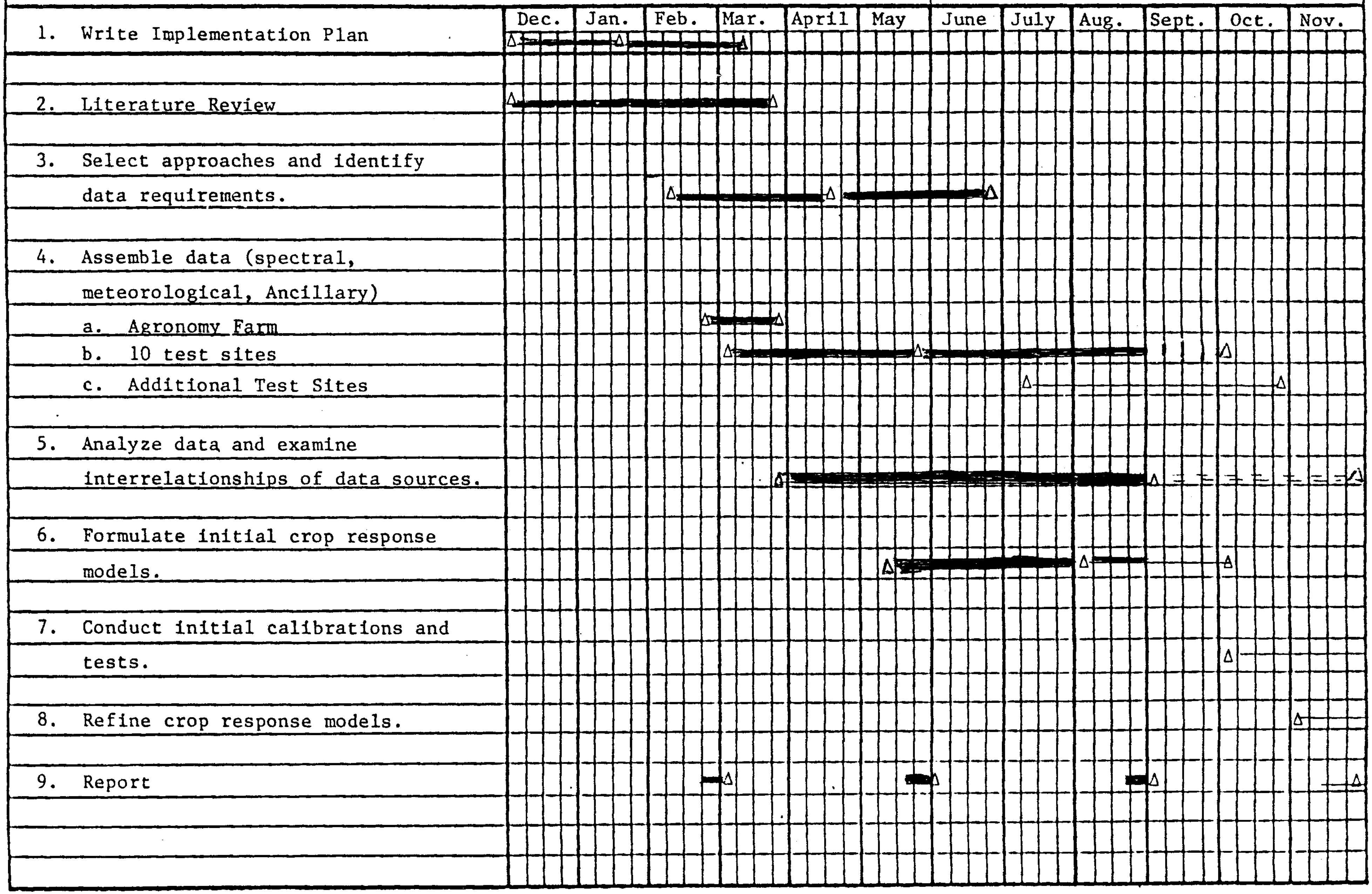
2. WRITE COMPUTER PROGRAMS FOR CROP MODELS.

3. BEGIN INITIAL CALIBRATIONS AND TESTS OF THESE MODELS WITH WHATEVER DATA IS AVAILABLE.

4. CONTINUE TO SUPPORT TASK 1A FOR DATA ANALYSIS.

   - BASIC SPECTRAL CHARACTERISTICS OF CORN
   - EFFECTS OF CULTURAL PRACTICES ON SPECTRAL CHARACTERISTICS
   - INTERRELATIONS AMONG DATA SOURCES

Figure 1. Detailed Task Schedule.-Task 2B. Initial Development of Spectral-Meteorological Crop Response Information System For Corn.



2C. Multispectral Data Analysis Research

Multistage Classification. During this quarter a survey of literature was completed and documented. Multistage classifier software developed earlier at LARS was assembled and made functional. Criteria for test data were established, a suitable data set was selected, and a baseline analysis was completed using the conventional maximum likelihood classifier. A research strategy for the near term, based on binary decision trees, was formulated and initiated.

Contextual Classification. Experimental results were obtained exploring empirical estimation of the context distribution; one method was evaluated and an alternative formulated. The Cyber-Ikon simulator was further improved and extended to provide additional features. The maximum likelihood classifier was implemented, and alternative Cyber-Ikon implementations of the contextual classifier were evaluated. Some question remains with regard to the availability to us of the Cyber-Ikon system at Control Data Corporation.

Additional details are contained in the attached presentation materials.

Task 2C. Multispectral Data Analysis Research

OBJECTIVES

2C1. Multistage Classification

1. TEST KNOWN MULTISTAGE PROCEDURES ON APPLICATIONS INVOLVING MULTITEMPORAL AND MULTITYPE DATA.
2. INITIATE DEVELOPMENT OF OPTIMAL DESIGN PROCEDURES FOR MULTISTAGE CLASSIFIERS.

2C2. Contextual Classification

1. DEVELOP PROCEDURES FOR DETERMINING AND REPRESENTING THE CONTEXTUAL CHARACTERISTICS OF A SCENE.
2. DEVELOP AN EFFECTIVE MULTIPROCESSOR IMPLEMENTATION OF THE CONTEXT CLASSIFIER ALGORITHM
   - ALGORITHM ANALYSIS
   - MULTIPROCESSOR SIMULATION
   - CDC CYBER-IKON IMPLEMENTATION.

2C1 MULTISTAGE CLASSIFICATION STATUS

1. INITIAL LITERATURE SURVEY COMPLETE.

   SOME 12 SCIENTIFIC PAPERS HAVE BEEN LOCATED AND REVIEWED AND THE CURRENT STATE OF THE SCIENCE EVALUATED.

2. MULTISTAGE CLASSIFIER SOFTWARE REFURBISHMENT.

   THE ORIGINAL MULTISTAGE CLASSIFIER DESIGN AND CLASSIFICATION SOFTWARE, WRITTEN SEVERAL YEARS AGO, HAS BEEN REASSEMBLED AND MADE FUNCTIONAL.

3. DATA SET SELECTION.

   A DATA SET SUITABLE FOR RESEARCH TESTS HAS BEEN LOCATED. CRITERIA FOR SELECTION:

   - WIDE VARIETY OF CLASSES
   - DIFFICULTY IN DISTINGUISHING BETWEEN CLASSES
   - A LARGE NUMBER OF CHANNELS
   - ADEQUATE GROUND TRUTH AVAILABLE

THE DATA SET SELECTED IS CBWE FLIGHTLINE 210.

4. BASELINE CLASSIFICATION

A BASELINE CLASSIFICATION HAS BEEN COMPLETED USING CONVENTIONAL (NON-LAYERED) DECISION LOGIC AND CONVENTIONAL TRAINING METHODS. PARAMETERS AND RESULTS ARE AS FOLLOWS:

- 103,230 PIXELS
- BEST 4 OF 9 CHANNELS USED
- 17 SPECTRAL CLASSES, 6 INFORMATIONAL CLASSES
- RESULTS:

SOYBEANS	76%
STUBBLE	45%
PASTURE	12%
CORN	79%
FOREST	83%
WATER	95%
OVERALL	69%

5. APPROACH FORMULATION

INTERIM TREE DESIGN PROCEDURE HAS BEEN CHOSEN FOR STUDY FOR THE NEXT SEVERAL MONTHS; INTENDED TO PROVIDE MODEST IMPROVEMENT OVER ORIGINAL METHODS AND TO LEAD TOWARD A MORE GENERAL OPTIMAL PROCEDURE. THE INTERIM APPROACH IS CHARACTERIZED BY

- BINARY TREE - TWO CLASS CASE EASIER TO ANALYZE THEORETICALLY AND EXPERIMENTALLY
- PRINCIPAL COMPONENTS - IMPOSES APPROXIMATE ORDERING ON FEATURES
- USE OF EXISTING SOFTWARE

2C1 Multistage Classification

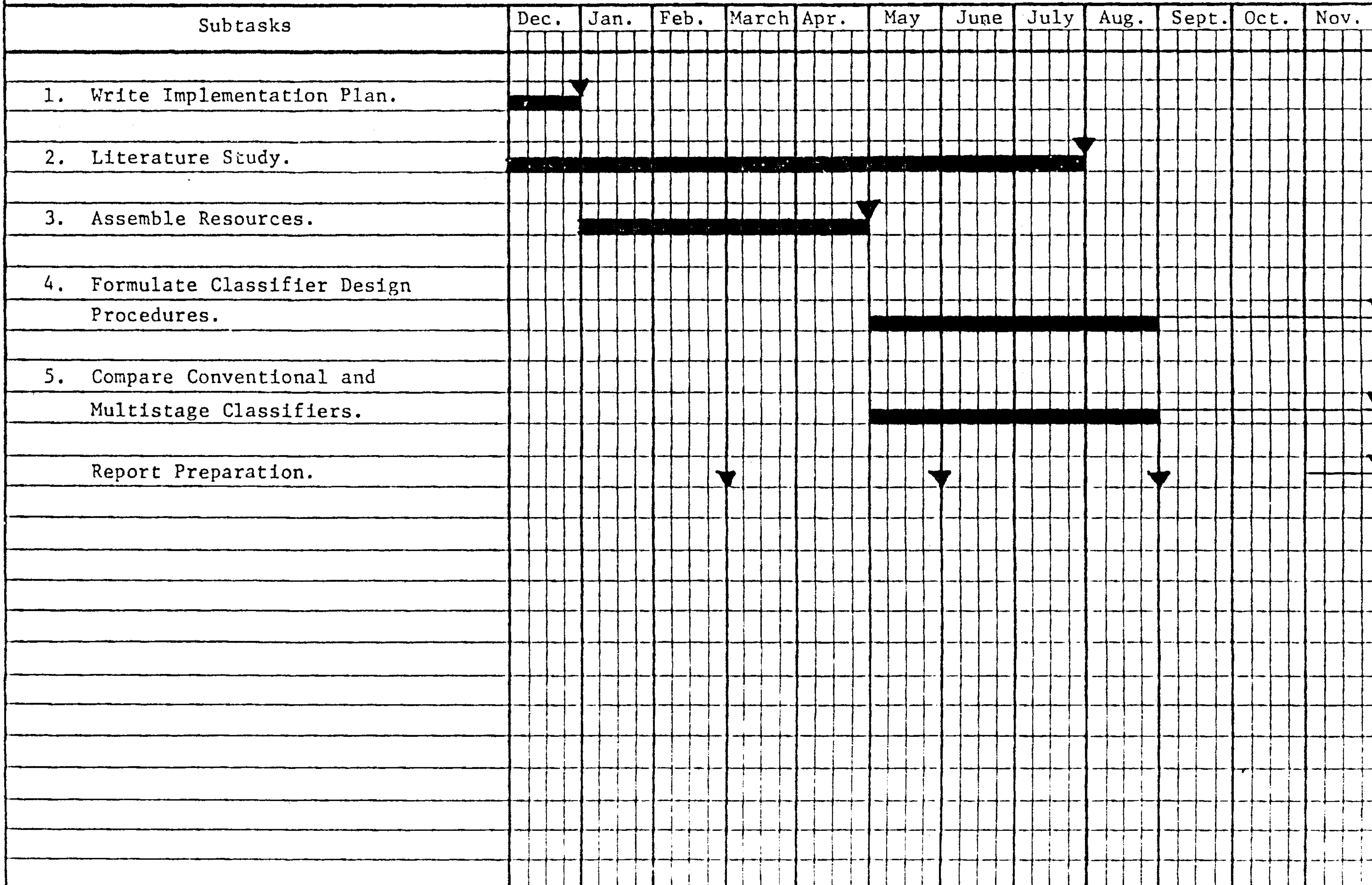
Plans for fourth quarter

1. Test interim approach for accuracy and efficiency.

2. Complete comparative tests of conventional and multistage classifiers.

3. Write a detailed report.

Figure 2C-1. Detailed Implementation Schedule for Task 2C1.



2C2 CONTEXT CLASSIFICATION

THIRD QUARTER ACCOMPLISHMENTS

1. BASELINE (NO-CONTEXT) ANALYSIS OF TWO 50-PIXEL-SQUARE SECTIONS OF BLOOMINGTON, INDIANA DATA COMPLETED (INCLUDING ASSEMBLY OF REFERENCE DATA FROM PHOTOGRAPHY). LACIE SEGMENT SELECTED.

2. CONTEXTUAL CLASSIFICATIONS OF BLOOMINGTON DATA COMPLETED UTILIZING VARIOUS CONTEXT CONFIGURATIONS AND TWO CONTEXT DISTRIBUTION ESTIMATION METHODS.

   FIRST METHOD: "ITERATIVE" APPROACH.

   SECOND: "AD HOC" APPROACH BASED ON MANUALLY CORRECTING TEST FIELD PORTIONS OF TEMPLATE (~50%).

3. CONTEXT ALGORITHM ANALYZED FOR MULTIPROCESSOR IMPLEMENTATION AND ALGORITHM REFINEMENT WELL UNDERWAY.

4. CYBER-IKON SIMULATOR: CONTINUED IMPROVING USER INTERFACE; DEVELOPED SPECIAL SOFTWARE TECHNIQUES TO EXPAND SIMULATOR TO HANDLE UP TO SIXTEEN FLEXIBLE PROCESSORS (MAX. NUMBER ALLOWED IN ACTUAL SYSTEM); IMPROVED SOFTWARE, GREATLY REDUCING EXECUTION TIME; BEGAN EXTENSION TO HANDLE INTER-FP COMMUNICATIONS.

5. COMPLETED IMPLEMENTATION OF MAXIMUM LIKELIHOOD CLASSIFIER ON CYBER-IKON SIMULATOR.

6. EVALUATED ALTERNATIVE METHODS FOR USING MULTIPLE FLEXIBLE PROCESSORS TO PERFORM CONTEXTUAL CLASSIFICATION.

7. UNIX OPERATING SYSTEM NOW AVAILABLE ON LARS PDP-11; BEGAN MOVE OF CYBER-IKON SIMULATOR TO LARS PDP-11.

2C2 CONTEXT CLASSIFICATION

PROBLEMS ENCOUNTERED

1. UNIX OPERATING SYSTEM IMPLEMENTATION ON LARS PDP-11 CONTINUED TO BE A PROBLEM, PREVENTING TRANSFER OF SOFTWARE TO LARS. EXPECTED TO BE FULL-UP EARLY IN FOURTH QUARTER.

2. ACTUAL ACCESS TO CYBER-IKON SYSTEM REMAINS UNCERTAIN DUE TO LACK OF COOPERATION BY CONTROL DATA CORP.

2C2 Context Classification

PLANS FOR FOURTH QUARTER

1. COMPLETE ALGORITHM REFINEMENT FOR MULTI-PROCESSOR IMPLEMENTATION AND TEST.

2. DEVELOP "AD HOC" APPROACH TO CONTEXT DISTRIBUTION ESTIMATION AS MORE FORMAL METHOD. EXPLORE LIMITATIONS OF THIS APPROACH.

3. EVALUATE CONTEXT CLASSIFIER PERFORMANCE ON DATA FROM LACIE SEGMENT.

4. COMPLETE TRANSFER OF CYBER-IKON SIMULATOR TO LARS PDP-11.

5. COMPLETE EXTENSION OF CYBER-IKON SIMULATOR TO HANDLE INTER-PROCESSOR COMMUNICATIONS.

6. IMPLEMENT VARIOUS SIZE AND SHAPE NEIGHBORHOOD CONTEXTUAL CLASSIFIERS ON THE CYBER-IKON SIMULATOR.

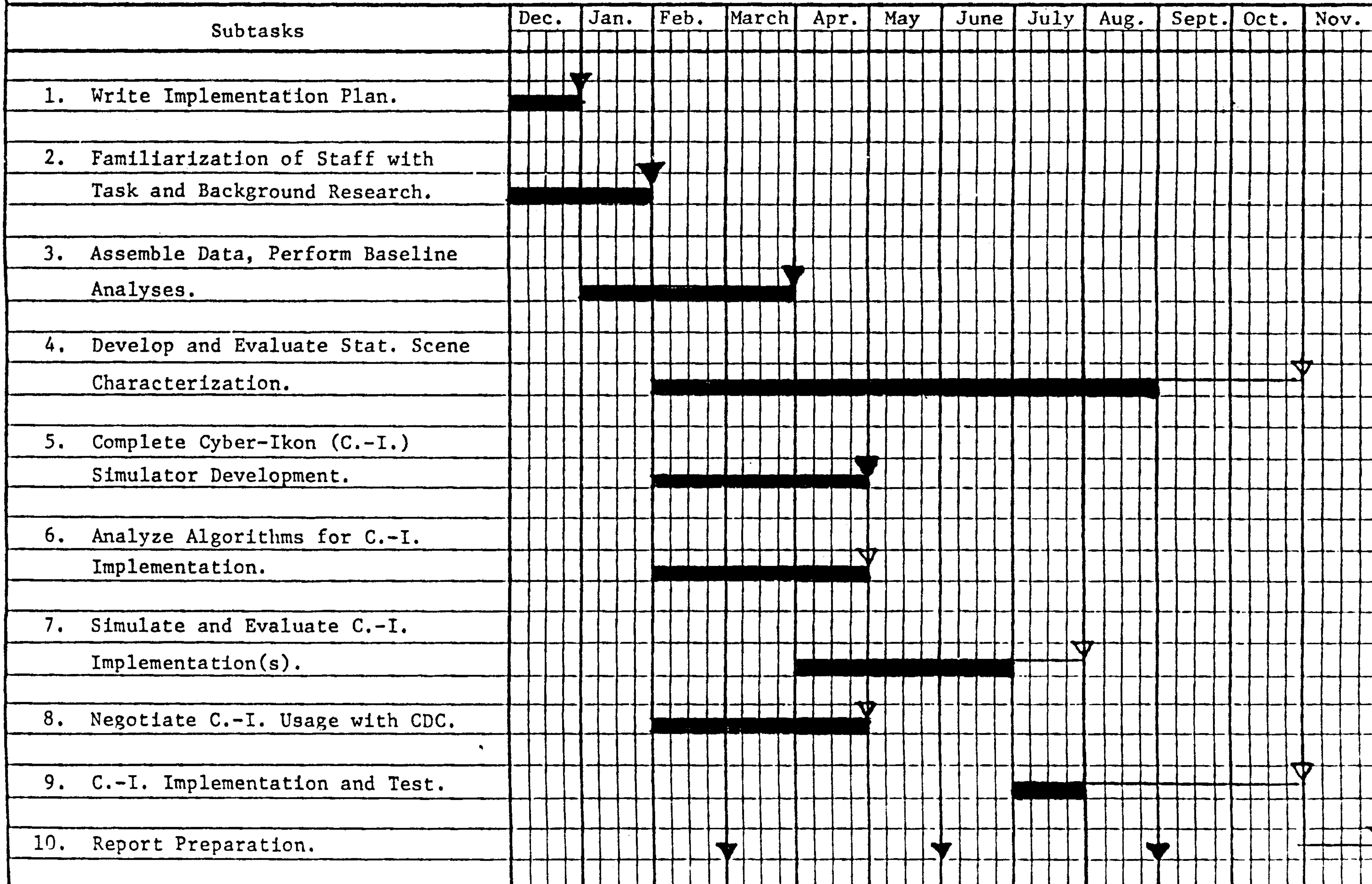
7. OBTAIN FROM CDC DETAILED INFORMATION ABOUT HOST/ARRAY INTERFACES IN THE CYBER-IKON SYSTEM.

8. EXECUTE MAXIMUM LIKELIHOOD CLASSIFIER ON ACTUAL CYBER-IKON SYSTEM.

9. EXECUTE CONTEXTUAL CLASSIFIER WITH SMALL NEIGHBORHOOD ON ACTUAL CYBER-IKON SYSTEM.

10. PREPARE FINAL REPORT FOR CONTRACT YEAR.

Figure 2C-2. Detailed Implementation Schedule for Task 2C2.



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TASK 2D. MULTISENSOR, MULTIDATE SPATIAL FEATURE MATCHING, CORRELATION, REGISTRATION AND INFORMATION EXTRACTION

OBJECTIVE

DEVELOP TECHNOLOGY FOR UTILIZING MULTIPLE DATA TYPES AND ANCILLARY DATA TO ENHANCE PERFORMANCE OF REMOTE SENSING DATA ANALYSIS FOR EARTH RESOURCE SURVEYS.

PROCEDURE

- ACQUIRE TEST DATA SETS WITH GROUND TRUTH: LANDSAT, A/C MSS, A/C SAR, SEASAT SAR AND ANCILLARY DATA.
- DEVELOP CORRELATION AND REGISTRATION METHODS FOR MSS AND SAR AND PRODUCE TEST REGISTERED DATA SETS.
- INVESTIGATE IMAGE ENHANCEMENT AND PRESENTATION METHODS FOR USING SAR DATA TO AID ANALYST.
- INVESTIGATE INFORMATION EXTRACTION METHODS FROM COMBINED SAR LANDSAT DATA SETS.

ACCOMPLISHMENTS IN PERIOD 3/1/79 - 8/31/79

- EXTENSIVE CLASSIFICATION ANALYSIS CARRIED OUT ON ARIZONA SAR/LANDSAT DATA SET USING PIXEL, AND FIELD CLASSIFIERS.
- A PROCEDURE FOR USING ANCILLARY DATA, AND DATA BASE TECHNIQUES FOR SPECTRAL CLASSIFICATION DEFINED AND EVALUATED.
- A SELF DEFINING DATA SET (SSDS) STRUCTURE WAS FORMULATED FOR MULTIPLE DATA TYPES AND IMPLEMENTATION AND TESTING WAS BEGUN.
- MANUAL CONTROL POINT FINDING METHODS EVALUATED USING MDP LIBRARY CONTROL POINTS AND A PREDICTION FUNCTION.
- USE OF HIGH RESOLUTION PANCHROMATIC IMAGERY (E.G. RBV, SAR) AND LOWER RESOLUTION SPECTRAL IMAGERY FOR RESOLUTION ENHANCEMENT STUDIED.
- COLOR MAP DIGITIZATION EXPERIMENTS COMPLETED.

CLASSES ANALYZED IN SAR/LANDSAT DATA

CLASS	NO. FIELDS	NO. OF PIXELS
COTTON	40	9377
ALFALFA	12	3345
BARLEY	2	364
URBAN	22	3968
TOTAL	76	17,054

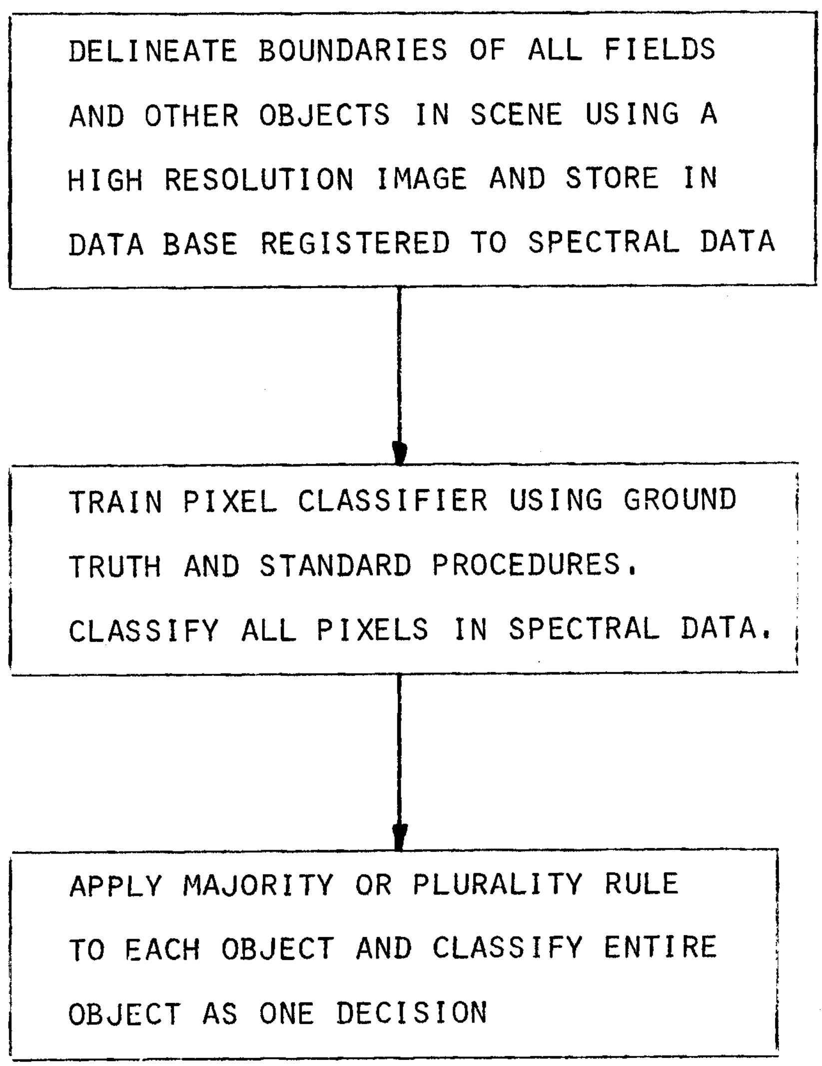
RATIONALE FOR OBJECT CLASSIFICATION

- FOR CASES IN WHICH THE SAME HIGHLY STRUCTURED SCENE SAMPLE AREA IS TO BE CLASSIFIED EACH YEAR FOR MANY YEARS A DATA BASE OF OBJECT BOUNDARIES CAN BE MAINTAINED.

- IMAGE SEGMENTATION TECHNOLOGY CAN BE USED TO ESTABLISH OBJECT BOUNDARIES INITIALLY AND UPDATE BOUNDARIES EACH YEAR.

- SPECTRAL CLASSIFICATION OF OBJECTS RATHER THAN PIXELS OR BLOBS CAN THEN BE CARRIED OUT.

OBJECT CLASSIFICATION USING BOUNDARY DATA BASE AND MAJORITY OR PLURALITY DECISION RULE



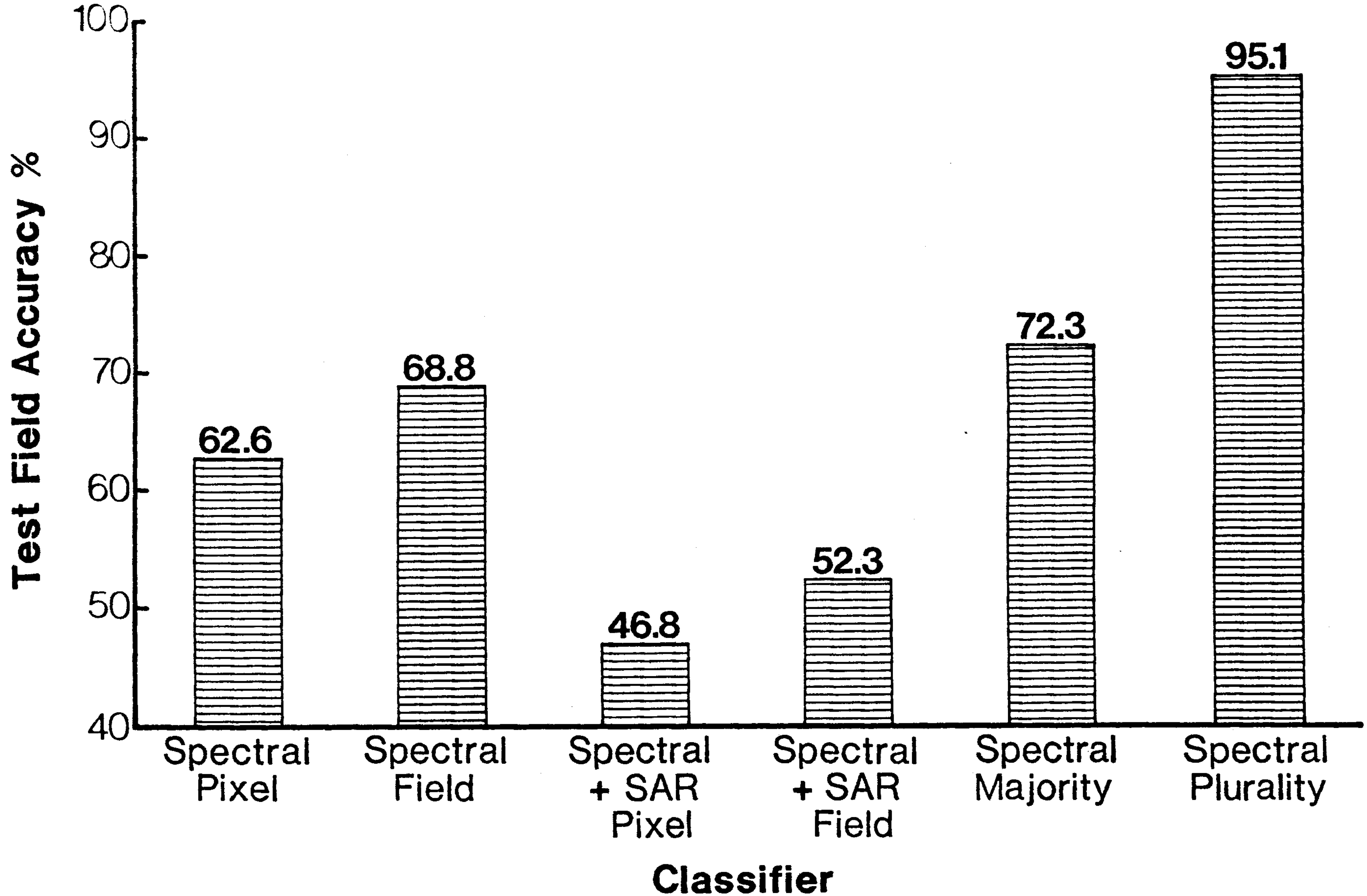
Classification Results

TEST FIELDS

% CORRECT

CLASS	SPECTRAL PIXEL CLASSIFIER	SPECTRAL FIELD CLASSIFIER	SPECTRAL + SAR PIXEL	SPECTRAL + SAR FIELD	SPECTRAL MAJORITY CLASSIFIER	SPECTRAL PLURALITY CLASSIFIER
COTTON	70.2	87.6	48.1	43.3	95.2	100.0
ALFALFA	59.8	35.5	67.8	80.7	60.1	93.3
BARLEY	63.5	42.3	20.3	55.2	100.0	100.0
URBAN	46.9	55.0	28.5	49.3	25.9	84.7
OVERALL	62.6	68.8	46.8	52.3	72.3	95.1

Overall Clasification Results



SELF DEFINING DATA SET

- COMPLETE GEOMETRIC DESCRIPTION OF DATA SET INCLUDED IN HEADER.

- FOR MULTITYPE, MULTITEMPORAL DATA SETS EACH CHANNEL WILL BE FULLY DESCRIBED.

- FORMAT FLEXIBLE TO ACCOMODATE DIFFERENT WORD SIZES AND RESOLUTIONS.

PARAMETERS FOR AN SDDS

DATA SET PARAMETERS

- CENTER LATITUDE & LONGITUDE AND CORRESPONDING LINE & COLUMN
- AZIMUTH OF CENTER COLUMN AT CENTER
- POLYNOMIAL FUNCTION FOR RELATING LINES & COLUMNS TO GEO REFERENCE COORDINATES (LAT, LONG OR VTM NORTHING, EASTING)

CHANNEL PARAMETERS

- TIME OF COLLECTION
- TYPE OF DATA
- BITS PER WORD
- CELL SIZE
- BAND CENTER
- FULL SCALE CALIBRATION
- MEAN
- VARIANCE

Proposed Changes to LARSYS Format

ADDITIONS TO ID RECORD

WORDS	
21	LATITUDE OF CENTER
22	LONGITUDE OF CENTER
23	COLUMN OF CENTER
24	LINE OF CENTER
25	HORIZONTAL PIXEL SCALE
26	VERTICAL PIXEL SCALE
27	PROJECTION CODE
31-40	COEF FOR LINE GEOMETRIC FUNCTION
41-50	COEFFICIENTS FOR COLUMN GEOMETRIC FUNCTION

CHANGES TO CHANNEL ID WORDS   K = 0,29

5K + 51	DATA TYPE CODE
5K + 52	COLLECTION DATE
5K + 53	BITS PER WORD
5K + 54	FULL SCALE CALIBRATION
5K + 55	BAND CENTER WAVELENGTH

MDP CONTROL POINT ANALYSIS FOR BACKUP GEOMETRIC CORRECTION CAPABILITY

- THE SET OF 20 GROUND CONTROL POINTS ACQUIRED FOR FARGO, GEORGIA SCENE PATH 18 ROW 39.
- PREDICTION PROGRAM WRITTEN TO DETERMINE CENTER LINE & COLUMN OF IMAGE SUBSET CONTAINING CONTROL POINT.
- CONTROL POINT IMAGE SUBSETS DISPLAYED IN LINE PRINTER AND VARIAN DOT PRINTER GRAY SCALE FORM AND CORRESPONDING TOPOGRAPHIC MAP BLOCK.
- PROGRAM WRITTEN TO DISPLAY THRESHOLDED IMAGE ON CRT TERMINAL SCREEN WITH CURSOR TO ENABLE CONTROL POINT SELECTION.
- CORRELATION ANALYSIS PERFORMED ON DEC. 30, 1976 AND APRIL 17, 1977 OVERPASSES FOR FOUR CONTROL POINTS.
- SENSOR AND SATELLITE MODELING GEOMETRIC CORRECTION SOFTWARE SYSTEM EVALUATED.

RESULTS OF CONTROL POINT EVALUATION

- POINTS DISTRIBUTED ALONG EDGES SO ARE USEFUL FOR ATTITUDE MODELING BUT MAY BE DIFFICULT TO USE FOR GENERAL POLYNOMIALS.

- SOME POINTS VERY DIFFICULT TO SEE IN IMAGERY.

- CRT TERMINAL USEFUL FOR DISPLAYING CONTROL POINT IMAGE IN MANY CASES.

- THE NASA/GSFC DIRS GEOMETRIC CORRECTION PACKAGE IS AN ATTRACTIVE APPROACH FOR A BACKUP SYSTEM FOR UNCORRECTED DATA.

Mixed Resolution Image Enhancement

Assumptions

LOW RESOLUTION SPECTRAL DATA WITH CELL SIZE D.

HIGH RESOLUTION PANCHROMATIC IMAGE WITH CELL SIZE $S < D$.

LOW RESOLUTION IMAGE CORRELATED WITH HIGH RESOLUTION CASE.

IMAGE ENHANCEMENT

$$G(u,v) = L(u,v) + F(u,v) \times H(u,v)$$

$L(u,v)$	FOURIER TRANSFORM OF LOW RESOLUTION IMAGE.
$H(u,v)$	FOURIER TRANSFORM OF HIGH RESOLUTION IMAGE.
$G(u,v)$	COMPOSITE OUTPUT IMAGE FT.
$F(u,v)$	FILTER TRANSFORM FOR EXTRACTING HIGH FREQ. INFORMATION.

Plans for Fourth Quarter

- EVALUATE USE OF SAR FOR URBAN/NON-URBAN CLASSIFICATION THEN SPECTRAL FIELD CLASSIFICATION FOR VEGETATIVE SPECIES.

- COMPLETE SOFTWARE FOR GENERATING AND PROCESSING SELF DEFINING DATA SETS FOR MULTIPLE DATA TYPES.

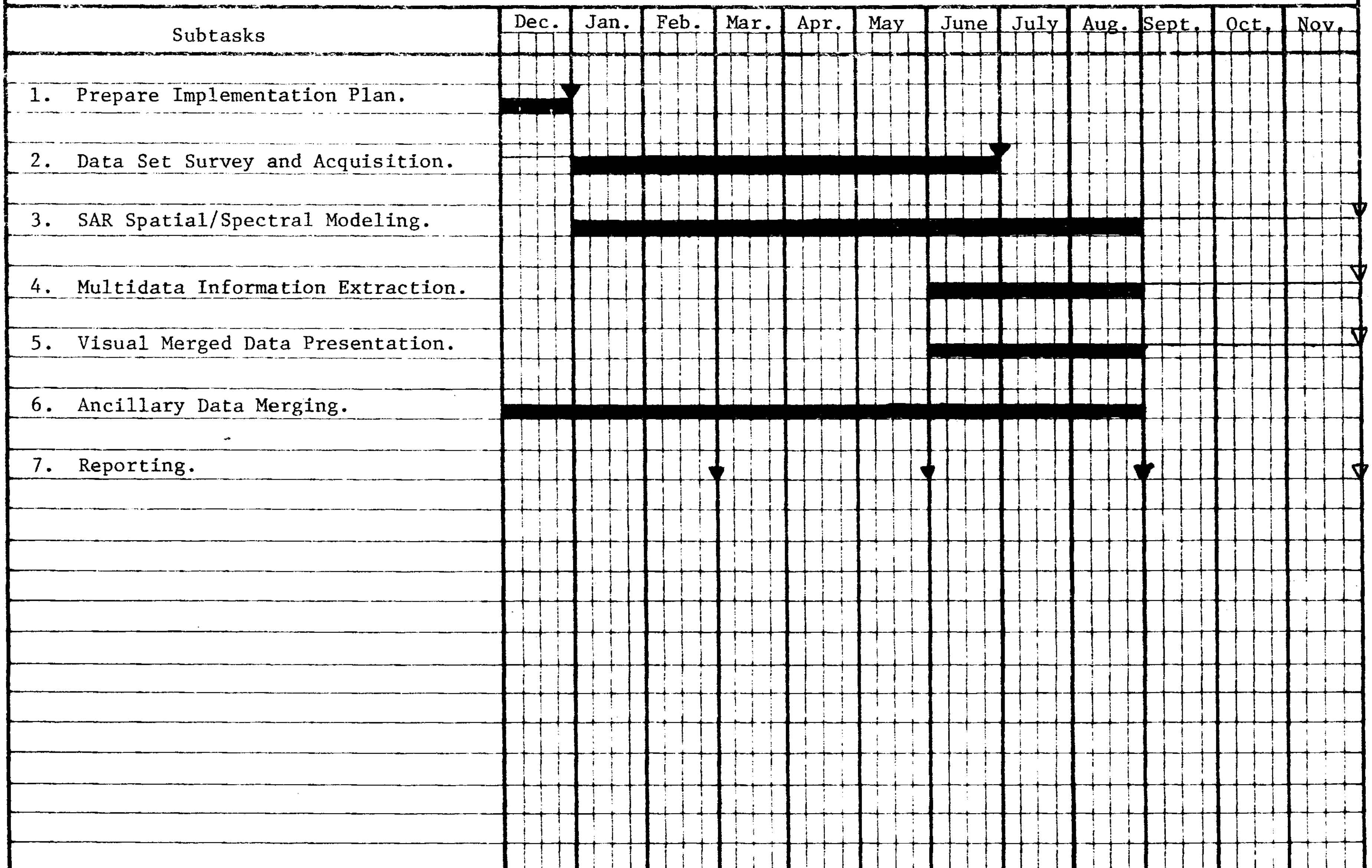
- INVESTIGATE MAP DIGITIZATION METHOD USING SPATIAL PATTERN RECOGNITION OF LINES (POLYGONS) AND LABELS.

- COMPLETE ANALYSIS AND DOCUMENTATION OF MDP CONTROL POINTS FOR TEST FRAME.

COLOR MAP DIGITIZATION

- HIGH SATURATION COLOR MAPS GENERATED.
- MAPS PHOTOGRAPHED AND COLOR SEPARATION FILM SCANNED TO PRODUCE THREE FEATURE SPECTRAL DATA.
- DATA SETS CLASSIFIED AND EVALUATED.
- POLYGON INTERIOR ACCURACY VERY HIGH, EDGE CLASSIFICATION SLIGHTLY POORER DUE TO PAINTING ERRORS AND MIXED PIXELS.

2D. Multisensor Multidate Spatial Feature Matching, Correlation, Registering, Resampling and Information Extraction



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Task 3. Computer Processing and Data Base Services

3A. Computer Processing Support

Attached are viewgraph materials highlighting the activities pursued this quarter, and outlining upcoming events. Appendix A presents the configuration of the IBM 3031, which will be installed at LARS during September. Benchmark tests on the 3031 indicate this machine is roughly three times as powerful as the IBM 370 Model 148 it replaces. Product rates have been adjusted to reflect the 3031 installation. The new rates, which will go into effect upon installation of the 3031, are listed in Appendix B.

During the third quarter, the design and implementation of the RT&E data base housed at LARS, and the software associated with it, were altered to accommodate different geographic areas which have been assigned to the same segment numbers. Appendix C documents the new data base format and changes to the data base software. As always, changes to the software and the data base have been documented in the SRTNEWS file.

COMPUTER PROCESSING SUPPORT

OBJECTIVE: PROVIDE JSC AND ITS ASSOCIATED RESEARCH COMMUNITY WITH THE ENVIRONMENT NECESSARY FOR THE IMPLEMENTATION OF A SHARED DATA PROCESSING SYSTEM FOR RESEARCH OF REMOTE SENSING.

PURDUE'S SUPPORT INCLUDES A COMPUTER AND SUPPORTING HARDWARE, SOFTWARE, DATA, PERSONNEL, PROCEDURES AND TRAINING.

JLK: 9/1/79

POTENTIAL BENEFITS

* THE OPPORTUNITY TO BETTER MOLD KEY, GEOGRAPHICALLY-DISPERSED RESEARCH GROUPS INTO A MORE INFORMED AND COORDINATED RESEARCH TEAM.

* A MECHANISM FOR EFFICIENT TRANSFER OF INFORMATION BETWEEN RESEARCH CENTERS, NASA, AND OTHER PARTICIPATING GOVERNMENT AGENCIES.

* FASTER, LESS REDUNDANT SOFTWARE DEVELOPMENT.

* FASTER TRANSFER OF NEWLY-DEVELOPED ANALYSIS TECHNIQUES AND RESEARCH RESULTS TO AND FROM PARTICIPATING RESEARCH GROUPS.

* CONCENTRATION OF SYSTEMS PROGRAMMING SUPPORT, DATA ACQUISITION, DATA LIBRARY AND CERTAIN COMPUTER SERVICES AT THE SYSTEM'S CENTRAL SITE.

JLK: 9/1/79

IN ORDER FOR A PROMISING NEW ANALYSIS TECHNIQUE TO BE SHARED WITHIN THE RESEARCH COMMUNITY, RECIPIENTS OF THE NEW TECHNIQUE MUST HAVE:

* ACCESS TO SOFTWARE SUPPORTING THE NEW TECHNIQUE;
* ACCESS TO HARDWARE WHICH SUPPORTS THE SOFTWARE;
* ACCESS TO THE DATA REQUIRED BY THE TECHNIQUE;
* A TECHNICAL UNDERSTANDING OF THE TECHNIQUE;
* KNOWLEDGE OF HOW TO OPERATIONALLY USE THE SUPPORTING SOFTWARE.

JLK: 9/1/79

THIRD QUARTER SOFTWARE UPGRADES

* A PROCEDURE FOR TRANSFERING IMPROPERLY-TERMINATED TAPES WAS IMPLEMENTED.

* AN INTERACTIVE "TROUBLE FILE" FOR REPORTING PROBLEMS WHICH USERS WERE ENCOUNTERING WAS IMPLEMENTED.

* SEVERAL ENHANCEMENTS TO EODLARSYS WERE SUGGESTED, AMONG THEM:

- HAVE THE DATA TAPE NUMBER APPEAR ON THE OUTPUT;
- ALLOW THE CAPABILITY TO REQUEST AN 800 BPI TAPE DRIVE;
- HAVE THE PROMPTING EXEC MAINTAIN THE CONTENTS OF THE CONSOLE STACK;
- ALLOW THE CAPABILITY OF USING DIFFERENT FILES ON SUBSEQUENT PASSES THROUGH THE PROMPTING EXEC;
- ENHANCEMENTS TO THE DATA FORMATS PRODUCED BY DATA MERGE.

* WORK ON AN ANALYSIS PROCEDURE USING ECHO WAS PURSUED.

- SOFTWARE TO CONVERT THE FORMAT OF STATISTICS FILES WAS IMPLEMENTED;
- THE CAPABILITY TO UTILIZE UNIVERSAL FORMATTED DATA WAS IMPLEMENTED IN LARSYS;
- THE DESIGN OF THE PROCEDURE WAS FINALIZED.

* INCLUDED IN THE LAST LARSPEC UPDATE WAS THE CAPABILITY TO SEND JOBS TO A BATCH MACHINE.

JLK: 9/1/79

THIRD QUARTER SOFTWARE UPGRADES
(CONTINUED)

* BATCH CAPABILITIES WERE ENHANCED.
  - IF A JOB TERMINATES IMPROPERLY, THE CONSOLE OUTPUT IS PRINTED.
  - ADDITIONAL CAPABILITIES IN ROUTING BATCH OUTPUT WERE ADDED.
  - WHEN TRANSFERRING A JOB TO BATCH, THE NOHEADER OPTION ON THE PUNCH COMMAND IS NO LONGER NECESSARY.
* SOFTWARE TO AID RESOURCE REQUESTS WAS IMPLEMENTED.
* 3031 BENCHMARK TESTING WAS COMPLETED AT GAITHERSBURG, MD AND REPORTED ON.
* A 3-DIMENSIONAL GRAPHICS SYSTEM WAS IMPLEMENTED.

BMS: 9/1/79

ANTICIPATED FOURTH QUARTER SOFTWARE UPGRADES

* All batch machines except BATONITE will be converted to CMS370 on October 14th.
* Enhancements of the BATCH capability are planned.
* Further work on the implementation of an ECHO-based procedure will be pursued.
* Efforts to enhance the compatibility of LARSYS with EODLARSYS will be pursued.
* Software to allow for the use of a DECwriter for graphics output will be developed.

BMS: 9/1/79

THIRD QUARTER HARDWARE UPGRADES

* RECEIVED A 1200 BAUD CLOCK TO SUPPORT AN EARLY OCTOBER INSTALLATION OF A STATISTICAL MULTIPLEXOR BETWEEN LARS AND JSC.

* INSTALLED A THIRD IBM-COMPATIBLE 3330 DISK DRIVE.

* SUPPORTED INSTALLATION OF A 9600 BAND MODEM ON THE HOUSTON LINE.

* INSTALLED A CONTROLLER FOR THE 3330 DISK SYSTEM IN PREPRATION FOR THE 3031 INSTALLATION.

* ORDERED AN EXTENSION OF THE COMMUNICATIONS CONTROLLER TO ALLOW ADDITIONAL PORTS ON THE SYSTEM.

JLK: 9/1/79

FOURTH QUARTER HARDWARE PLANS

* A 3031 will be installed at LARS during mid-September.

* A dial-up port for ERIM's COPE 1200 RJE will be installed. (ERIM is currently using Goddard's port.)

* Installation of an extension to the 3705 communications controller will be pursued.

JLK: 9/1/79

THIRD QUARTER DATA BASE WORK

1. IMPLEMENTED NEW RT&E DATA BASE DESIGN.

2. ENTERED PHASE I AND MULTICROP DATA BASES INTO SEGMENT CATALOG.

3. VALIDATED RT&E DATA BASE AND THE FOREIGN TRANSITION YEAR TAPE DATA BASE.

4. REVIEWED MET WEATHER DATA BASE PROPOSALS WITH NOAA.

JLK: 9/1/79

PLANNED DATA BASE WORK FOR FOURTH QUARTER

1. RECEIVE AND VALIDATE U.S. AND CORRECTED FOREIGN TRANSITION YEAR TAPE DATA BASES.
2. ENTER TRANSITION YEAR DATA INTO THE SEGMENT CATALOG.
3. MAKE FINAL DESIGN AND TASK IMPLEMENTATION TIMETABLE RECOMMENDATIONS FOR THE NOAA MET WEATHER DATA BASE.

JLK: 9/1/79

USER COMMUNICATION

* A VISITING CONSULTANT TRIP TOOK PLACE DURING JULY.

* 'TROUBLE', AN INTERACTIVE ERROR REPORTING SYSTEM, WAS IMPLEMENTED.

* A DEMONSTRATION OF A LOW-COST GRAPHICS HARDWARE CAPABILITY WAS PRESENTED AT JSC DURING JULY.

JLK: 9/1/79

TRAINING COURSE DEVELOPMENT
FOR
USERS OF THE PURDUE/LARS COMPUTER SYSTEM

THIRD QUARTER ACCOMPLISHMENTS

1. REVIEW PREVIOUS COURSE MATERIALS, PRESENTATIONS AND EVALUATIONS.

2. INITIATE COMMUNICATION BETWEEN LARS AND JSC CONCERNING THE TRAINING NEEDS OF USERS OF THE PURDUE/LARS COMPUTER SYSTEM.

3. DEVELOP INITIAL TRAINING MODULE TITLES AND OUTLINES.

RKB: 9/1/79

TRAINING COURSE DEVELOPMENT
FOR
USERS OF THE PURDUE/LARS COMPUTER SYSTEM

FOURTH QUARTER PLANS

1. DEVELOP TRAINING MODULE DESCRIPTIONS AND PREREQUISITES.

2. STUDY THE CONSISTENCY OF THE PROPOSED MODULES WITH THE TRAINING NEEDS RESULTING FROM THE DIVERSITY OF USERS OF THE SHARED COMPUTER NETWORK.

3. ASSEMBLE MODULE MATERIALS.

4. PRESENT TRIAL RUN OF COURSE AT LARS.

5. MAKE CHANGES IN MODULES BASED ON RESPONSE TO TRIAL RUN.

6. REQUEST JSC INPUT AT EACH STEP.

7. PRESENT COURSE AT JSC.

RKB: 9/1/79

ADMINISTRATIVE MATTERS

* USE OF THE COMPUTER RESOURCE REQUEST SYSTEM WAS INITIATED.
* RATES TO BE EFFECTIVE UPON INSTALLATION OF THE 3031 WERE ANNOUNCED.

JLK: 9/1/79

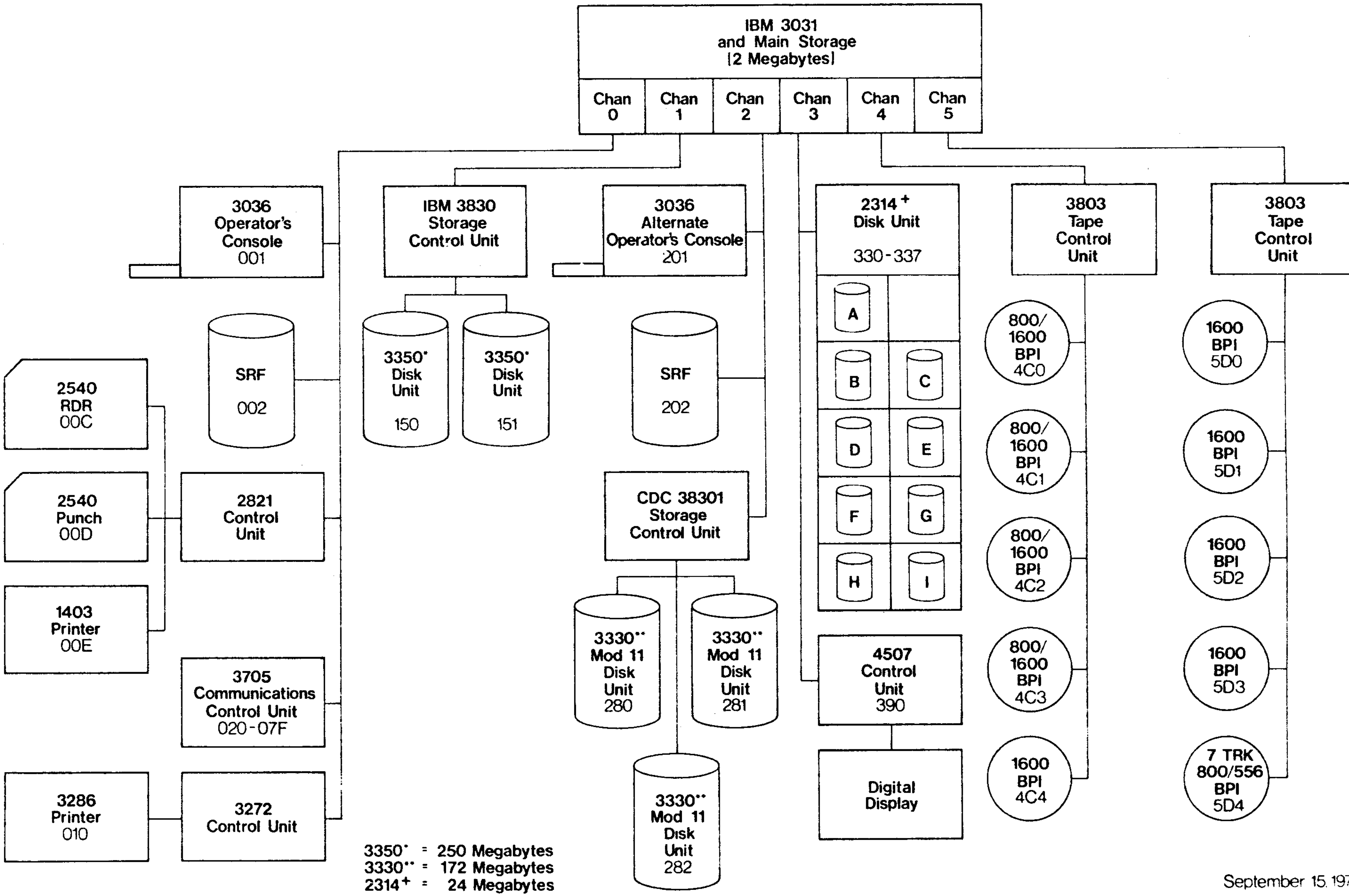
PLANNED ADMINISTRATIVE ACTIVITIES

* A NEW COMPUTER USER'S GUIDE WILL BE PUBLISHED DURING OCTOBER, 1979.
* 3031 RATES WILL BE REVIEWED AT THE END OF DECEMBER AND, IF USAGE WARRANTS, ADJUSTED.
* INFORMATION AND SUPPORT WILL BE PROVIDED FOR THE ACQUISITION AND IMPLEMENTATION OF AN EOD COMPUTER FACILITY.
* PURDUE/LARS WILL EXPLORE WAYS TO SERVE AS A BACKUP FOR THE EOD COMPUTER.
* PURDUE IS EXAMINING WAYS FOR THE DATA PROCESSING CAPABILITIES IN THE REMOTE SENSING RESEARCH COMMUNITY TO BE SHARED.

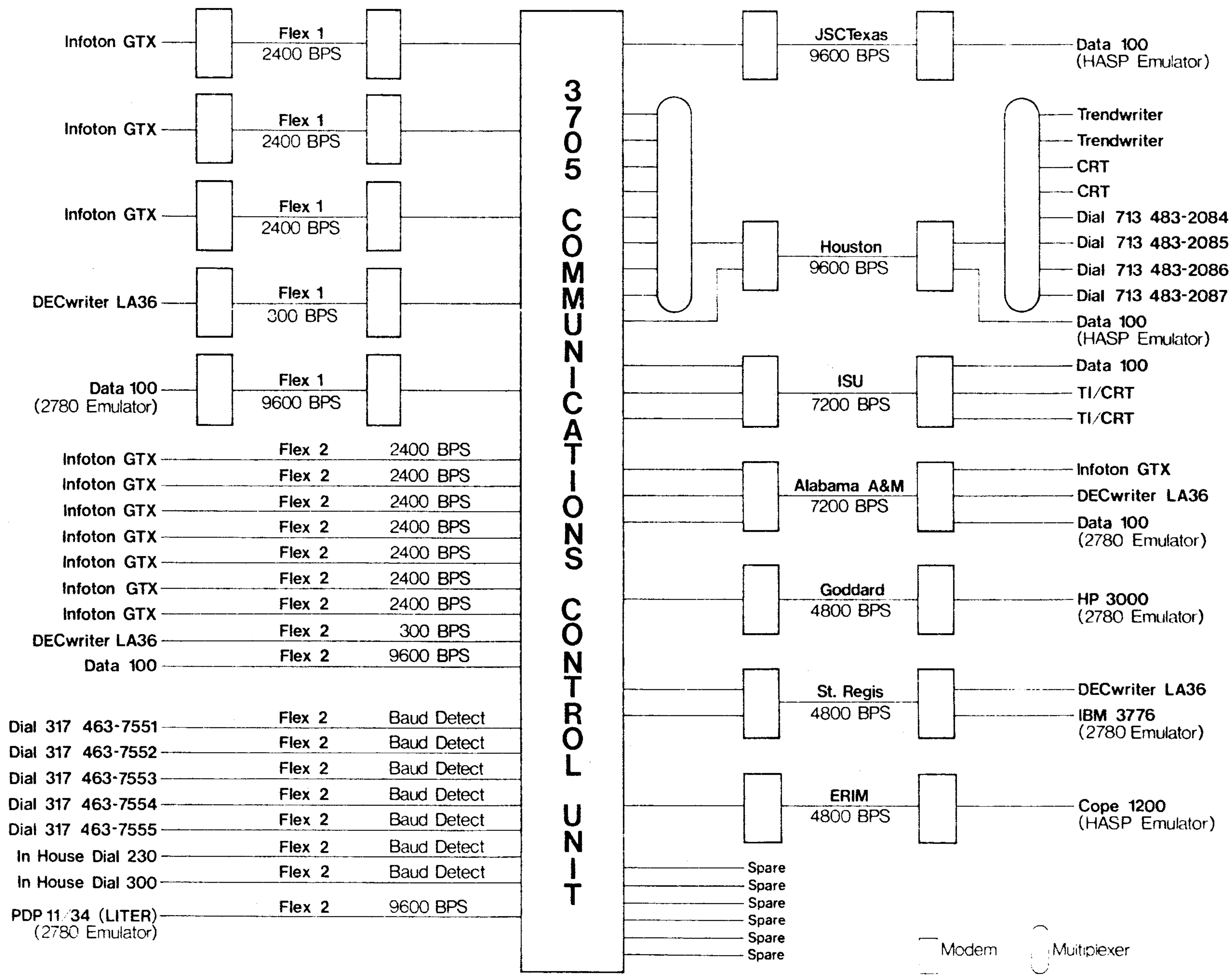
JLK: 9/1/79

APPENDIX A

3031 Hardware Configuration



September 15, 1979


3705 COMMUNICATIONS CONTROL UNIT
Infoton GTX
Flex 1
2400 BPS
Infoton GTX
Flex 1
2400 BPS
Infoton GTX
Flex 1
2400 BPS
DECwriter LA36
Flex 1
300 BPS
Data 100
(2780 Emulator)
Flex 1
9600 BPS
Infoton GTX
Flex 2
2400 BPS
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Infoton GTX
Flex 2
2400 BPS
DECwriter LA36
Flex 2
300 BPS
Data 100
Flex 2
9600 BPS
Dial 317 463-7551
Flex 2
Baud Detect
Dial 317 463-7552
Flex 2
Baud Detect
Dial 317 463-7553
Flex 2
Baud Detect
Dial 317 463-7554
Flex 2
Baud Detect
Dial 317 463-7555
Flex 2
Baud Detect
In House Dial 230
Flex 2
Baud Detect
In House Dial 300
Flex 2
Baud Detect
PDP 11/34 (LITER)
(2780 Emulator)
Flex 2
9600 BPS
JSCTexas
9600 BPS
Data 100
(HASP Emulator)
Trendwriter
Trendwriter
CRT
CRT
Dial 713 483-2084
Dial 713 483-2085
Dial 713 483-2086
Dial 713 483-2087
Houston
9600 BPS
Data 100
(HASP Emulator)
ISU
7200 BPS
Data 100
TI/CRT
TI/CRT
Alabama A&M
7200 BPS
Infoton GTX
DECwriter LA36
Data 100
(2780 Emulator)
Goddard
4800 BPS
HP 3000
(2780 Emulator)
St. Regis
4800 BPS
DECwriter LA36
IBM 3776
(2780 Emulator)
ERIM
4800 BPS
Cope 1200
(HASP Emulator)
Spare
Spare
Spare
Spare
Spare
Spare
Modem
Multiplexer

APPENDIX B

APPENDIX B

Updated
8/16/79

PURDUE UNIVERSITY/LARS
System Services Products and Rates
July 1, 1979 - June 30, 1980

DEPT. REF.	ITEM	UNIT	RATE/UNIT
02001*	Computer Service	1 hour	$ 150.00
02003*	Local Terminal	1 hour	3.00
02011*	Priority Service	1 hour	80.00
02016*	Disk Storage Space	1 meg. mo.	6.00
02017	Computer Tapes	1 tape	12.50
02018	Polaroid Film B&W	1 pack	4.20
02019	Polaroid Film Color	1 pack	6.60
02020	Polaroid Film P-N	1 pack	5.20
02024	Digital Display	1 hour	20.00
02026*	7-Track Tape Drive	1 hour	50.00
✓ 02030	Local Terminal	1 hour	6.00
✓ 02040	Varian Plotter	1 foot	.75
02083*	Professional Assistant	1 hour	19.50
02084	Technical Assistant	1 hour	13.00
02085*	Professional Staff	1 hour	32.00
02088*	Service Staff	1 hour	9.45
02089*	Clerical Staff	1 hour	8.00
02090*	Student Staff	1 hour	6.75
✓ 02800	Computer Service	1 hour	400.00
✓ 02805	Priority Service	1 hour	240.00
✓ 02810	Disk Storage	1 meg. mo.	8.50
✓ 02815	7-Track Tape	1 hour	35.00
✓ 02891	Professional Staff	1 hour	38.80
✓ 02892	Professional Asst. Staff	1 hour	19.25
✓ 02894	Service Staff	1 hour	9.15
✓ 02895	Clerical Staff	1 hour	8.90
✓ 02896	Student Staff	1 hour	7.35
02103	Landsat Reformatting	1 job	135.00
02104	Geometric Correction	1 run	270.00
02122	A/D Converter	1 hour	90.00
02125	Geometric Correction Data Points	1 mill pts	80.00
02126	Image Registration	1 run	1300.00
02127	Image Registration Data Points	1 mill pts	500.00
02128	Exotech Reformatting	1 run	15.00
02129	LARSYS Reformatting	1 run	90.00
02130	Precision Registration	1 run	1540.00
02131	Precision Registration Maps	1 map	320.00
02132	Boundary Definition Option	1 definition	920.00
02133*	Mead Photo Processing	1 run	350.00
02134	Landsat Frame Connection	1 frame connect.	230.00
02135	Table Digitizer	1 hour	20.00
02136*	Varian Plotter Output	1 foot	.35
✓ 02140	Color Class. Map	1 run	500.00
02183*	Professional Assistant Staff	1 hour	19.50
02190*	Student Staff	1 hour	6.75
✓ 02192	Professional Assistant Staff	1 hour	19.25
✓ 02196	Student Staff	1 hour	7.35

DEPT. REF.	ITEM	UNIT	RATE/UNIT
02203	LARSYS Version 3.1 Documentation	1 copy	1000.00
02204	LARSYS Educational Package	1 package	1250.00
02206	Student and Instructor Notes	1 set	760.00
02208	LARSYS Users Manual	1 manual	70.00
02210	Student Notes	1 set	30.00
02212	Thermofax Transparencies	1 page	.85
02213	Framed Transparencies	1 copy	1.00
02214	Slides	1 slide	2.50
02215	Printed Material	1 page	.08
02284*	Technical Assistant Staff	1 hour	13.00
/ 02293	Technical Assistant Staff	1 hour	13.40
02301*	Statistical Services	1 hour	150.00
/ 02302	Statistical Services	1 hour	500.00
02305*	LARSYS	1 hour	100.00
/ 02306	LARSYS	1 hour	350.00
02310*	LARSPEC	1 minute	3.55
/ 02311	LARSPEC	1 minute	10.00
02315*	Optronics Experiment	1 unit	90.00
02383*	Statistical Consultant	1 hour	19.50
/ 02390	Student Staff	1 hour	
/ 02392	Professional Assistant Staff	1 hour	19.25
/ 02396	Student Staff	1 hour	7.35

* rates discontinued after 3031 installation

√ new rates effective 09/79

APPENDIX C

APPENDIX C

RT&E DATA BASE---NEW VERSION

A new version of the RT&E data base will be available beginning Monday, August 27th. For two weeks following this date, both the old and new versions will be available. Afterward, the old version is slated to be removed.

The new version and its accompanying software can be accessed in the same way as the old. They are both located on JSCDISK 19A. There have been a few changes, however. The software for the new version can be accessed by loading the text files 'SEGFO2', 'GTINFO2', 'GETACQ2' and/or 'RTEERR', depending on the subroutine(s) desired. When using the new versions of SEGFO and GTINFO, you need no longer make any special FILEDEFS.

SUBROUTINES SEGFO AND GTINFO

```
CALL SEGFO (SEGNUM, ACQCNT, ACQ, INDEX, ERROR, DEVICE)
CALL GTINFO (SEGNUM, ACQCNT, ACQ, INDEX, ERROR, DEVICE)
```

Both of these subroutines now have an additional input argument. It is 'DEVICE,' an INTEGER*4 variable used to pass to the subroutine a data set reference number that the subroutine will use to access the files of the data base (this parameter takes the place of the previously-needed FILEDEFS.) When writing programs that use these subroutines, you should pass each subroutine a unique DEVICE number that is used for no other purpose. Also, the routines no longer write out error messages: they simply return an appropriate value in the 'ERROR' parameter. An informative message can still be obtained by calling the new subroutine 'RTEERR', which is described further below.

SUBROUTINE GETACQ

```
CALL GETACQ (UNIT, SEGNUM, ACQ, ERROR, DEVICE)
```

GETACQ, like SEGFO and GTINFO, also requires that the final parameter in the call be DEVICE. This variable serves the same function as the one used in SEGFO; therefore, follow the same rules stated above. GETACQ also no longer prints out error messages, but the messages can be displayed by calling RTEERR.

NEW SUBROUTINE RTEERR

```
CALL RTEERR (E, DEVICE)
```

Usage Notes: If an error message is desired, call RTEERR immediately after the call to the routine in which the error may have taken place (either SEGFO, GTINFO, or GETACQ). You must pass as argument 'E' the variable which contains the return code from the routine in question, and as 'DEVICE' you must pass the data set reference number of the device on which you wish the error message to appear. Please note: the 'DEVICE' must be previously defined with a FILEDEF command.

JLK: 9/1/79

SEGMENT CATALOG

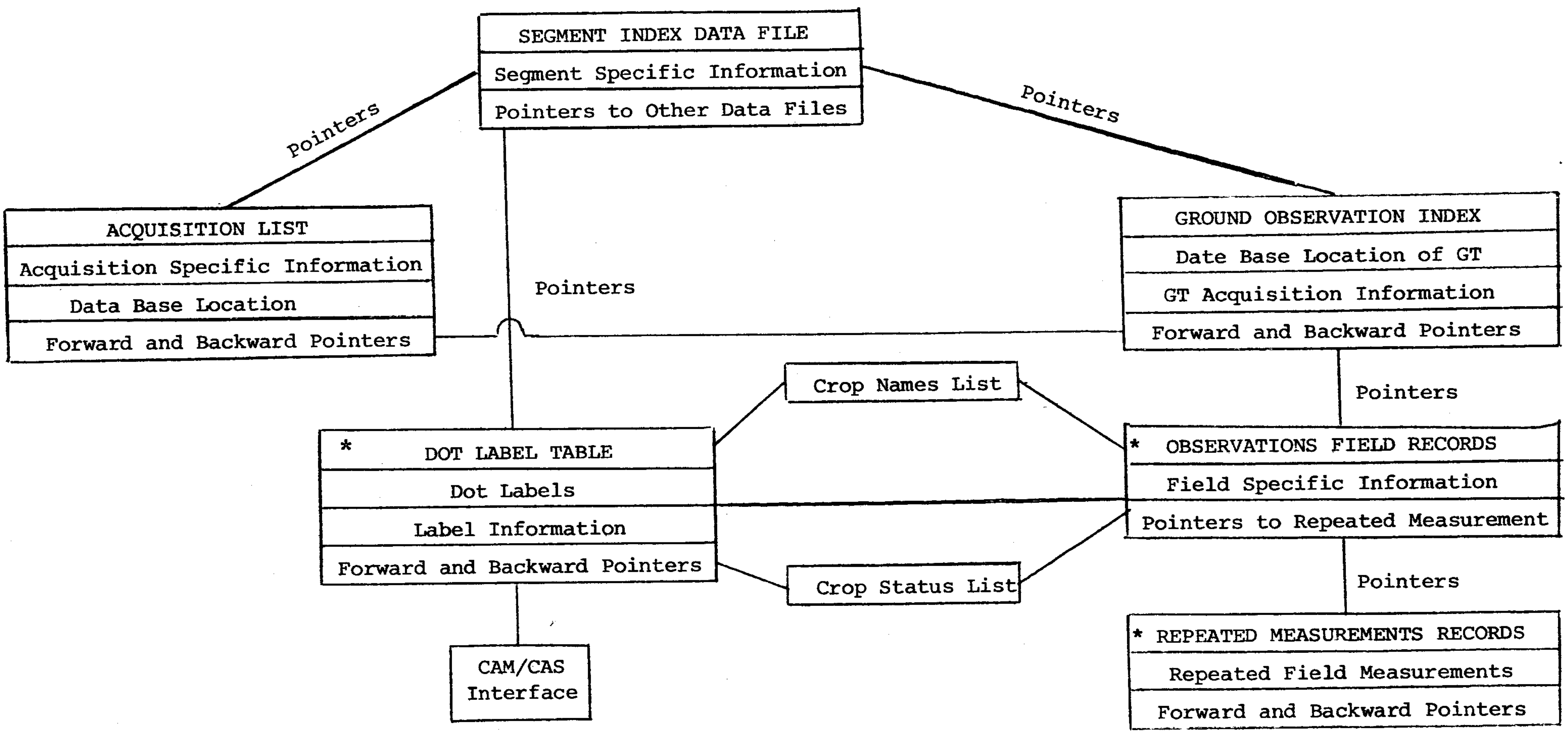


Figure A

*Not implemented

Format of Segment Index Records

Entry		Format	Bytes
Date Segment Initiated (YYDDD)		I*4	1-4
Segment Descriptor (county, state, other)		8A4	5-36
Acquisition List Pointer:	First Entry	I*4	37-40
	Last Entry	I*4	41-44
Label Index Pointer:	First Entry	I*4	45-48
	Last Entry	I*4	49-52
Ground Observation Index:	First Entry	I*4	53-56
	Last Entry	I*4	57-60
Segment Number		I*2	61-62
Segment Center Latitude (minutes north)		I*2	63-64
Segment Longitude (minutes east)		I*2	65-66
Country (number coded)		I*2	67-68
State (number coded)		I*2	69-70
County (number coded)		I*2	71-72
Agro-Physical Unit		I*2	73-74
Crop Reporting District		I*2	75-76
Undefined			77-80

Format of Acquisition List Records

Entry	Format	Bytes
Sensor System	A8	1-8
Previous Acquisition	I*4	9-12
Next Acquisition	I*4	13-16
Orbit Number	I*4	17-20
Scene Frame ID (SFI)	I*4	21-24
Reference SFI	I*4	25-28
Reference SFI for Ground Observations	I*4	29-32
Date Data Collected (YYDDD)	I*4	33-36
Time Data Collected (GMT)	I*4	37-40
Date Entered In (YYDDD)	I*4	41-44
Goddard Processing Date	I*4	45-48
Date of Unload Tape	I*4	49-52
Peak Sharpness	R*4	53-56
Normalized Peak to Background Ratio	R*4	57-60
Segment Number	I*2	61-62
Sun Elevation (min.)	I*2	63-64
Sun Azimuth (min.)	I*2	65-66
Tape Number	I*2	67-68
Lines of Data	I*2	69-70
Columns of Data	I*2	71-72
PFC Bias for Channel 1	I*2	73-74
PFC Bias for Channel 2	I*2	75-76
PFC Bias for Channel 3	I*2	77-78
PFC Bias for Channel 4	I*2	79-80
PFC Gain for Channel 1	I*2	81-82
PFC Gain for Channel 2	I*2	83-84
PFC Gain for Channel 3	I*2	85-86
PFC Gain for Channel 4	I*2	87-88
Cloud Cover	L*1	89
Processing Flag	L*1	90
Greeness of Soil Line	L*1	91
XSTAR Haze Parameter	L*1	92

Format of Acquisition List Records

Entry	Format	Bytes
File Number	L*1	93
First Channel	L*1	94
Last Channel (NC)	L*1	95
Crop Year Designator	L*1	96
Landsat Number	L*1	97
Data Classification	L*1	98
Undefined	L*1	99-120

Format of Dot Label Table Records

Entry	Format	Bytes
Previous Label Entry	I*4	1-4
Next Label Entry	I*4	5-8
Segment Number	I*2	9-10
Analyst Identifier	L*1	11
Number of Categories	L*1	12
Labelling Convention	I*2	13-14
Experiment	I*2	15-16
Date of Labelling (YYDDD)	I*4	17-20
Acquisitions Used in Labelling		
Date #1 (YYDDD)	I*4	21-24
Date #2 (YYDDD)	I*4	25-28
⋮		
Date #8 (YYDDD)	I*4	39-52
Category Names		
Crop Annotated as Category 1	I*2	53-54
Crop Annotated as Category 2	I*2	55-56
Blank fill or Crop Annotated Category 3	I*2	57-58
⋮		
Blank fill or Crop Annotated Category 30	I*2	111-112
Pointer to First Test Field	I*4	113-116
Pointer to Last Test Field	I*4	117-120
Pointer to First DO/DU Field	I*4	121-124
Pointer to Last DO/DU Field	I*4	125-128
CAM/CAS Tape Number	I*2	129-130
CAM/CAS File Number	I*2	131-132
Number of Labels (NC)	I*2	133-134
Labels and Annotation		
Labelled Line for Dot 1	I*2	135-136
Labelled Column for Dot 1	I*2	137-138
*Dot Label for Dot 1	I*2	139-140
**Dot Annotation for Dot 1	L*1	141

Format of Dot Label Table Records

Entry	Format	Bytes
Dot Status for Dot 1	L*1	142
.		
.		
.		
Labelled Line for Dot NC	I*2	127+8*NC-128+8*NC
Labelled Column for Dot NC	I*2	129+8*NC-130+8*NC
*Dot Label for Dot NC	I*2	131+8*NC-132+8*NC
**Dot Annotation for Dot NC	L*1	133+8*NC
Dot Status for Dot NC	L*1	134+8*NC

* 1 - N - 30 == Type one dot corresponding to category name N

** 129 - N - 158 == Type two dot corresponding to category name N-128

** 0 == A Field Pixel

1 == Dot in DO Area

2 == Dot in DU Area

3 == Dot is an edge pixel

4 == Dot is a boundary pixel

Crop Name List

Entry	Format	Byte
Name for Label 1	A8	1-8
Variety for Label 1	A8	9-16
Name for Label 2	A8	17-24
Variety for Label 2	A8	25-32
⋮		⋮

Crop Status List

Entry	Format	Byte
Name of Status 1	A8	1-8
Name of Status 2	A8	9-16
⋮		⋮

Ground Observations Table

Ground Observations Index

Entry	Format	Bytes
Previous Ground Truth Entry	I*4	1-4
Next Ground Truth Entry	I*4	5-8
Segment Number	I*2	9-10
Number of Fields Monitored for Agronomic Data	I*2	11-12
Date of Initial GT Record (YYDDD)	I*4	13-16
Date of GT Reference (YYDDD)	I*4	17-20
Pointer to Acquisition List for first W to W GT	I*4	21-24
Pointer to Acquisition List for last W to W GT	I*4	25-28
Pointer to first Monitored Field	I*4	29-32
Pointer to last Monitored Field	I*4	33-36

Observation Field Records

Entry	Format	Bytes
Previous Field Monitored	I*4	1-4
Next Field Monitored	I*4	5-8
Segment Number	I*2	9-10
Field Number	I*2	11-12
Field Identifier	A8	13-20
Crop Names Entry	I*2	21-22
Crop Status Entry	I*2	23-24
Date Planted (YYDDD)	I*2	25-26
Nitrogen Fertilization	I*2	27-28
Row Width (meters)	R*4	29-32
Pointer to first of Repeated Measures Data	I*4	33-36
Pointer to last of Repeated Measures Data	I*4	37-40
Number of ARCS (NARC)	I*2	41-42
Line Coordinate 1	I*2	43-44
Column Coordinate 1	I*2	45-46
Line Coordinate 2	I*2	47-48
Column Coordinate 2	I*2	49-50
⋮		
Line Coordinate NARC	I*2	39+NARC*4-40+NARC*4
Column Coordinate NARC	I*2	41+NARC*4-42+NARC*4

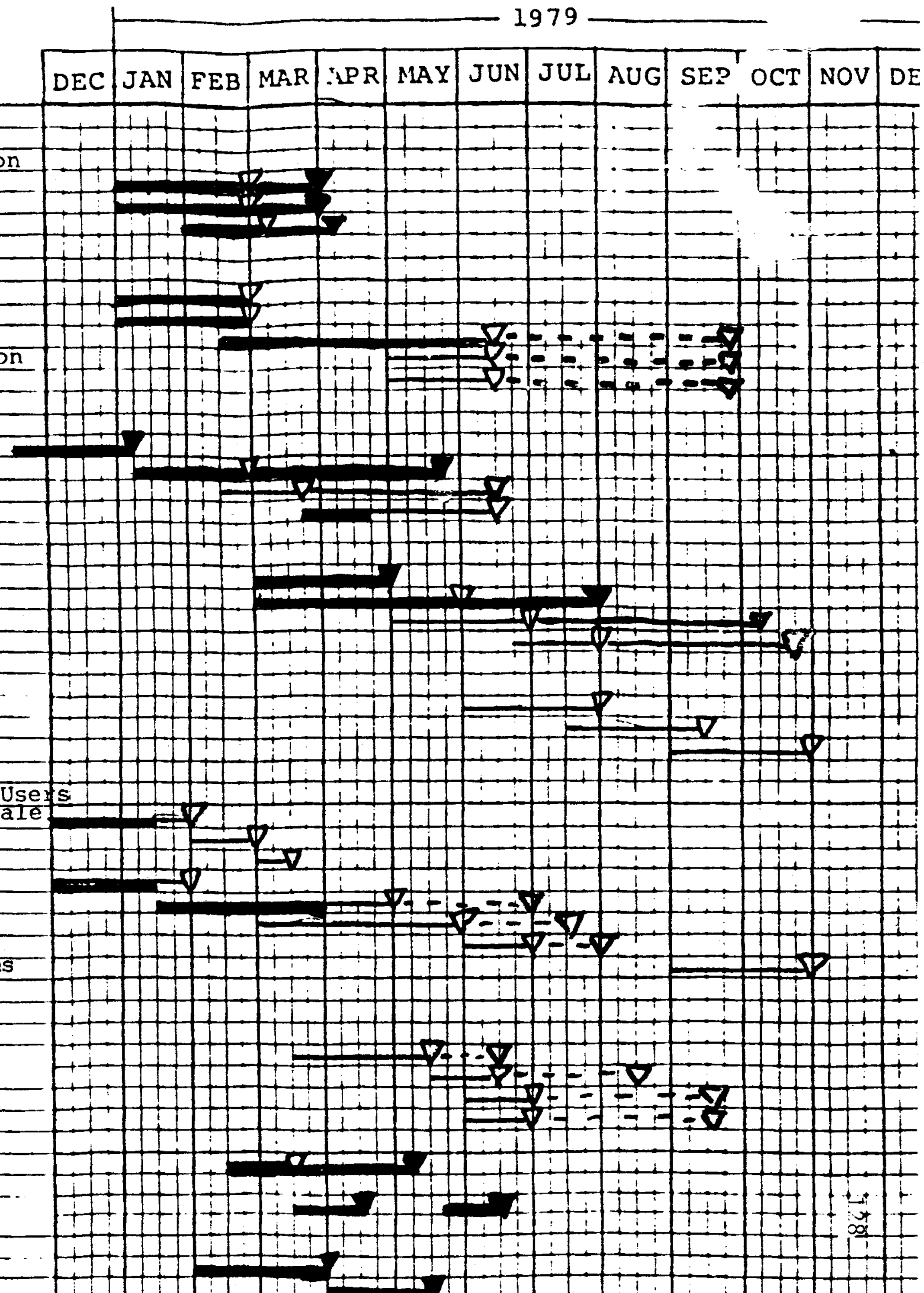
Repeated Measurement Record

Entry	Format	Bytes
Previous Measurement	I*4	1-4
Next Measurement	I*4	5-8
Segment Number	I*2	9-10
Field Number	I*2	11-12
Date Measured (YYDDD)	I*4	13-16
Maturity	L*1	17
% of Ground Cover	I*1	18
% of Green Leaves	L*1	19
Condition	L*1	20

Computer Capabilities Milestone Chart

Figure 2

DETAILED IMPLEMENTATION SCHEDULE



I. COMPUTER SYSTEMS SUPPORT

Support Replacement of JSC 2780 Remote Job Entry Station
- Reconfigure communications controller
- Alter RSCS
- Document system

Support Upgrade of Keyboard Terminals at JSC
- Alter 3705 emulator program for different baud rate
- Alter CP
- Install 1200 baud clock
- Upgrade 3705 emulator program for 1200 baud operation
- Install new modem/multiplexor

CSMP Installation
- Order software package
- Install under OS
- Document for User
- Install under CMS

Investigate Interactive Color Device for Remote Usage
- Investigate market alternatives
- Investigate user needs
- Confer with JSC
- Make proposal to JSC

Upgrade Support for other SR&T Sites
- Contact sites, review needs & available equipment
- Identify equipment & other resource upgrades needed
- Propose support to sites, JSC

Improve Potential Computing Dollar Efficiency for JSC Users
- Investigate necessary components of a Third Shift Sale
- Negotiate 3rd shift sale with JSC
- Propose 3rd shift sale
- Assess major batch problems
- Improve usability of JSC batch machines
- Document new batch machine characteristics
- Present a seminar on new batch capabilities
- Transfer responsibility for batch support to systems group

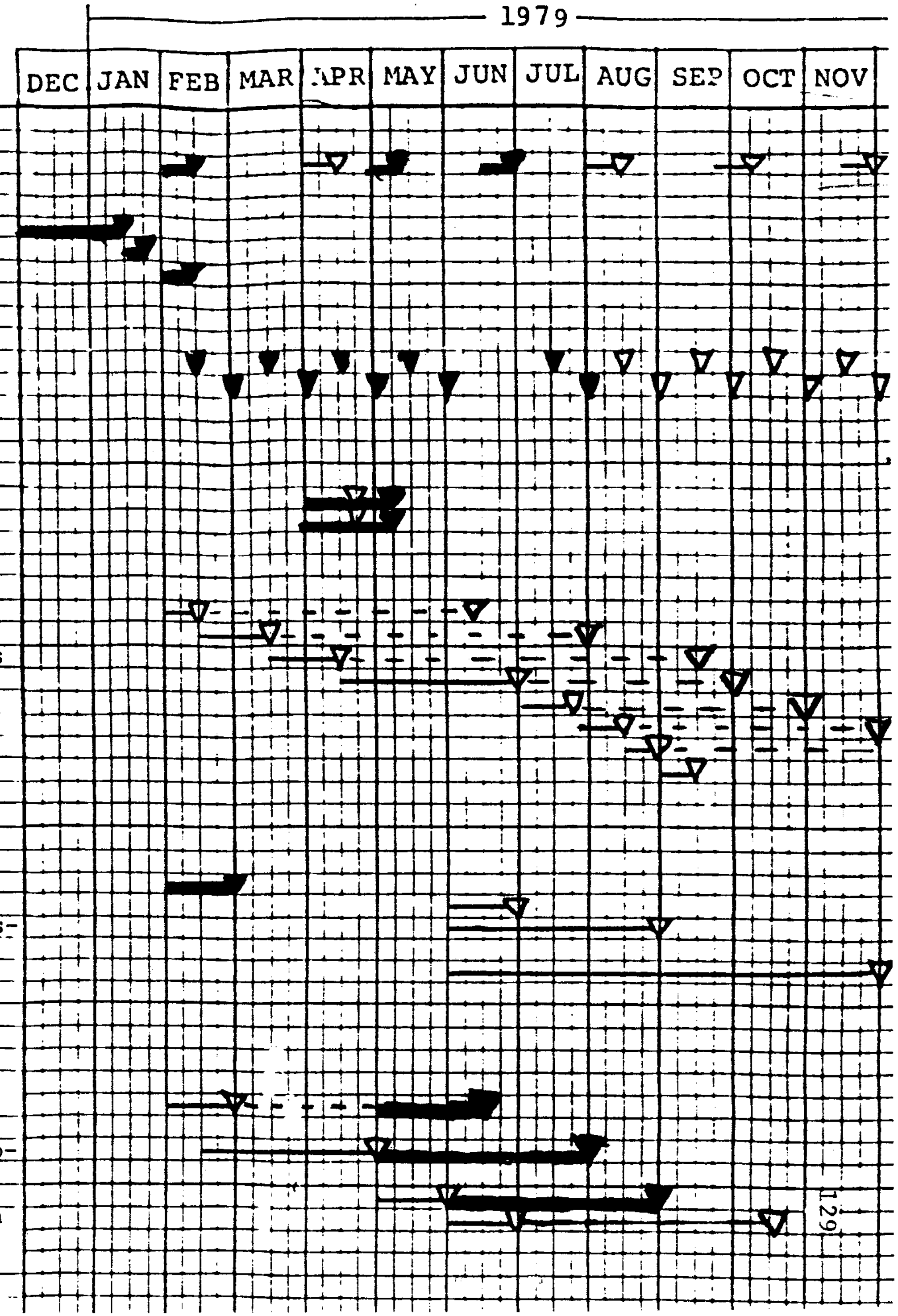
SAS Installation
- Order CMS Version of SAS
- Install SAS
- Document Access to SAS
- Present seminar on SAS use

Install SPSS Version 8

Install New Disk System

Upgrade Tape Transfer Software
- Improve software reliability
- ...ment

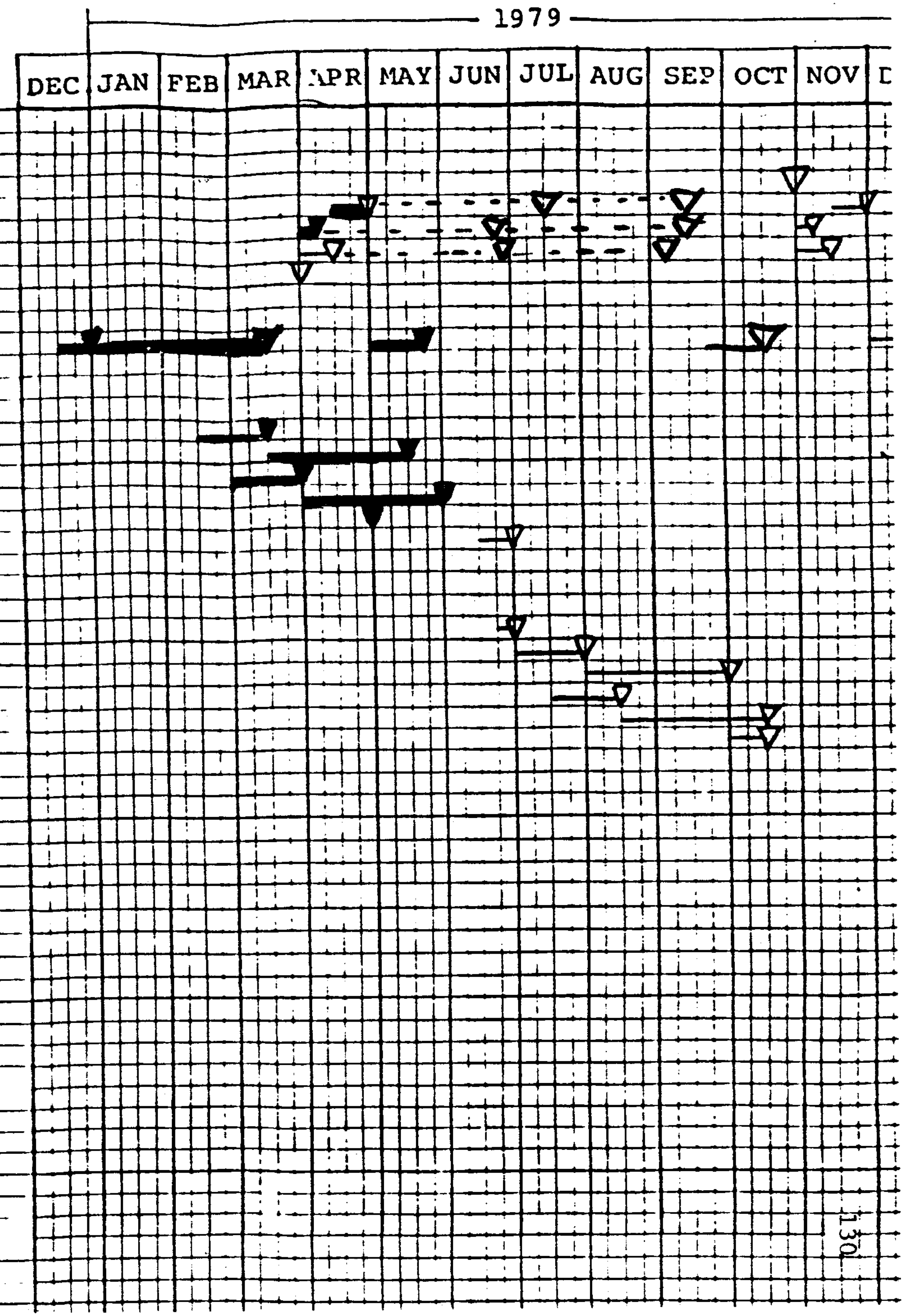
Computer Capabilities Milestone Chart



II. CONSULTING SUPPORT & TECHNIQUES INTERCHANGE

- Make Visiting Consultant Trips
- Present Short Course on LARS System
  - Prepare course on CMS370, LARS system characteristics
  - Present course at LARS
  - Present course at JSC
- Document System Upgrades & News in LARS' SCANLINES
  - Collect SCANLINES input
  - Distribute Newsletter
- Transfer Responsibility for EOD/LARSYS Prompting EXEC to EOD/LARSYS Librarian
  - Deliver Prompting EXEC documentation
  - Provide detailed instruction in EXEC maintenance
- Establish Standard Training Course
  - Identify course goals
  - Identify course components
  - Identify organizational responsibility for components
  - Assemble materials for LARS areas of responsibility
  - Integrate course components
  - Present course at JSC
  - Review contents for omissions
  - Upgrade course
- Support Development of Programming, Documentation and Techniques Delivery Standards
  - Provide LARSYS Version III Standards as input to JSC
  - Publicize Standards through SCANLINES, SRTNEWS, etc.
  - Standardize software delivered under Computer Processing Task
  - Aid LARS researchers in standardization of future software
- Investigate Procedures to Interchange Technology using the LARS System
  - Analyze the current Technology Transfer procedures used in the JSC research community
  - Identify perceived organizational roles and responsibilities for techniques interchange
  - Identify problem areas
  - Propose a system for interchange of technology within the research community

Computer Capabilities Milestone Chart



III. DATA BASE MANAGEMENT

Receive Landsat Data Bases
- Receive tapes
- Label, forward/rewind, enter on tape racks
- Communicate data receipt
- Copy to 1600 bpi
- Receive new copies of unusable tapes

Catalog Landsat Data in Segment Catalog

Implement Data Base (Ground Truth Data)
- Design data entry software
- Implement data entry software
- Design data maintenance software
- Implement data maintenance software
- Receive GT data from JSC
- Present seminar at JSC

Implement Data Base (Dot Label File)
- Have meeting to determine software specifications
- Design data entry software
- Implement data entry software
- Design data maintenance software
- Implement data maintenance software
- Present seminar at JSC

3B. Field Research Data Base Management and Distribution

The overall objective of this task is to assure the timely availability to researchers of the Johnson Space Center field research data stored at Purdue/LARS. The following pages contain the material presented in the oral briefing for this quarterly report.

The first two charts summarize the objectives for this task. The third chart lists the specific accomplishments in this quarter. The Exotech 100 field multiband radiometer data and agronomic measurements collected during 1978 at the Purdue Agronomy Farm are available for researchers to use. Field research data (the 1975-77 Williams County, N. Dakota and the 1975-77 Finney County, Kansas field averaged FSS data) were distributed to Goddard Institute for Space Studies. Also the 1978 FSS data collected over the Hand County, So. Dakota test site are available to researchers in both single scan and field average formats.

The fourth chart summarizes the status of the data processing. Chart five is a summary of the non-SR&T users of the data.

The last chart includes the plans for the next quarter.

FIELD RESEARCH DATA BASE MANAGEMENT AND DISTRIBUTION

OBJECTIVE:

ASSURE THE TIMELY AVAILABILITY TO RESEARCHERS OF THE JOHNSON SPACE CENTER FIELD RESEARCH DATA STORED AT PURDUE/LARS.

SPECIFIC OBJECTIVES:

1. DISTRIBUTE FIELD RESEARCH DATA FOR ALL APPROVED REQUESTS.
2. MAINTAIN AND UPDATE DATA BASE.
   - 1978 PURDUE AGRONOMY FARM DATA
   - 1978 HAND COUNTY, SOUTH DAKOTA DATA
   - 1979 FIELD RESEARCH DATA
   - SOILS DATA OF TASK ID
3. REVISE AND UPDATE FIELD RESEARCH DATA CATALOGS.
4. DOCUMENT CALIBRATION AND CORRELATION OF THE SPECTRAL DATA IN THE DATA BASE.
5. DETERMINE FEASIBILITY OF USING COMPUTER DATA BASE MANAGEMENT SYSTEM.

ACCOMPLISHMENTS THIS QUARTER

* ALL OF 1979 EXOTECH 100 MULTIBAND RADIOMETER DATA COLLECTED AT PURDUE AGRONOMY FARM MADE AVAILABLE TO RESEARCHERS.

* FIELD RESEARCH DATA DISTRIBUTED TO GODDARD INSTITUTE FOR SPACE STUDIES.

* 1978 FSS DATA COLLECTED AT HAND COUNTY, SOUTH DAKOTA INTENSIVE TEST SITE MADE AVAILABLE TO RESEARCHERS.

* REPORT WRITTEN SUMMARIZING CALIBRATION AND CORRELATION OF THE SPECTRAL DATA IN THE DATA BASE.

PROCESSING STATUS FOR FIELD RESEARCH DATA BASE

INSTRUMENT/DATA TYPE	CROP YEAR(S) 1975-1978	1979 COMPLETE	IN PROCESSING
LANDSAT MSS			
WHOLE FRAME CCT (FRAMES)	124	---	---
AIRCRAFT SCANNER (DATES/FLIGHTLINES)	46/301	1/5	---
HELICOPTER MOUNTED FIELD SPECTROMETER (DATES/OBSERVATIONS)			
FIELD AVERAGES	74/6870	---	2/
INDIVIDUAL SCANS	74/114,829	---	2/
TRUCK MOUNTED FIELD SPECTROMETER/MULTIBAND RADIOMETER (DATES/OBSERVATIONS)			
FSAS	45/813	---	---
EXOTECH 20C	87/6371	---	21/827
EXOTECH 20D	45/645	---	---
EXOTECH 100	32/6077	---	16/4123

PLANS FOR NEXT QUARTER

* THE SOILS DATA COLLECTED FOR THE SOILS STUDY TASK (1D) WILL BE INCLUDED AS A PART OF THE FIELD RESEARCH DATA BASE

* A PORTION OF THE 1979 FIELD RESEARCH DATA WILL BE AVAILABLE FOR RESEARCHERS

* REVISED FIELD RESEARCH CATALOGS WILL BE AVAILABLE

* WRITE FINAL REPORT

Figure 3B-1 Detailed Implementation Schedule for Task 3B